



STRENGTHENING UNIVERSITY CONTRIBUTIONS TO CLIMATE COMPATIBLE DEVELOPMENT IN SOUTHERN AFRICA



Swaziland Country Report



SARUA CLIMATE CHANGE COUNTS MAPPING STUDY

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STRENGTHENING UNIVERSITY CONTRIBUTIONS TO CLIMATE COMPATIBLE DEVELOPMENT IN SOUTHERN AFRICA

Swaziland Country Report

Series Editor: Piyushi Kotecha

Authors: Penny Urquhart and Heila Lotz-Sisitka



Note

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

*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 authors are responsible for the choice and the presentation of the facts contained in this document and for the opinions expressed therein, which are not necessarily those of SARUA and do not make any commitment for the Association.

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Acronyms

ATPSN	African Technology Policy Studies Network
BID	Background Information Document
CA	Conservation Agriculture
CCAM	Conformal-Cubic Atmospheric Model
CCD	Climate compatible development
CDKN	Climate and Development Knowledge Network
CDM	Clean Development Mechanism
CGCMs	Coupled Global Climate Models
CGIAR	Consultative Group on International Agricultural Research
CSIR	Council for Scientific and Industrial Research
DAC	Directorate of Assessment and Compliance
DNA	Designated National Authority
DWA	Department of Water Affairs
ERM	Environment and Resources Management
FANRPAN	Food, Agriculture and Natural Resources Policy Analysis Network
GEF	Global Environmental Facility
GHG	greenhouse gas
ICRISAT	International Centre for Research in the Semi-Tropics
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICT	Information and Communication Technology
IWRM	Integrated Water Resources Management
KOBWA	Komati Basin Water Authority
LULUCF	Land Use, Land Use Change and Forestry
LUSIP	Lower Usuthu Smallholder Irrigation Project
MESA	Mainstreaming Environment and Sustainability into African Universities
MIC	MESA Implementation Committee
MNRE	Ministry of Natural Resources and Energy
MTEA	Ministry of Tourism and Environmental Affairs
NC	National Communications
NCCC	National Climate Change Committee
NCCCC	National Climate Change Coordination Committee
NCCFP	National Climate Change Focal Point
NCSA	National Capacity Self-Assessment
NGO	Non-Governmental Organisation
OSSREA	Organisation of Social Science Research in Eastern and Southern Africa
PRSAP	Poverty Reduction Strategy and Action Plan
RE	Renewable Energy
REASWA	Renewable Energy Association of Swaziland

SADC	Southern African Development Community
SADC REEP	Southern African Development Community Regional Environmental Education Programme
SANU	Southern Africa Nazarene University
SARUA	Southern African Regional Universities Association
SASSCAL	Southern African Science Service Centre for Climate Change and Adaptive Land Use
SCOT	Swaziland College of Technology
SEA	Swaziland Environment Authority
SERA	Swaziland Educational Research Association
SNC	Second National Communication
SNTC	Swaziland National Trust Commission
SWASA	Swaziland Standard Authority
TNA	Technology Needs Assessment
UNDP	United Nations Development Programme
UNFCCC	UN Framework Convention on Climate Change
UNISWA	University of Swaziland
WEMAC	Water and Environment Management Action Campaign

1 INTRODUCTION

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

Globally, southern Africa is one of the regions most vulnerable 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.

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.

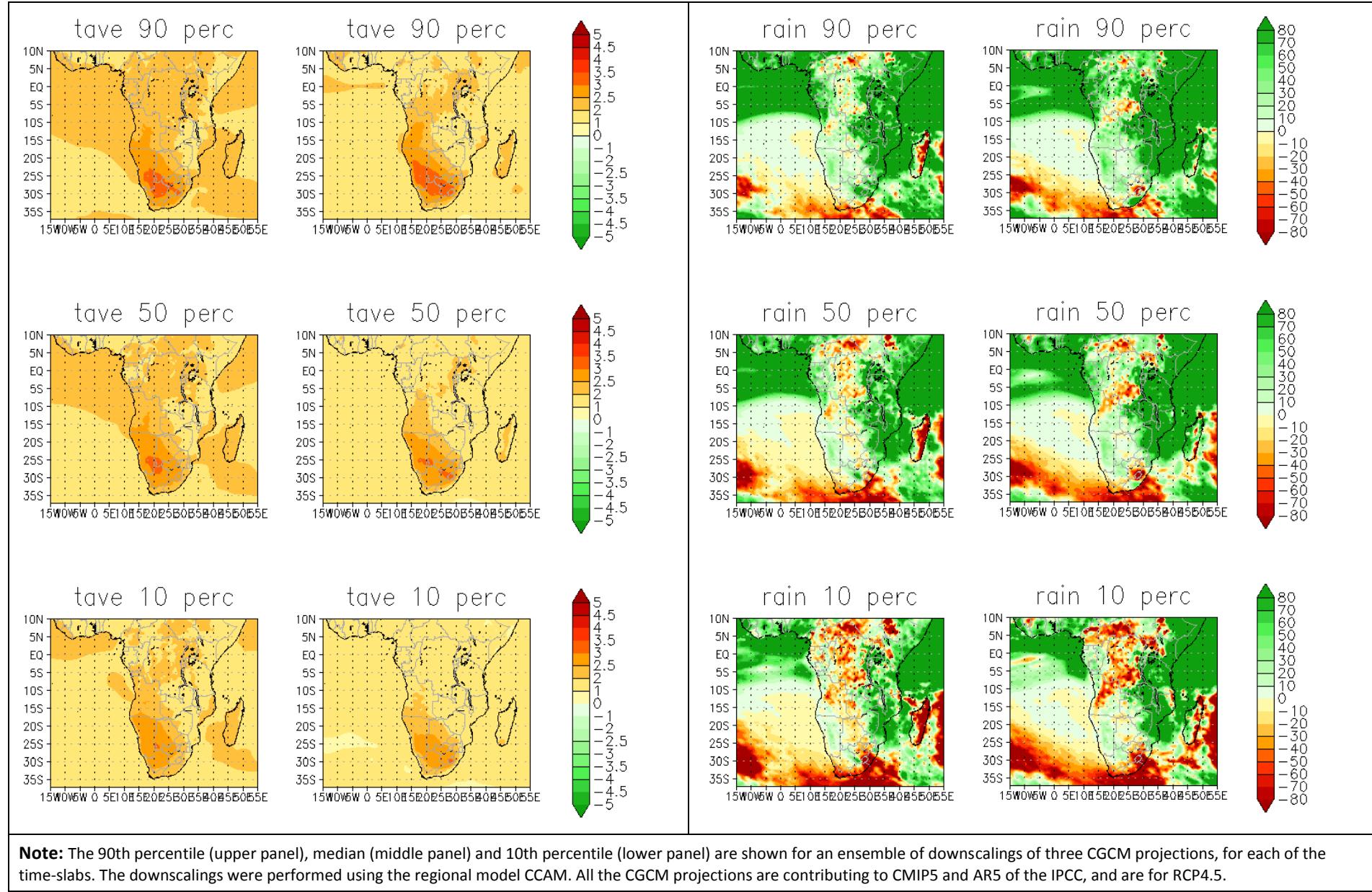


Figure 1: Projected change in the annual average temperature ($^{\circ}\text{C}$) and annual average rainfall (mm) over the SADC region, for the time-slab 2040–2060 and 2080–2099, relative to 1970–2005

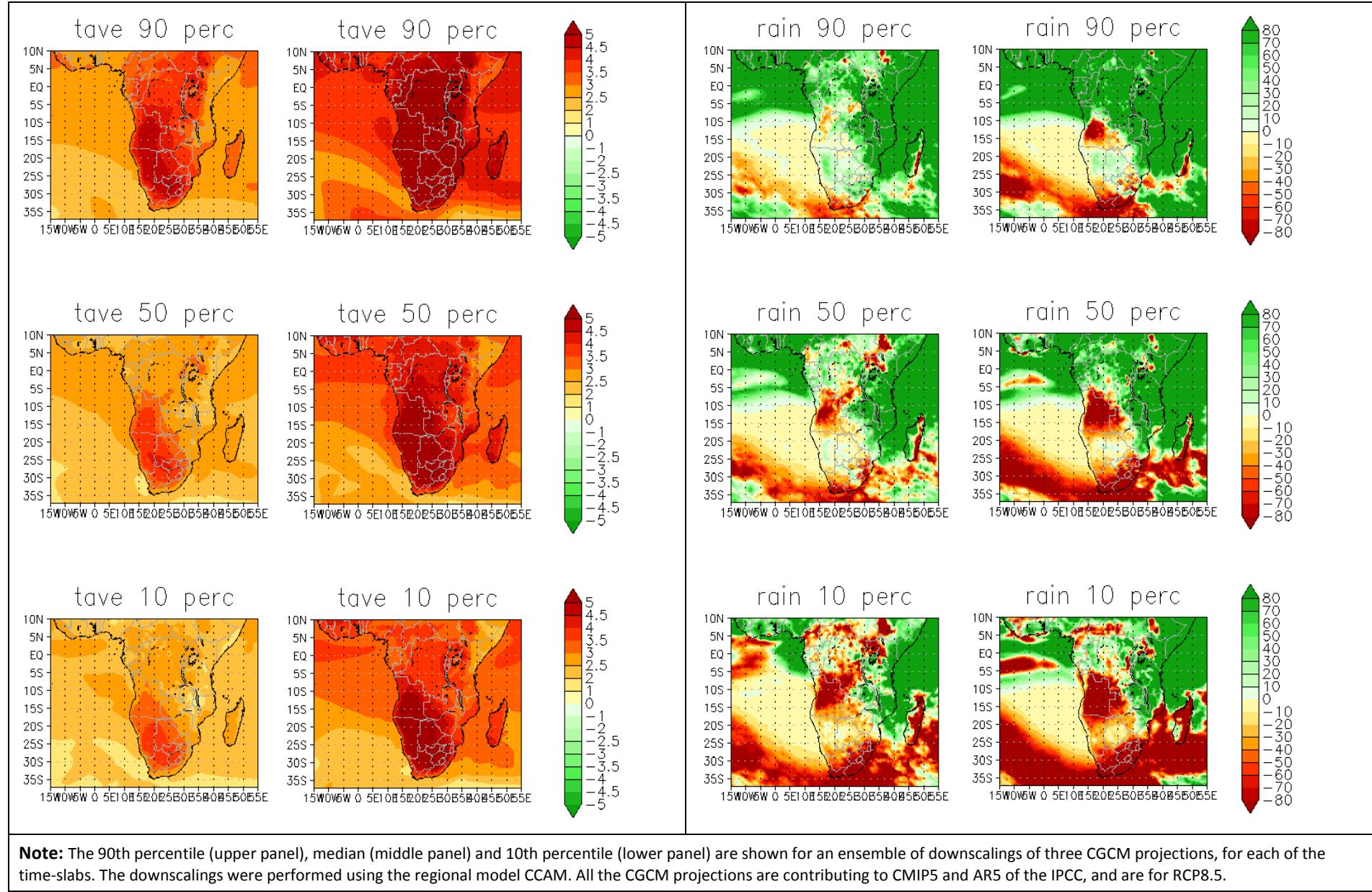


Figure 2: Projected change in the annual average temperature ($^{\circ}\text{C}$) and annual average rainfall (mm) over the SADC region, for the time-slab 2040–2060 and 2080–2099, relative to 1970–2005

Figures 1 and 2³ showed the projected change in the annual average temperature (°C) and annual average rainfall (mm) over the SADC region, for the time-slabs 2040–2060 and 2080–2099, relative to 1970–2005. Figure 1 CGCM projections are for RCP4.5 and Figure 2 projections are for RCP8.5.

Swaziland's Second National Communication to the United Nations Framework Convention on Climate Change recognises the fundamental link between climate change and development and states, and has diagnosed the country's high degree of vulnerability to climate change (Box 1).

Box 1: Swaziland's vulnerability to climate change

The Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC) for Swaziland (SNC 2012) recognises that the country is highly vulnerable to climate change effects. Over the period covering 1960–2005, most stations indicate significant increases in both mean minimum and mean maximum temperatures, with heterogeneous trends in rainfall indices a concern (SNC 2012). Swaziland's Energy, Water and Industrial Processes, Agriculture, Land Use Change and Forestry, Waste, Health, and Socio-Economic sectors are vulnerable to these climate changes. For example:

High temperatures are likely to lead to high evaporation and high water demand by forest plantations and indigenous forests. The country may be much drier posing potential changes to ecosystems. Frequent outbreak of forest fires is most likely to occur in linear year to year intervals. Climate change will affect production of crops differently depending on the crop type. Maize yields for example are most likely to be high when planted in the first week of December rather than when planted in mid-October when there is enough rain. Swaziland's grassland and Lebombo bushveld is likely to be affected by climate change although with varying degrees of severity if the moderate case scenario (A1B) conditions prevail. Both vegetation types will likely lose more than half of their current bioclimate area. This has significant implications on biodiversity and people's livelihoods with most of the country's current vegetation types and species experiencing notable declines. The projected runoff change is negative in Usuthu, Mbuluzi and Ngwavuma catchments except for the Komati catchment. Climate change will affect the basic requirements for maintaining healthier nation, clean air and water, sufficient food and adequate shelter. Catastrophic weather events, variation in weather systems that affect food and water supplies, ecosystem changes are all associated with global warming and pose health risks. Climate and weather risk may result in increased deaths due to heat waves, and natural hazards such as floods, vector-borne diseases such as malaria and other existing and emerging infectious diseases.

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.

Shifting perspective from ‘development’ to ‘climate compatible development’ requires significant scientific and social innovation. New forms of learning, leadership, planning, policymaking and knowledge production are needed. New collaboration platforms will be needed within and between countries and their universities. Universities have a key role to play in supporting societal innovation and change for CCD. Not only do they develop the knowledge and competence of future leaders in government, business and civil society, but they also provide immediate societal responses given their pivotal role as centres of research, teaching, knowledge sharing and social empowerment. Given the risk multiplier effect of climate change, coupled with the multiple stressor context, it is clear that the impacts of climate change will be far-ranging, acting upon diverse sectors such as transportation, agriculture, health, industry and tourism. This necessitates a wide-ranging and cross-sector response, in which non-climate-related knowledge fields will be called upon.

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

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

In recognition of the above issues and their longer term implications for society and universities, the Southern African Regional Universities Association 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.

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);
- **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 Swaziland Country Report forms part of the mapping study.

The initiative is diagrammatically illustrated below.

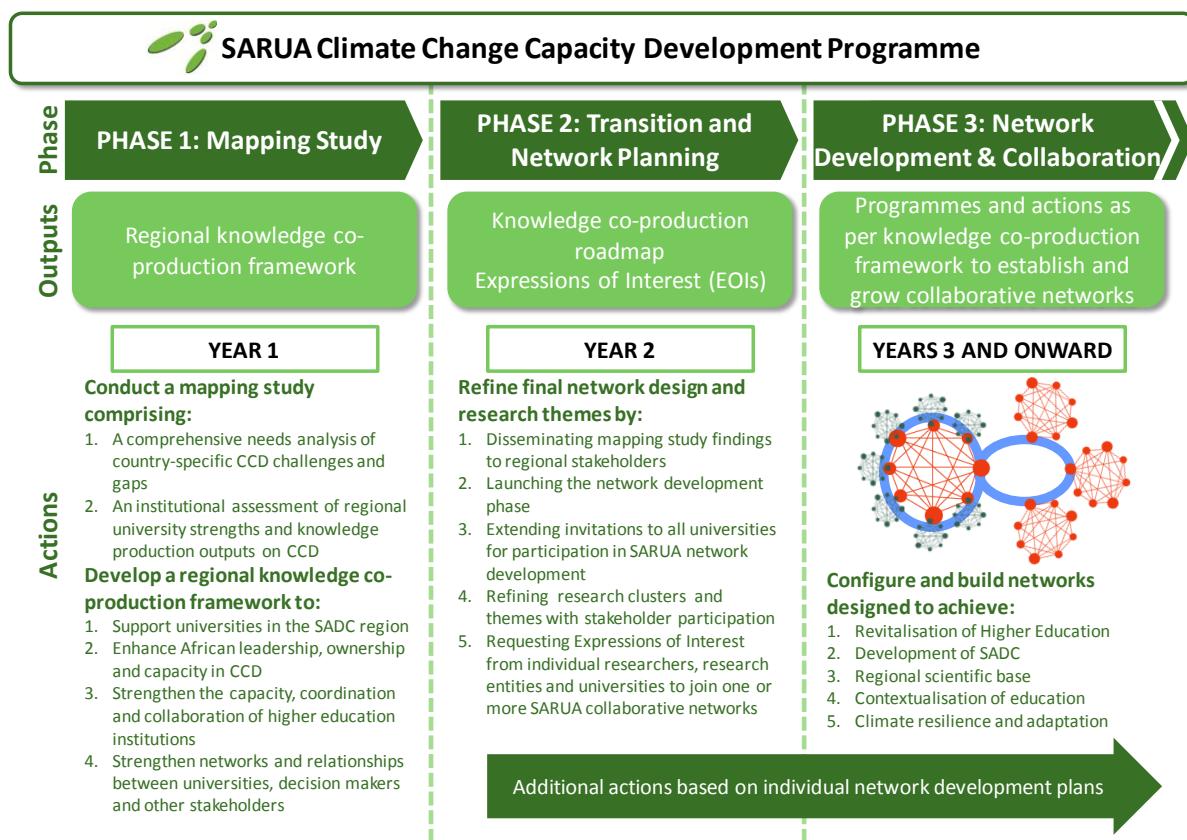


Figure 3: The SARUA Climate Change Capacity Development Programme, showing the mapping study

The intended outcome of the SARUA **mapping study** will be a collaborative research framework to enhance co-production of knowledge on CCD. It will include strategies to strengthen networks for climate compatible development research, teaching, community and policy outreach involving knowledge co-production processes between participating universities and policy and community

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

stakeholders. This framework will form the basis for the realisation of the longer term objectives of the SARUA programme outlined above, as well as for a SADC-level research programme and various country-based partnership agreements. It will provide a ‘knowledge platform’ for regional and country-based fundraising for research and knowledge co-production. As such the framework seeks to benefit universities themselves, while also strengthening regional interaction and co-operation.

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

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

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

To address these factors, the mapping study aimed to:

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

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 Swaziland.

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

1.4 Key concepts

Climate Compatible Development

Climate compatible development (CCD) is low carbon, climate resilient development. The concept has been developed in recognition of the urgent need for adaptation, given current climate variability and the severity of projected climate impacts that will affect the region; and the need to reduce emissions as rapidly as possible to avoid more catastrophic climate change in the future. Thus while CCD can be framed in different ways, given nationally and locally specific development trajectories, it does require that current and future climate risks are mainstreamed into development, and that both adaptation and mitigation are integral goals of development, as indicated by Figure 4. Thus CCD not only recognises the importance of both adaptation and mitigation in new development pathways, but, as further explained in Mitchell and Maxwell (2010), “Climate compatible development goes one step further by asking policy makers to consider ‘triple win’ strategies that result in low emissions, build resilience and promote development simultaneously”. In the southern African context, poverty reduction, as an integral component and goal of regional and national development strategies, would be a desired co-benefit. Uncertainties in major drivers of change, including climate, socio-economic and political risks, necessitate that CCD be viewed as an iterative process, in which vulnerability identification and risk reduction responses are revised on the basis of continuing learning. Climate compatible development emphasises climate strategies that embrace development goals and development strategies that integrate the threats and opportunities of a changing climate.⁵ Thus climate compatible development opens up new opportunities for interdisciplinary and transdisciplinary research, teaching and engagement with communities, policy makers and practitioners.

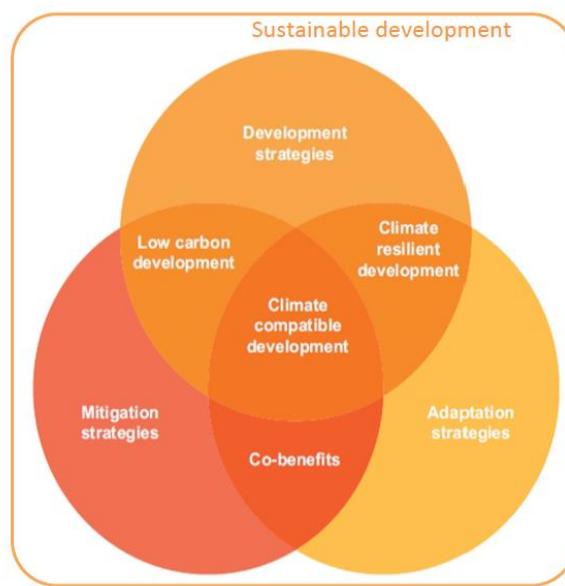


Figure 4: Conceptual framework for Climate Compatible Development (adapted from Mitchell and Maxwell, 2010)

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 Brundtland 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

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

⁷ Ibid.

through space, time and quality of life, and thus necessitates a systems approach to understanding and solving interlinked social, environmental and economic problems.

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

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 Swaziland 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 Swaziland, within an overall interpretive, participatory and consultative and social realist methodology⁸:

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.

For the Swaziland Country Report, the following key policy and programme documents were analysed through rapid desk review:

- Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC), Swaziland: Ministry of Tourism and Environmental, August 2012 (referred to as SNC (2012) in this report);
- Swaziland GEF Fact Sheet, 2012;
- Southern African Agriculture and Climate Change: A comprehensive analysis, Swaziland chapter, 2012;
- Initial National Communication to the United Nations Framework Convention on Climate Change (UNFCCC), 2002; and
- Food, Agriculture and Natural Resources Policy Analysis Network (FANRPAN), 2010. Assessing the Vulnerability of Agriculture to Climate Change in Southern Africa Part of "Strategies for Adapting to Climate Change in Rural Sub-Saharan Africa: Targeting the Most Vulnerable".

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

2.1.2 Stakeholder and university staff consultations (national workshop):

As part of the SARUA Initiative Climate Change Counts, country consultations were held in Swaziland at the Kwaluseni Campus of the University of Swaziland on 6 and 7 June 2013. 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. A summary of the session content is provided below. 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 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

TIME		DAY 1: 6 June 2013		DAY 2: 7 June 2013			
INTRO	Introductory remarks, welcome address and official opening – SARUA Initiative Overview	INTRO	Recap of day 1 and Agenda for day 2				
SESSION 1	Framing Climate Compatible Development	SESSION 5	Breakaway groups and plenary <ul style="list-style-type: none"> ■ 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	Swaziland priorities and needs <ul style="list-style-type: none"> ■ Knowledge and institutional gaps and capacity 	SESSION 6	Plenary discussion <ul style="list-style-type: none"> ■ 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) <ul style="list-style-type: none"> ■ Swaziland priorities and needs, knowledge and institutional gaps and capacity ■ Plenary report-backs from group work 	SESSION 7	Opportunities for collaboration <ul style="list-style-type: none"> ■ Policy implications for government, universities and donors 				
SESSION 4	What is the role of the university sector? <ul style="list-style-type: none"> ■ Identifying other knowledge partners 	SESSION 8	Way forward and closure				

2.1.3 Questionnaires

Two different questionnaires were prepared to obtain more in-depth data on climate change and CCD knowledge co-production practice and possibilities, and to enable people who were unable to attend the country workshops to participate in the mapping study (See Appendices C and D). One

was designed for university professionals, and the other for national and regional stakeholders who are involved in climate change and CCD. For Swaziland, a total of 32 questionnaires were answered, which included 20 stakeholders and 12 university professionals. Questions covered these 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 Swaziland, 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. However, the **best available information was carefully consolidated, reviewed and verified** in the construction of this Country Report. Overall, the mapping study was further constrained by a budget cut imposed mid-way through the study.

While much information could be obtained on CCD 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 what existing research, knowledge co-construction practice and possibilities currently exist, but there is also more to learn about these. This Country Report

therefore presents as a useful ‘initial document’ and it is hoped that Swaziland, and in particular, the University of Swaziland (UNISWA), Southern Africa Nazarene University (SANU), William Pitcher College, Ministry of Natural Resources and Energy, Department of Water Affairs, Swaziland Environment Authority, Ministry of Agriculture, National Curriculum Centre and other national stakeholders can take this analysis forward in ongoing mapping and planning activities related to CCD research and knowledge co-production.

2.3 Expanding the mapping study

There are numerous ways to expand this study, most notably by administering the questionnaires (included in Appendices C and D) in a manner that would include every academic at the University of Swaziland, Nazarene Teachers Training College, and William Pitcher College, and other higher education institutions, and in a way that would allow for aggregate data within and across Faculties and Departments. The scope of such a detailed analysis lay beyond the capacity of the current mapping study. Data from questionnaires is therefore indicative rather than conclusive. Similarly, the questionnaire for stakeholders can be administered with additional national and local stakeholders (Appendix D) involved in environment and development initiatives in Swaziland to understand the full scope of CCD responsiveness in Swaziland, and to further develop the knowledge co-production capacity for CCD in Swaziland. 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 Swaziland, 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 Swaziland. Ministries who could take this study forward could include the Ministry of Education and Training, Ministry of Natural Resources and Energy; Department of Water Affairs, Ministry of Agriculture and the Ministry of Minerals, Energy and Water Resources together with other relevant partners and stakeholders.

2.4 Analysis logic

The analysis logic informing this Country Report is threefold. It firstly maps out a ‘needs analysis’ which identifies country based knowledge, research and capacity gaps for key CCD priorities as articulated in documents, workshop and questionnaire responses. Secondly, it provides an ‘institutional analysis’ providing insight into existing institutional capacity for CCD knowledge co-production. Thirdly, it provides a perspective not only on existing knowledge co-production practice for CCD in Swaziland, 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 Swaziland, which may also assist Swaziland **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 Swaziland's socio-economic context, which provides the baseline for addressing the climate change-related needs and priorities in the country (section 3.2), and a summary of the observed and projected climatic changes for the country (section 3.3). This is followed by an overview of the broader priorities for addressing climate change as identified by policy (section 3.4.1), in workshops (section 3.4.2) and via the questionnaires (section 3.4.3). A summative discussion is then provided of the broader climate change-related priorities and needs from these three sources of data in section 3.4.4. The needs analysis then moves on to describe more specific priorities and needs, and their associated knowledge, research and capacity gaps (section 3.5). The following differentiation of knowledge, research and capacity gaps is used:

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

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

3.2 Socio-economic context

The Kingdom of Swaziland is a landlocked and mountainous country located at the transition of the South African Plateau to the Mozambican coastal plain. The country covers a land area of 17 364 km² and has a population of 1 018 449 (2007 figure). Despite its size, the landscape, geology, soils, climate and biodiversity vary greatly across the country. The climate is mainly subtropical with hot and wet summers and cold and dry winters; it ranges across physiographic zones from sub-humid and temperate in the Highveld to semi-arid and warm in the Lowveld. There is high inter-annual variation in precipitation, which results in periods of flash flooding or drought. Serious land degradation hinders socio-economic development and goals of food self-sufficiency. While Swaziland is categorised as a lower middle income country with a per capita income of \$5 708 (IMF 2010), approximately 69 percent of the population lives below the poverty line. The direct contribution to GDP of agriculture has declined in recent years, but manufacturing is still heavily agro-based. The need has been identified to diversify both food crops (currently predominantly maize) and adding other cash crops to the sugar industry, as well as developing agro-processing industries. The country is highly dependent on South Africa, which accounts for 90 percent of Swaziland's imports, 60 percent of its exports, and 80 percent of its electricity. Life expectancy has declined over the past two decades from 60 years in 1990 to just 45 years in 2005, driven by the high prevalence of HIV/AIDS and the impacts of poverty. There are currently more than 200 000 people living with HIV and about 130 000 orphans and vulnerable children in Swaziland.

3.3 Observed and projected climatic changes, impacts and vulnerabilities

3.3.1 Observed climatic changes

Temperature analysis of historical observations has showed a significant increase in the observed annual mean temperature of more than 3 °C in the period from 1961 to 2000 in all agro-ecological zones.⁹ Over the period covering 1960–2005, most stations indicated significant increases in both mean minimum and mean maximum temperatures. The frequency of cold nights (and frost where it occurs) has decreased, whilst the frequency of hot nights has increased, as has the length of heat waves. Trends in rainfall indices were far more heterogeneous than those for temperature. There were statistically significant increases in some rainfall intensity-related indices at specific locations and for specific periods. There is evidence that the onset of rainfall has been delayed since around 1980, with rains ending earlier over most of the country.

3.3.2 Projected climatic changes

Climate change projections from both a statistically downscaled ensemble of seven GCMs and using the Climate Change Explorer tool were developed in the SNC (2011). Both minimum and maximum temperatures are projected to increase in all seasons and all regions/zones in the country by both methods used. Both methods were in agreement with temperature increase and they clearly demonstrated that temperatures are expected to rise by 1.5 to 2.5°C by the 2046–2065 period. Largest increases are more extensive over the Highveld and northern Lowveld, before the onset of the rains. Both methods project an increase in rainfall in the period from 2081 to 2100, with some disagreement over the period 2046 to 2065. Both methods also suggest an increase in droughts for both periods and an increase in flooding in the late century. There will be no significant change in the total annual rainfall.

3.3.3 Impacts and vulnerabilities

Climate change in Swaziland is expected to lead to overall warming and drying, with a greater frequency and an intensification of droughts and floods. Increased aridity will be linked to ecosystem changes, with the drier Acacia savanna likely to be dominant. Invasion by alien plant species and bush encroachment is most likely to increase. Frequent outbreak of forest fires is most likely to occur in linear year to year intervals. Climate change will on the whole have a negative impact on water resources. Surface flows in rivers and streams are likely to have greater variation, with lower base-flows in the dry season, potentially resulting in water shortages for domestic, industrial and agricultural use. Groundwater reserves, which are an important source of water for many rural communities, may be reduced as a result of increased rainfall intensity and concomitant increases in surface runoff. The SNC notes variable changes to agricultural crops, depending on agro-ecological zone and the planting time period for the particular crop. For example, maize yields for the period from 2046 to 2065 will likely be higher when planted in first week of December than when planted

⁹ Swaziland Second National Communication, 2011: 34

in mid-October. On the other hand, if maize is planted in February, maize yields will probably be reduced by at least 50 percent from the December planted maize. The possible impacts of climate change on forest plantations include change in the location and optimum growing size of species, more frequent outbreak of fires, shifts in species composition and size of forest estates, and change in the type, location and intensity of pests and other pathogens. Climate and weather risk may result in increased deaths due to heat waves, and natural hazards such as floods, vector-borne diseases such as malaria and other existing and emerging infectious diseases.

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

Section 3.4 focuses on the broad priorities and needs for addressing climate change and moving towards CCD in Swaziland. Section 3.4.1 highlights key priorities and needs articulated in policy and strategy, after which some of the broader priorities articulated by workshop participants are discussed in section 3.4.2. This is followed by a presentation of the broader needs for CCD as specified in the questionnaire responses (section 3.4.3). Finally, a summative perspective on the broader identified needs for adaptation, mitigation and, ultimately, for CCD, is provided in section 3.4.4.

3.4.1 Identified adaptation and mitigation priorities articulated in policy and strategy

Key vulnerabilities lie in agriculture, forestry, food security, water resources, biodiversity and terrestrial ecosystems. Priority sectors for adaptation in Swaziland include **agriculture, water and energy**, and **health**. Moreover, the country's serious land degradation problems are likely to be exacerbated by climate change. Preliminary analysis suggests that climate change will have an increasingly adverse effect on **agricultural production**, particularly on smaller households of the 78 percent of the population in rural communities. Combined with other stressors such as land degradation, erosion and uncontrolled bushfires, this is likely to increase vulnerability and lead to chronic food shortages, with many households depending on food aid (UNDP 2010). The health sector is likely to be adversely affected by climate change due to an increase in vector-borne diseases resulting from temperature and precipitation increases.

The following list summarises priority adaptation measures identified in the SNC (2012):

- **Biodiversity:** increasing awareness of climate change impacts and capacity to respond; minimising the impacts of climate change on aquatic and semi-aquatic species, communities and ecosystems, and indigenous terrestrial species; and factoring the impacts of climate change on biodiversity into natural resource management and land-use planning.
- **Agriculture:** shifting planting periods, growing of drought tolerant crops, and raising suitable crops in appropriate regions. For livestock, raising them in the most suitable areas – for example, raising dairy cattle mainly in the Highveld and wet Middleveld where it is cooler; and irrigation support through developing small dams primarily for livestock and domestic water with supplementary irrigation for horticulture. The sugar industry is responding to climate change by planting drought-tolerant cane varieties and using more water-efficient irrigation systems.

- **Water resources:** implementation of efficient water use, strengthening of stream flow observation, early warning systems, implementation of integrated water resources management and rain water harvesting.
- **Forestry:** developing sustainable forest management systems, integrated fire management frameworks, alien invasive plant species comprehensive programmes, community-based forest management programmes, selection of suitable tree species suitable for each ecological zone.

Stringent implementation of identified mitigation measures under energy and Land Use, Land Use Change and Forestry (LULUCF) would gradually contribute to moving Swaziland from a carbon source to a carbon sink after 2030. Mitigation measures considered include fuel switch from coal to sugarcane trash in the sugar industry, strengthening and promoting renewable energy sources, efficient energy system and ethanol blending under the energy sector. Under LULUCF, measures considered include conservation farming, reforestation, regeneration, and bio-electricity.

Barriers to adaptation

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

- Low levels of awareness of the threats and opportunities of climate change;
- Limited human resources in a small country;
- Low technological capacity; and
- Availability of the financial resources to address climate adaptation.

3.4.2 Identified adaptation and mitigation priorities articulated by workshop participants

When speaking in broad terms of adaptation and mitigation priorities for Swaziland, workshop participants highlighted the need to adopt land use systems aimed at mitigation and adaptation of climate change impacts such as conservation agriculture. Research and adoption of renewable sources of energy and innovative methods of water harvesting, storage and usage were also noted as key necessary elements of the country's response. Mainstreaming climate change dimensions and issues into other national socio-economic development sectors was highlighted, as well as the need to pursue green economy principles in the production sectors.

Responding appropriately to climate change would require developing and empowering people with adaptive and resilience skills beyond the general skills they currently possess, and constantly integrating new knowledge on climate change into people's actions. When considering the regional climate change projections, it was noted that Swaziland stakeholders should consider conducting transdisciplinary research regardless of what the projections portray. Mr Mandla Mlipha from the University of Swaziland (UNISWA) highlighted the role of innovation, stating that "this must not just be a buzz word, but needs to be harnessed to address climate challenges, and collaboration is critical to achieve the necessary – at institutional, national and regional levels". In the conclusion of the discussion participants noted that development activities in Swaziland are destroying the country's ecosystems, but development cannot be sustainable if it does not take into consideration the impacts on the environment. Hence the need for interventions that result in the restoration of the country's vulnerable ecosystems such as wetlands and grasslands.

It was observed that climate change is not always about negative impacts, but that there could be positive impacts which needed to be appreciated and taken advantage of in economic development, such as the opportunity to develop *climate compatible infrastructure* to withstand floods and other adverse impacts of climate change. The discussion on infrastructure highlighted the need for models to predict future impacts of climate change on infrastructure and other development projects undertaken in the country. The new international airport was an example of a project implemented without knowing the future impacts of climate change on it. This was mentioned to highlight the nature of *climate change impacts being area and/or site-specific*, hence the need for appropriate site-specific data and models for modelling future impacts.

Participants highlighted the need to *create a knowledge society* in which every individual would comprehend the approaching situation, to “avoid being cursed by future generations”. However, it was noted that despite the implementation of government initiatives to create awareness, people still lack knowledge about climate change issues. Doubts were also raised about the adequacy of knowledge alone in the fight against the impacts of climate change, thus calling for *action-oriented programmes of climate change adaptation and mitigation*, in addition to awareness raising and knowledge.

3.4.3 Identified needs for CCD articulated in questionnaire data

Questionnaire data showed that while there is a relationship between institutional interest / mandate and/or disciplinary interest / mandate and the definition of priority needs there is also a broader more nuanced understanding of the needs, sometimes with suggested needs falling outside of an institution’s mandate or disciplinary interest. Synthesising the points raised in the questionnaire data results in the following groupings of identified needs for CCD:

- *Policy*: Having the right policies in place, with climate change and CCD concerns mainstreamed in these;
- *Implementation*: Implementing, enforcing and monitoring these policies across sectors, including industry and energy, food security and agriculture, health, water (conservation), and infrastructure improvement;
- *Education and empowerment*: Educating and raising awareness on climate change and CCD across all sectors and levels, which needs to include curriculum reform, and empowering communities to adapt to the projected impacts;
- *Capacity development*: Extensive and ongoing capacity development programmes; and
- *Research*: Strengthening research and specific technological development and innovation, including financial support to expand research efforts.

Clearly, individuals completing the questionnaires have a wider and more nuanced understanding of CCD needs that goes beyond their disciplinary boundaries. Apart from identifying and recognising these different perspectives in knowledge co-production processes and approaches, it is interesting to note too that many respondents identified similar cross-cutting needs, such as the need for policy and curriculum reform, for political will and capacity to ensure implementation of policies, and for capacity development and knowledge management and dissemination. See Table 2 below.

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

Need identified	Institutional interest / mandate and/or disciplinary interest / mandate
■ Enforcement in terms of skill development and change of character - Compatible policies development - Develop more innovation and research - Develop specific technologies	■ United Nations Educational, Scientific and Cultural Organisation (UNESCO) ■ Science and Culture
■ Ensure that human activity is monitored so that it does not harm our environment so as to impact climate negatively	■ UNDP/ Department of Water Affairs Climate Change Project
■ Capacity Building - Information management and dissemination and access - Conducting of baselines - Developing appropriate technologies and innovativeness	■ Swaziland National Trust Commission ■ Nature Conservation
■ Adoption of appropriate climate change practices	■ UNICEF ■ Child Survival and Development
■ Educating the society on climate change and having policies that are going to protect the environment	■ Ezulwini Municipality – Swaziland ■ Administration
■ Industrial development - introduce guidelines to greenhouse gases -Policy development - no industrialisation policy - Deal with food security issues (need more research)	■ Ministry of Natural Resources and Energy ■ Energy Department
■ Environmental management and impact assessment of human activities	■ UNESCO National Commission ■ Education and Science
■ Land degradation and water reservations	■ Matsapha Town Council ■ Environment and Public Health
■ Research that responds to changes ■ Empower community to adapt to changes taking place	■ UNDP ■ Energy, Environment, Climate Change and Disaster Risk Reduction
■ Provide financial support for research to address CCD ■ Have policies that are in line with CCD ■ Make sure that policies are implemented	■ National Curriculum Centre ■ Social Science
■ Strengthen institutional capacity to train people at all levels to understand and appreciate climate change and its impact ■ Strengthen research dealing with climate change adaptation and develop technologies that deal with best practices	■ Swaziland Electricity Company ■ Environment Department
■ Integrate CCD into the national Environmental impact assessment process for all development projects	■ Swaziland Environment Authority ■ Policy, Information and Research
■ Political will, capacity strengthening	■ Komati Basin Water Authority ■ Water Management
■ Governance, particularly at policy and decision making level ■ Inclusive socio-economic development strategies that deal with climate change adaptation	■ Swaziland National Trust Commission ■ National Environmental Education Programme
■ Policy and legislation ■ Capacity on CCD technology and expertise	■ UNISWA Green Team ■ Executive
■ Food security and agriculture ■ Health ■ Education and training	■ Ministry of Agriculture ■ Early Warning Unit
■ Reduce reliance on coal/fossil fuels or sources of energy	■ Komati Basin Water Authority ■ Environment and Development

Need identified	Institutional interest / mandate and/or disciplinary interest / mandate
<ul style="list-style-type: none"> ■ Water conservation ■ Rangeland management improvements ■ Energy ■ Infrastructure improvement 	<ul style="list-style-type: none"> ■ Swaziland Water and Agricultural Development Enterprise ■ Lower Usuthu Smallholder Irrigation Project
<ul style="list-style-type: none"> ■ Review of tertiary institutions' curriculum to embrace CCD issues 	<ul style="list-style-type: none"> ■ William Pitcher College ■ Faculty of Education
<ul style="list-style-type: none"> ■ Adaptation of mechanisms to deal with climate change issues Integration and filling knowledge gap between academics and people on the ground like farmers through participatory research projects 	<ul style="list-style-type: none"> ■ Swaziland Environment Authority ■ Environmental Compliance and Assessment
<ul style="list-style-type: none"> ■ Enforcement in terms of skill development and change of character ■ Compatible policies development ■ Develop more innovation and research projects ■ Develop specific technologies that will address issues of climate change 	<ul style="list-style-type: none"> ■ University of Swaziland ■ Faculty of Social Science
<ul style="list-style-type: none"> ■ Ensure that human activity is monitored so that it does not harm our environment so as to impact climate negatively 	<ul style="list-style-type: none"> ■ University of Swaziland ■ Administration
<ul style="list-style-type: none"> ■ Capacity Building ■ Information management and dissemination and access ■ Conducting baseline surveys that informs the status of the environment ■ Developing of appropriate technologies and innovativeness that will strive to address issues of climate change 	<ul style="list-style-type: none"> ■ William Pitcher College ■ Faculty of Education
<ul style="list-style-type: none"> ■ Adoption of appropriate climate change practices 	<ul style="list-style-type: none"> ■ Nazarene Teachers Training College (SANU) ■ Faculty of Education
<ul style="list-style-type: none"> ■ Educating the society on climate change and having policies that are going to protect the environment 	<ul style="list-style-type: none"> ■ Nazarene Teachers Training College (SANU) ■ Faculty of Education
<ul style="list-style-type: none"> ■ Industrial development - introduce right strategies that will help to control and regulate/measure greenhouse gases ■ Policy development - no industrialisation policy ■ Deal with food security issues –need for more research 	<ul style="list-style-type: none"> ■ University of Swaziland ■ Faculty of Social Science
<ul style="list-style-type: none"> ■ Environmental management and impact assessment of human activities 	<ul style="list-style-type: none"> ■ University of Swaziland ■ Faculty of Agriculture
<ul style="list-style-type: none"> ■ Land degradation and water reservations 	<ul style="list-style-type: none"> ■ Nazarene Teachers Training College (SANU) ■ Faculty of Education
<ul style="list-style-type: none"> ■ Do research that brings on alternatives and provides solutions to climate change issues ■ Empower community to adapt to changes brought by climate change 	<ul style="list-style-type: none"> ■ University of Swaziland ■ Faculty of Science
<ul style="list-style-type: none"> ■ Provide financial support for research to address CCD ■ Have policies that are in line with CCD ■ Make sure that policies are implemented 	<ul style="list-style-type: none"> ■ University of Swaziland ■ Faculty of Agriculture

3.4.4 Summative perspective on broad needs identification related to adaptation and mitigation priorities for CCD

From this first part of the needs analysis, which has explored broader priorities and needs identified for Swaziland, it is apparent that there is broad agreement amongst the three data sources (policy, workshop, questionnaires) on the priority focus areas for adaptation – namely, agriculture and food security, terrestrial ecosystems, biodiversity and forestry, and water resources; with some additional emphasis in the questionnaire responses on health and on infrastructure.¹⁰ This is not surprising given that Swaziland's key climate vulnerabilities lie in these areas. The data sources also agree on broad mitigation priorities and needs, which encompass industry and energy, and Land Use, Land Use Change and Forestry (LULUCF). 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 industrial policy and development to reduce greenhouse gas emissions, without specifically noting desired technologies to achieve this. Both policy documents and workshop data emphasise the need to strengthen and promote renewable energy sources. While the policy documents note the need for mitigation to gradually contribute to moving Swaziland from a carbon source to a carbon sink after 2030, this issue was not mentioned in other data sources.

Overarching barriers to adaptation discerned from national climate change documents included **low levels of awareness** of the threats and opportunities of climate change; **limited human resources** in a small country; **low technological capacity**; and availability of the **financial resources** to address climate adaptation. The workshop and questionnaire responses echoed and further developed these constraints through the identification of a range of cross-cutting needs for responding better to CCD, amongst which capacity development, training, enhanced and better resourced research, technology development and innovation, and mainstreaming climate change into policy and ensuring implementation through awareness raising and enforcement, were key. These data sources highlighted the need not only for awareness raising and capacity development but also empowerment of Swazis to become more resilient to current and future climatic changes.

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

A second part of the needs analysis undertaken in the mapping study involves more detailed analysis of CCD knowledge, research and capacity gaps, with a focus on those gaps identified in key national documents, and as articulated by stakeholders and university staff attending the workshops and completing questionnaires.

¹⁰ It is assumed that this refers to climate-proofing infrastructure against climate risks such as more intense rainfall and increased flooding.

3.5.1 Needs analysis: Specific research needs and knowledge gaps

In general, the various assessments carried out in Swaziland have noted information gaps regarding education, training and public awareness. Efforts have been made to strengthen the *capacity of the Ministry of Education and Training* to lead and coordinate the integration of climate change in the *school curricula*. Priorities aimed at strengthening national capacity in *assembling and interpreting climate data and information* were further identified. Swaziland's Second National Communication (2012) to the UNFCCC highlights the need for national *research institutions to coordinate their actions better* and to *upgrade their technical and human capacities* so that future National Communication Reports are conducted based on readily available, useful, relevant data and information.

The SNC notes the need to *consolidate and reinforce research* relating to programmes containing measures for mitigation of, and adaptation to, climate change. Of great relevance for the SARUA programme, the SNC highlights that active *information sharing mechanisms* are yet to be explored and reinforced in order to access and use existing information technologies related to climate change regionally or beyond. It further states that securing assistance to overcome the identified technological needs will require the development of project proposals and political will.

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

- Agriculture and Science;
- Education and Training;
- Water Resources and Energy; and
- Health and Social Dynamics.

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

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

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
Food security	<ul style="list-style-type: none"> ■ The extent of the climate change problem on crop production ■ Proactive system for detecting crop failure 	<ul style="list-style-type: none"> ■ Contextualised research for the agro zones ■ Research on the variety of maize which can withstand harsh conditions 	<ul style="list-style-type: none"> ■ Capacity building for subsistence farmers to address their own localised agricultural problems 	<ul style="list-style-type: none"> ■ Ministry of Agriculture should increase the capacity of existing extension officers by training them and availing resources ■ Localise extension officers so that they know the details of the area
Health: Shifting disease patterns	<ul style="list-style-type: none"> ■ An understanding of the shifting patterns 	<ul style="list-style-type: none"> ■ Evidence-based research on the patterns 	<ul style="list-style-type: none"> ■ Information on symptoms of the diseases 	<ul style="list-style-type: none"> ■ Capacity of the health sector to deal with diagnosis and treatment of the diseases
Rural-urban migration	<ul style="list-style-type: none"> ■ Benefits and drawbacks of urban migration 	<ul style="list-style-type: none"> ■ Research on retention strategies of people in the rural areas 	<ul style="list-style-type: none"> ■ Survival skills in the rural areas 	<ul style="list-style-type: none"> ■ Rural development area programs should address the needs of the people ■ There is a need for an integrated rural development strategy
There is need to focus on alternative renewable sources of energy	<ul style="list-style-type: none"> ■ Power generation potential in Swaziland ■ Area specific information on renewable energy ■ Lack of localised data ■ Lack of access to available information about renewable energy resources 	<ul style="list-style-type: none"> ■ There is need for research on development of solar energy in Swaziland ■ There is a need for area-specific research for renewable energy whether wind or solar 	<ul style="list-style-type: none"> ■ We need to train more local experts on sustainable development and renewable energy ■ Need to train and sensitise political leaders on renewable energy and link with addressing climate change 	<ul style="list-style-type: none"> ■ Shortage of funds for needed research ■ Insufficient training by institutions on renewable energy sources ■ Capacity to manage the available data about renewable resources

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
Courses/curriculum addressing climate change from primary throughout tertiary	<ul style="list-style-type: none"> ■ Lack of conceptual understanding ■ Policy development is not informed by research ■ Curriculum is too much inclined to theory rather than practical – lack of praxiological orientation 	<ul style="list-style-type: none"> ■ Little awareness of the research undertaken on this aspect – no well-known research database ■ No platform and regulation where research can be easily accessible ■ The environment doesn't promote well-undertaken research due to lack of funding and follow-up ■ Need for collaboration among researchers in order to make a meaningful contribution ■ Information flow between practitioners and researchers is lacking. Information doesn't reach all the people it should reach 	<ul style="list-style-type: none"> ■ Lack of experts ■ Lack of experience with collaborative curriculum development 	<ul style="list-style-type: none"> ■ Ineffective functioning of the national research council ■ Institutions have very few postgraduates (Masters and PhDs) students that can carry out research that can contribute to the society meaningfully ■ Lack of funding for research at post graduate level – a lot of people have to fund themselves or are funded by South African institutions hence will carry out research focused for South Africa ■ Our institutions are not in networks at global level
There is a need for water conservation and demand management	<ul style="list-style-type: none"> ■ Knowledge gap on groundwater availability, management, development, use, conservation and demands 	<ul style="list-style-type: none"> ■ Lack of models for management of water catchment ■ There is a gap in remote sensing technologies for water demands 	<ul style="list-style-type: none"> ■ Train more hydrologists ■ Water management engineers and civil engineers up to PhD level ■ There is a need to train irrigation specialists and civil engineers on CCD 	<ul style="list-style-type: none"> ■ Lack of enabling resources (funds) ■ There is a need for institutional development on water demand management
Climate proofing of water and energy infrastructure		<ul style="list-style-type: none"> ■ There is a need for research to understand the magnitude of climate change impacts on infrastructure 		<ul style="list-style-type: none"> ■ Disaster management capacity ■ Build national capacity on disaster preparedness and response

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
Appropriate technology in mitigation strategies in relation to CCD	<ul style="list-style-type: none"> ■ Government is promoting conservation agriculture (CA) but people implementing are at different levels of understanding of the concepts ■ We need to customise CA for our situation in Swaziland ■ Approaches to CA messages vary, meaning that there is no one clear message ■ Appropriateness of technology-potholing 	<ul style="list-style-type: none"> ■ How is CA different from conventional agriculture in terms of impacts, benefits, cost-benefit analysis ■ Scientific evidence supporting benefits of CA – organised information is needed to attribute impact to CA and comparison with more conventional agricultural approaches ■ Use of agro-bio products – need research on this so that a clear cost ratio list can be formulated 	<ul style="list-style-type: none"> ■ Training of trainers on CA ■ We do not have enough written material people can refer to e.g. manuals on CA ■ Knowledge management – we have to document the lessons learnt, meaning the existing knowledge possessed by individuals 	<ul style="list-style-type: none"> ■ Lack of finance – to develop technologies and for equipment ■ Linkage between training institutions and government, especially employment of graduates ■ Land tenure system – installing infrastructure and uncertainties related to this ■ Appropriate technology should be available and enough in RDAs to support farming ■ Privatisation of services like agricultural mechanisation ■ Need for appropriate policies to encourage CA
Rangelands and livestock	<ul style="list-style-type: none"> ■ Lack of information on draft land policy and whether it covers rangeland issues 	<ul style="list-style-type: none"> ■ Little research has been done on rangelands management – principles and practices ■ Research on pastures, plants, species that would grow well under new climatic conditions 	<ul style="list-style-type: none"> ■ We need to capacitate climate-resilient land use, especially amongst community leaders, as they are the ones allocating land 	<ul style="list-style-type: none"> ■ Land policy needs to be concluded ■ Harmonisation of existing policies that touch on issues of land and climate change ■ Land use planning
Collaboration of existing agricultural extension systems	<ul style="list-style-type: none"> ■ Knowledge management, data collection, and documentation 	<ul style="list-style-type: none"> ■ Priority research on the feasibility of collaboration amongst existing extension systems ■ Research on the most important issues that should be documented 	<ul style="list-style-type: none"> ■ No expertise or appropriate training of extension officers 	<ul style="list-style-type: none"> ■ Silos, a lot of duplication ■ Planning together is needed, not the current sectoral approach to planning ■ There must be a centralised data source ■ Coordination by MOA of extension services ■ No institutional training of extension officers

Table 3 indicates that common emphasis is placed on curriculum development priorities for CCD, with knowledge and research needs carefully defined. Addressing the process question related to CCD policy implementation requires a strong analysis of individual and institutional capacity gaps, which are addressed in the following two sections.

An issue discussed throughout the Swaziland workshop was the importance of exploring the contribution that could be made through the integration of indigenous knowledge with scientific methods for responding to climate change. In a presentation made at the workshop, Professor A. M. Manyatsi of UNISWA highlighted, for example, the following indigenous methods to predict weather patterns: nesting position of *Ploceus spp* birds (**Emahlokokholoko**); cry of *Cuculus solitarius* bird (**Phezukwemkhono**); cry of frogs during the summer season; chirping of *Centropus burcehellii* bird (**Umfuku**); the visit of *Scopus umbretta* bird (**Tsekwane**) in a homestead; and the abundance of butterflies, locusts and grasshoppers during farming season. Professor Manyatsi further summarised the following needs and issues in his presentation:

- Local people are repositories for traditional and indigenous knowledge expertise, skills and practices relevant to climate change;
- Response to climate change should be demand driven, location specific and participative;
- It should consider gender specific needs as well as priorities of other vulnerable communities;
- Climate change concerns should be integrated into food security and development planning across all sectors; and
- Climate change adaptation and mitigation issues should be addressed as an ongoing social learning process that integrates local and scientific knowledge.

Specific **knowledge gaps** emergent from the workshops and questionnaires reveal **insufficient data and data coordination and storage capacities** to establish climate change baselines in Swaziland. Both the SNC and the workshop data pointed to a considerable **lack of observational data on climate change**. Participants pointed specifically to the need for data and information on **waste, water resources, agriculture, biodiversity, energy and industry**, and **health sector-related data to underpin climate assessments of impacts and vulnerability**. Another specific knowledge gap included **insufficient mapping** of local areas with high levels of vulnerability or that are prone to climate change impacts. **Relevant technologies for climate adaptation and mitigation** have not been tested.

With regard to **research gaps** in Swaziland the workshops and questionnaires revealed a variety of research needs. Participants highlighted the lack of research programmes and **curriculum** specifically targeted to climate change, leading to climate change being treated somewhat superficially. In courses **agricultural research** gaps frequently cited by participants included the development of drought-resistant crops, exploration of agricultural technology for climate change adaptation, afforestation technologies and **sustainable forest management**. Other prioritised research gaps included **tropical disease control** and the effects of climate change on this; and climate change **compatible building technology and town planning methods**, as well as the use of **indigenous knowledge systems** in addressing climate change challenges. Inhibiting factors affecting climate change and CCD-related research

included a **lack of collaboration** within and between sectors and disciplines. In addition to this there were concerns over the few climate change-related Masters or PhDs available. Finally participants raised concern over the noticeable lack of an **overarching framework for collection of climate change data**.

Questionnaire responses frequently corresponded with certain policy and workshop discussion issues regarding CCD capacity gaps, emphasising their importance and high priority status. An example repeated in all three data sources was developing adequate data capture, storage and information on climate change in Swaziland, and specifically how these can be used to establish baselines, and be developed through observational data and linked to indigenous knowledge. In the SNC, research capacity gaps were mainly focused on agricultural adaptation, while workshop discussions and questionnaires raised other concerns regarding lack of collaborative research, and the need for more postgraduate research (particularly Masters and PhDs). Two different participants raised the research gap exploring CCD related to indigenous knowledge systems.

Individual and institutional capacity gaps noted in Table 3 are discussed in sections 3.5.2 and 3.5.3.

The mapping study identified a number of programmes and projects involving government and donor agencies that are specifically focused on addressing climate change challenges, and which include research needs (implicit or explicit) that would need to be addressed through knowledge co-production involving multi-stakeholders at different levels, as shown in Table 3 below. Some suggestions are provided for research and knowledge gaps that may be at least partially addressed by these programmes. It is not clear to what extent university researchers are involved in these programmes, although it is likely that this is the case, given the small set of researchers working on climate change in Swaziland.

Table 4: Research needs, linked to specific knowledge needs and knowledge co-production partners as identified in the SNC (2012), with refinements /additions from workshop and questionnaire data

Project/programme	Partner organisations	Related research needs, linked to specific knowledge needs (as indicated in policy, and supplemented by workshop and questionnaire data)
<p>Lower Usuthu Smallholder Irrigation Project (LUSIP-GEF) (ongoing)</p> <p><i>Aims to reduce land degradation, biodiversity loss and mitigate climate change through the application of sustainable land management practices</i></p>	<p>LEAD AGENT:</p> <ul style="list-style-type: none"> ■ Ministry of Agriculture and Cooperatives <p>PARTNERS:</p> <ul style="list-style-type: none"> ■ Swaziland Water and Agricultural Development Enterprise, IFAD 	<p>Research on land degradation, biodiversity loss and mitigation/adaptation – the project could potentially partially address the following knowledge/research gaps:</p> <ul style="list-style-type: none"> ■ Understanding the impacts of climate change on biodiversity ■ Local areas either vulnerable or prone to climate change impacts are not mapped ■ Regional suitability production through introducing sustainable land resource planning and management
<p>GEF-SCCF project on adapting national and trans boundary water resource management in Swaziland to manage expected climate change (2013–2016)</p> <p><i>Climate risks incorporated into Integrated Water Resources Management (IWRM), focusing on the Incomati, Umfolozi and Maputo Rivers. Piloting community level adaptation, including practices that increase infiltration, rainwater harvesting</i></p> <p><i>Information generated and lessons learned from pilot-scale adaptation measures funded by the project, will assist policy implementation for effective adaptation planning and climate risk management in the water sector</i></p>	<p>LEAD AGENT:</p> <ul style="list-style-type: none"> ■ Ministry of Natural Resources and Energy (MNRE) – Department of Water Affairs (DWA) <p>PARTNERS:</p> <ul style="list-style-type: none"> ■ UNDP, funded by GEF-SCCF 	<p>Research on water resource management and climate change – the project could potentially partially address the following knowledge/research gaps:</p> <ul style="list-style-type: none"> ■ Knowledge gap on groundwater availability, management, development, use, conservation and demands ■ Lack of models for management of water catchment

This section has provided some indication of where the major knowledge and research needs are, which could be helpful in the development of Swaziland's Climate Change Strategy and Action Plan. The mapping study needs analysis has identified related individual and institutional capacity gaps in Swaziland, as will now be discussed in sections 3.5.2 and 3.5.3.

3.5.2 Needs analysis: Individual capacity gaps

According to the SNC (2012), capacity building priorities have been identified as improving the technical competence of key officials involved in assembling and interpreting climate data and information. Skills and equipment to manage information are still to be developed. The National Communication has identified areas in which data and information need to be improved (e.g. waste, health sector, water resources, agriculture, energy, and industry). While several technical working groups were established to source and interpret information and data about climate impacts in the development of the SNC, it was noted that the capacity and skills available locally still needs to be developed, as does the baseline information to model, analyse or interpret climate impacts. Hence, the SNC recommended that national research institutions need to upgrade their capacities and skills to ensure that future National Communication Reports are completed based on readily available, useful and relevant data and information.

The SNC noted that the Department of Meteorology, as the National Climate Change Focal Point, has been engaged in a capacity building exercise through the World Meteorological Organisation, which involved training individuals on the key aspects required for implementing projects and for doing research directed at attaining the objectives of the UNFCCC. Capacity developed should be important in preparing the Third National Communication. Some of the capacity constraints identified under the National Capacity Self Assessment report were inappropriate institutional structures, inadequate manpower and inadequate policy framework.

Taken together, the SNC, workshops and questionnaires revealed a variety of more detailed individual capacity gaps. Overall a broadened understanding of climate change and its impacts was called for, with concerns raised that there is currently insufficient trained and skilled people working on climate change in Swaziland. For example, a lack of understanding of climate models and use of estimate values for national conditions in Swaziland was highlighted, pointing to the need to develop skills for systematic observation and modelling of climate change. Workshop discussions raised the issue of technical competence of key officials involved in assembling and interpreting climate data and information. The capacity to translate and transmit expert knowledge to local communities is also needed. Other specific human and technical capacity gaps raised in the workshop included the ability to mobilise financial support; project preparation skills to access international funding for climate change; training of extension officers on climate change issues; capacity on climate change and land use issues, especially community leaders who are the land allocators; and improved collaborative capacities at different levels. Thus a number of gaps can be clustered around the area of **community outreach and education**. Finally a commonly quoted individual capacity required is **improved leadership and management skills** across institutions, with points raised about the need for enhanced political will to address the scale of the challenges.

In discussing the human capacity priorities of Swaziland with regard to implementation of the UNFCCC, the SADC Regional Environmental Education Programme in 2012 identified the following individual skills: foresters, climate change and adaptation specialists, natural resource economists, environmental lawyers, environmental educators, soil chemists, microbiologists and physicists, and remote sensing, survey and land use planners. The main cross-cutting issues identified included capacity to: coordinate multiple actors; collect, manage and exchange information; develop and use economic instruments and sustainable financing mechanisms; develop and transfer technology; develop and enforce policy, legislation and regulations; and plan and manage monitoring and evaluation processes.

A spokesperson from the Ministry of Agriculture had this to say regarding individual CCD capacity gaps in Swaziland in the questionnaire:

"We need specialists trained on climate change issues, adaptation and mitigation in each and every Ministry or organisation. Universities need to introduce programmes on climate change long term or short term in order to capacitate communities. Communities must be well informed on issues of climate change and survival skills."

Similar sentiments were raised in the questionnaire by a representative from the UNDP:

"There is generally inadequate expertise and skills in climate change research. There is also lack of vigorous sensitisation and sharing of information with regards to climate change issues."

3.5.3 Needs analysis: Institutional capacity gaps

The SNC reported that establishing an institutional framework to conduct National Communications (NCs) was underway in Swaziland. Thematic groups were established and capacitated to carry out activities of the NC in their respective areas. There was also training for conducting GHG inventories to one of the permanent member of the climate change office and two more officers have been trained on climate change including climate projections. As a result of the training and capacity building in the existing institutional arrangement, it is now easier to do greenhouse gas inventories. The only challenge under GHG inventory is activity data in the sectors and the performance of QA/QC which we expect to pay more attention to in the Third National communication. With regard to mitigation measures, the Energy sector is more structured than other sectors like Waste and Land Use and Forestry. The health and Economy sector still need more attention as they are lagging behind, mainly because of lack of understanding and use of appropriate models.

As it stands the institutionalisation of climate change issues and processes is mandated to the Swaziland Meteorological Services under the Ministry of Tourism and Environmental Affairs. This is where the National UNFCCC Focal Point is housed. The department works closely with the Swaziland Environmental Authority in screening and approving possible projects. In preparation for the First National Communication, the Department of Meteorology established a project office; while this office is still operational, it is not staffed full time for the purposes of administration of climate change matters.

Notable institutional gaps identified by workshop participants (Table 2) focus on funding, lack of postgraduate research and an ill-equipped and responsive National Research Foundation. In addition to this, policy development does not seem to be informed by research. In his presentation at the workshop, Professor Manyatsi of UNISWA highlighted the following key institutional capacity constraints in Swaziland:

- Absence of climate change policy and legislation;
- Lack of an agency that has the sole responsibility for climate change issues;
- Insufficient well-trained people in climate change;
- Inadequate climate change data and information collection framework and database management system;
- Limited access to concessional funding, largely due to Swaziland's lower middle income status; and
- Inadequate resources, including financial, material and technical know-how.

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 for a small country with a limited skills base. **Financial resourcing** was a priority gap highlighted, specifically to improve the **distribution of the country's weather observation station network**. 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. A **lack of clearly defined mandates and responsibilities** as well as consolidated framework for **coordination of education, training and public awareness** activities in different sectors on climate change is needed. Overall participants felt that a **mainstreaming 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. A workshop discussion specifically highlighted the institutional capacity needs within the **meteorological services** department, which currently deals with national climate related issues and lacks adequate resources and manpower to engage fully with climate changes issues.

A synthesis perspective on the above knowledge, research, individual and institutional capacity needs analysis is provided in section 6.1.

4 INSTITUTIONAL ANALYSIS

4.1 Introducing the institutional analysis

This section describes the current climate change related institutional responses, within the context of the above-mentioned research, knowledge and capacity gaps. Core emphasis is placed on higher education institutions, in line with the brief for this study, and in recognition of their important role in research, education and training, and in providing policy and strategy support and leadership for development.

The institutional analysis begins with a summary of wider institutional arrangements for CCD, including any relevant research and development frameworks. It then discusses some of the current CCD initiatives and programmes in Swaziland, and identifies some of the key stakeholders that could form part of a Swaziland 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 CCD, namely community engagement, student involvement, policy engagement and campus sustainability initiatives, to the extent that sufficient data to do so was obtained within the constraints of the mapping study.

4.2 Policy and institutional arrangements

4.2.1 Policy and institutional arrangements governing Higher Education in Swaziland¹¹

Higher education is provided by two public and two private institutions, with the former being the University of Swaziland (UNISWA) and the Swaziland College of Technology (Kotecha 2008). The University of Swaziland developed from the University of Lesotho, Botswana and Swaziland, which was previously known as the University of Basutholand. In 1982 the University of Swaziland was established, initially funded by the Catholic Church. The university consists of three campuses: the Layengo campus (home to the Agriculture faculty), the Kwaluseni campus (which houses the faculties of Humanities, Commerce, Education, Science and Social Sciences), and the Mbabane campus (which focuses on Health Sciences). The university is affiliated with the teaching college and the nursing school.

The University of Swaziland has not been able to keep up with the demand for higher education. One response has been the opening of an institute for distance learning that caters for the study needs of students who are unable to attend campus full-time (Swaziland Review

¹¹ This short summary is derived from a SARUA Country Profile compiled by Leapetswe Malete and Kagiso Kobedi. 2011 "Chapter 3: Swaziland." In *A profile of Higher Education in Southern Africa. Volume 2.* (www.sarua.org)

2011). Historically, the government has financed the majority of the students going to university (approximately 75 percent), and the government provides adult education to improve the country's literacy rate. Besides the University of Swaziland, there are several other tertiary institutions, including three teacher training colleges, two nursing colleges, and the Swaziland College of Technology. In 2011, two private universities were opened: the Limkokwing University of Creative Technology and the Southern African Nazarene University (Mbanza 2011). These new universities provide places for students who want to study architecture and other courses not offered by UNISWA. A third private university, the Swaziland Christian Medical University, is due to become operational in 2013. This new university, funded by the Republic of Korea, will be located near Mbabane and will include three colleges (medicine, nursing and ICT).

4.2.2 Policy context for climate change

Swaziland is working toward developing a climate change strategy and action plan with financial support from the UNDP Country Office. This would create a platform for developing a legislative instrument for mainstreaming climate change into national development policies and programmes. While the 2012 National Development Strategy does represent more recent efforts toward integration between sectoral policy and practice, the process of mainstreaming climate change has not yet reached major Government programmes such as the Poverty Reduction Strategy and Action Plan (PRSAP), which only recognises drought as a climate factor. Nevertheless, climate change considerations are integrated to some extent into recent policies and strategies, including:

- Food security and agricultural sector policies;
- Biodiversity conservation and management policy;
- Natural disaster and emergency policy;
- National biofuels strategy and action plan; and
- National energy policy implementation strategy.

Moreover, the Ministry of Agriculture is developing a Climate Agriculture strategy. A National Capacity Self-Assessment (NCSA) was carried out in 2005 to identify capacity needs, constraints and priorities for the implementation of the Climate Change, Desertification and Biodiversity Conventions; and a Climate Change Technology Needs Assessment (TNA) in 2010. The TNA identifies and evaluates climate change mitigation and adaptation technologies and measures linked to the national development priorities of Swaziland. Policy-related opportunities and strengths identified by Professor A. M. Manyatsi in his presentation at the workshop included that the country is party to several international conventions and agreements, including the UNFCCC, UNCCD, UNCBD and the Kyoto protocol; and the existence of a policy framework to address the different sectors including the Comprehensive Agriculture Sector Policy, the National Irrigation Policy and the Livestock Development Policy.

4.2.3 Institutional arrangements for Climate Change

Institutionalising climate change issues and processes is the mandate of the Department of Meteorology (MET), within the Ministry of Tourism and Environmental Affairs (MTEA), which is the national focal point for the UNFCCC, as well as the Designated National Authority (DNA) for

the Clean Development Mechanism (CDM). The SNC notes the intention to establish a National Climate Change Unit which will be guided and will report to the National Climate Change Focal Point with four key sections:

- Climate Change Science and Impacts Research;
- Climate Change Mitigation and Adaptation;
- Climate Change Information; and
- Climate Change Projects section.

In 2010 a multi-sectoral National Climate Change Committee (NCCC) comprising various government ministries was established to develop and coordinate programmes and projects aimed at addressing climate change, in line with the country's development priorities. The committee will carry out education and public awareness campaigns on climate change and act as the interface between the National Climate Change Focal Point (NCCFP) and the Climate Change Unit, while guiding the establishment of a Technical Board comprised of representatives from NGOs and the private sector. The SNC notes that stakeholder participation in the national climate change adaptation debate has been slow since the Convention was ratified by Swaziland in 1996. It is hoped that the NCCC will help to strengthen the capacity of the relevant stakeholders to fulfil the country's mandate under the Convention, whilst also helping to mobilise financial and technical support to address Swaziland's climate change challenges.

While Swaziland establishes the National Climate Change Unit, the National Disaster Agency, housed under the Deputy Prime Minister's Office, is a relevant existing entity, which was set up to assess the effects of natural disasters and to coordinate response at national level (FANRPAN 2010).

4.3 Research and development frameworks

The Swaziland National Research Council establishes research priorities and a national research programme to meet the needs of the country, in conjunction with other key stakeholders such as the University of Swaziland. The 2005 NCSA called for a clearly defined national research strategy to be developed through the reinvigoration of the National Research Council. Of relevance for some of the key knowledge and research gaps identified in section 3, the 2008–2013 Government Programme of Action notes the need to shift the former emphasis on humanities graduates to technical and scientific skills, in order to meet the needs of the modern economy.

4.4 Some current CCD initiatives and programmes

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

Government Departments and Parastatals: Parastatals operate in a very similar way to government since they are government entities, hence procedures and process of conducting business are more or less similar. Therefore most of the activities related to CCD are conducted by the institutions of departments but under the leadership of internal expertise. Most of the CCD-related activities identified in the workshop were concerned with energy and water resources, including innovative initiatives for efficient use of the resources. The activities are mainly aimed at raising awareness and knowledge transfer about new technologies on use of energy and water. The activities also involve introduction of innovative approaches as best practices to be adapted to local conditions and needs. However the following observations were made by participants in this group:

- “There is a gap between theory and practice or activation in the pursuit of CCD related activities.”
- “There is lack of collaboration and exchange of information among institutions and organisations dealing with climate change. The lack of capacity among institutions of higher education and training was the bottleneck in the uptake of CCD related technologies and training programmes.”

NGOs and Private Sector: Most of the institutions pursued activities aimed at enhancing agricultural production, monitoring of aquatic ecosystems, greening of the landscape, biodiversity conservation and prevention of land degradation as well as climate change communication. The activities were implemented by institutions not individuals, though internal expertise was used to lead the implementation process. The activities were mainly aimed at issues of compliance with national, regional and global standards, community development as well as education and awareness raising. On how the activities respond to CCD the group noted that:

- “Activities include projects to increase vegetation coverage that provide a carbon sink. Some are based on pursuit of sustainable development which relates closely to issues of CCD. Other activities address the awareness and education about climate change and equip society with means of adapting to climate change.”

Table 5: Some CCD initiatives and programmes in Swaziland

Programme / Initiative	Driving agency / department	Focus and time frame	Status / additional comments
Energy Mitigation in Swaziland: Awareness and energy efficiency	<ul style="list-style-type: none"> ■ Swaziland Electricity Company ■ Funding such as CDM from GEF 	<ul style="list-style-type: none"> ■ Promotes energy efficiency – mitigate ■ Campaigns – raise awareness on energy awareness and CC ■ Radio programmes ■ Compact fluorescence light – energy saving 	<ul style="list-style-type: none"> ■ Promotes the use of light emitting diode ■ Installation of prepaid meters – promotes energy saving ■ Data collection to assess where there is maximum solar and wind energy potential ■ Explore diversifying possibilities into other renewables ■ How to reduce carbon print as a company
Swaziland's Climate Change Focal Point	<ul style="list-style-type: none"> ■ Meteorology Department 	<ul style="list-style-type: none"> ■ Designated national authority on clean development mechanism ■ Provide early warning meteorological information 	<ul style="list-style-type: none"> ■ Need to extend and elaborate programme on public awareness and climate change legislation
Water and Environment Management Action Campaign (WEMAC)	<ul style="list-style-type: none"> ■ Komati Basin Water Authority 	<ul style="list-style-type: none"> ■ Resilience of communities to extreme events (droughts and floods) ■ Climate proofing of dam infrastructure ■ Capacity building of staff, communities and water users ■ Teaching and awareness in the schools 	<ul style="list-style-type: none"> ■ Emergency preparedness and drought preparedness plans ■ Climate change strategy
Renewable energy, energy efficiency, bio fuels and bio mass conservation	<ul style="list-style-type: none"> ■ Ministry of Natural Resources and Energy – Energy Department 	<ul style="list-style-type: none"> ■ Policy development and conducting studies on RE viability such as mini-micro hydro, wind, solar and bio fuels 	<ul style="list-style-type: none"> ■ Raise awareness on energy efficiency and conservation ■ Provide and enabling environment for energy development
Swaziland National Trust Commission (SNTC): Community Outreach Research Programme	<ul style="list-style-type: none"> ■ SNTC – Directorate of Nature Conservation 	<ul style="list-style-type: none"> ■ Environmental education and awareness raising ■ Community development initiatives through the community outreach programme ■ Conduct Research – mainly on Biodiversity conservation 	<ul style="list-style-type: none"> ■ Strengthening synergies particularly in the areas of research and project development and implementation

Programme / Initiative	Driving agency / department	Focus and time frame	Status / additional comments
SEA: EIA process and ecosystem restoration	■ Swaziland Environment Authority (SEA): DAC- Directorate of Assessment and Compliance	■ Review, monitor compliance of projects ■ Wetland rehabilitation and land degradation rehabilitation	■ EIA ensure development are climate proof ■ Use ecosystem services to help people to adapt to the adverse effects of climate change their improving their livelihoods
Agricultural extension services	■ Ministry of agriculture (Extension Department)	■ Conservation agriculture ■ Agroforestry	■ Revitalise through the improvement of biomass ■ Retaining soil moisture

Note: The list is not comprehensive.

Notable stakeholder initiatives on climate change include the following:

- The Komati Basin Water Authority (KOBWA) has developed a Climate Change Strategy and is implementing a water and environmental management action campaign (WEMAC)
- Matsapha Municipality has developed infrastructure that converts waste to energy in the landfill
- Implementation of the GEF-funded LUSIP project which aims to reduce land degradation, biodiversity loss and mitigate climate change through the application of sustainable land management practices

The institutional analysis has indicated that while none of the exiting initiatives have labelled themselves as 'CCD', given that this is a new term developed recently by CDKN and not used in international assessments such as those carried out by the IPCC, many of these initiatives are dealing with CCD-related matters. This may not always be in the comprehensive sense of the term, which requires an integrated approach to adaptation, mitigation and development. An exception to this would be the LUSIP GEF-funded project on sustainable land management. Some of the initiatives may focus solely on mitigation, such as that of the Swaziland Electricity Company, while others may indeed indicate an integrated approach to adaptation and mitigation. Examples of the latter are the promotion of conservation agriculture by the agricultural extension services, and the renewable energy initiatives of the Ministry of Natural Resources and Energy, which include feasibility studies – a key research gap highlighted in the Needs Analysis. Most of the initiatives listed in Table 4 were identified by workshop participants. It is positive that the Swaziland Environment Authority is engaged in projects for restoring ecosystems and in so doing enhancing ecosystem services which may serve as a basis for local adaptation strategies and more climate-resilient livelihoods for people on the ground. Some non-academic institutions are actively engaging in research, such as the Swaziland National Trust Commission's Directorate of Nature Conservation. While their research focuses primarily on biodiversity conservation, and thus not necessarily CCD, the focus on strengthening linkages between research and project development and implementation is extremely important for addressing key institutional constraints discussed below. Table 4 also shows strong potential knowledge partners for universities and HEIs, not only for research, but also in the areas of teaching and community and policy outreach.

Among the main gaps noted by stakeholders (i.e. non-university staff) were lack of collaboration among stakeholders, lack of stronger implementation tools, lack of training as well as technical and financial support. This raised the debate on the role of government in ensuring availability of resources for climate change mitigation and adaptation. Government's role in the provision of this was deemed to be discouraging and government commitment was solicited.

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

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

While CCD is not a concept that appears in national policy on climate change, various documents, including the SNC (2012), identify the importance of focusing on both adaptation and mitigation. Given that Swaziland is a net emitter of greenhouse gases – that is, the country is a carbon source, rather than a carbon sink, unlike most other countries in the region, mitigation measures will increasingly play an important role in the national response. Due to the lack of an overarching policy framework, there is a need to develop a common understanding of the core issues of CCD necessary for knowledge co-production, which may indeed be one of the steps taken in developing the forthcoming Climate Change Strategy and Action Plan for Swaziland.

According to the SNC, Swaziland has reasonable potential to contribute towards a low carbon economy through implementation of mitigation options under energy, land use change and forestry, agriculture and waste. Under energy, the government is in the process of implementing the Swaziland National Energy Policy of 2003 with overall objectives of promoting the utilisation of renewable energy resources for electricity production.¹² While renewable energy can certainly be considered as an area in which both adaptation and mitigation goals are combined, this is not overtly stated in the document.

Workshop discussions highlighted that CCD needs to be located within the umbrella of sustainable development, as is indeed highlighted in the United Nations Framework Convention on Climate Change (UNFCCC). Workshop participants identified a potential weakness of the CCD framework, as formulated by CDKN, in that the framework was perceived to demonstrate lack of consideration of other broader concerns to the lives of human beings. For instance, participants felt that the framework appears to put emphasis on development and less on management and leadership issues, yet such issues also need to be tackled in order for climate change intervention efforts to succeed. While these other factors may be inherent in the framework, they need to be stated more explicitly, which may highlight new possibilities to partner with entities with the necessary strengths – for example, on the management side. It was also suggested that the emerging concept of ecosystem-based adaptation should be considered together with the CCD framework, which would emphasise the ecological bottom-line.

¹²This will involve promoting efficient and environmentally sound technologies for the utilisation of indigenous resources for electricity production, facilitation of appropriate financing mechanisms to strengthen capacities of development agencies which promote and implement sustainable programmes on renewable energy. Financing is also required to encourage a wider use of solar water heaters for residential and commercial buildings through promotional means and support for private sector initiatives.

"Climate change issues need to clarified and be related to national development plans, for politicians to relate to climate change. It is important to understand the intentions and actions of leaders, so we need to clarify climate change issues and in so doing connect with the leaders."

Swaziland workshop participant

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:

- "Economically viable, socially equitable and environmentally friendly development that takes into consideration the consequences of variations in climate patterns."
- "Climate compatible development is the kind of development that takes into account climate change and the environment in a sustainable manner. This advocates for development but aspects of climate change must be considered and the environment too."
- "It is the sustainable development pathway that seeks to minimise the direct and indirect negative impacts and hazards of climate change by promoting development activities that reduce greenhouse emissions."
- "It is the inclusion of aspects that would respond and cushion the effects brought about by climate change."
- "Climate compatible development has to do with first looking at the effects that proposed development will bring/contribute to climate change and how to adapt and mitigate that so that the development is sustainable."
- "Climate compatible development is development that is low carbon producing and climate resilient in nature."
- "CCD is that kind of development that will take cognisance of the impacts it is making to the earth's climatic conditions and thus put in place mitigation and adaptation strategies."
- "Ensuring that development undertaken has no emission to atmosphere or minimal emissions."
- "Development which takes in consideration issues of climate mitigation and adaptation."
- "Economic and social growth initiatives designed with appropriate consideration of climate change dynamics."
- "Efforts towards limiting the impacts of climate change across the board, including mitigation and adaptation."
- "Sustainable development with minimal contribution to climate change."
- "Climate Compatible Development is development that minimises its impacts on the atmosphere i.e. with minimal climate or greenhouse impact."
- "Development that has the ability to withstand impacts imposed by extreme changes in weather and climate."
- "Strategies put in place to lower the greenhouse emitted gases."
- "Development that utilises resources without compromising the future generations' benefit from them."
- "Sustainable use of resources without pollution etc."

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

- “Development that minimises the impacts from climate change, while maximising opportunities for human development towards low emission”
- “Refers to the ways in which we combat issues that relate to climate change such as ensuring low carbon, mainstreaming, adoption etc.”
- “Coming with strategies that will incorporate issues of climate change.”
- “Development approach that minimises the impact of climate changes.”
- “Development which will not affect the climate in general. The development should be environmental friendly.”
- “Development that takes into account climate change issues. Including all levels of development planning.”
- “Issues relating to the sustainable environmental management.”
- “Development that minimises the harm caused by the climate impacts.”
- “Development that will take into consideration the vagaries of climate and tailor such development to take maximum advantage of changes of climate.”
- “I think CCD means development that does not result in climate change. For example industries must use processes that do not release compounds that will destroy the ozone layer hence changing climate patterns.”
- “Development that is able to withstand the diversity in the climatic conditions.”

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, such as the academic in chemistry at UNISWA who had to imagine or intuitively guess the meaning of the concept. **Context** also has an influence on how CCD is understood, and influences meaning making and understanding of the concept. This has important implications for knowledge co-production processes, and will require careful engagement in development of mutual understanding in such processes.

4.5.2 Current climate compatible development research

While Swaziland currently lacks targeted national policy on climate change and CCD, the mapping study has found examples of CCD-related activities underway in government ministries, universities and within some private consultancies, which appear to be contributing to CCD research and the development of a national Climate Change Strategy. However, due to the current lack of overarching national policy and inadequate mainstreaming of climate change into sectoral policies, there is limited policy-based information on what research outcomes are needed for CCD. There is little to no information on what research *is already being done*, other than brief details in the SNC. Table 4 identified some examples of initiatives with research relevance, and this section seeks to provide further insight into the status of research in Swaziland on climate change and CCD.

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

The Second Communication to the UNCCF (SNC 2011) shows the following recent¹³ research-based initiatives for climate change in Swaziland (taken from the reference list of the SNC, 2011) which are mainly from Government commissioned reports:

- Dlamini, W.M. 2010. "Management of Forest Fire Disasters: Perspectives from Swaziland," in *Natural and Anthropogenic Disasters: Vulnerability, Preparedness and Mitigation*, edited by M.K. Jha, 366–385. New Delhi: Springerlink/Capital Publishing Co.
- GOS-MEPD. 2010. Swaziland Millennium Development Goals Progress Report. Ministry of Economic Planning and Development, Mbabane.
- GOS-MNRE/ED. 2010. Woodfuel Pricing Data Report – Swaziland. Energy Department. Ministry of Natural Resources and Energy, Department of Energy, Mbabane. German Technical Cooperation – Programme for Basic Energy and Conservation (GTZ-ProBEC)
- GOS-NMS/SNC. 2010. Climate Data Analysis. Swaziland Second National Communication. Prepared by F.D. Yamba. Ministry of Tourism and Environmental Affairs, Department of Meteorology, National Climate Office, Mbabane.
- GOS-NMS/SNC. 2010. Swaziland's Climate Change Technology Needs Assessment Synthesis Report. Prepared by M. Mathunjwa. Ministry of Tourism and Environmental Affairs, Department of Meteorology, National Climate Office, Mbabane.
- GOS-NMS/SNC. 2010a. Vulnerability and Adaptation to Climate Change: Agriculture and Food Sector. SNC Vulnerability and Adaptation Technical Working Group. Prepared by A.M. Dlamini. Ministry of Tourism and Environmental Affairs, Department of Meteorology, National Climate Office, Mbabane.
- GOS-NMS/SNC. 2010b. A Vulnerability and Adaptation Assessment of Swaziland's Biodiversity. SNC Vulnerability and Adaptation Technical Working Group. Prepared by W.M. Dlamini. Ministry of Tourism and Environmental Affairs, Department of Meteorology, National Climate Office, Mbabane.
- GOS-NMS/SNC. 2010c. Climate Data Analysis. Swaziland Second National Communication. Prepared by F.D. Yamba. Ministry of Tourism and Environmental Affairs, Department of Meteorology, National Climate Office, Mbabane.
- GOS-NMS/SNC. 2010d. Vulnerability and Adaptation to Climate Change on the Sector of Water Resources in Swaziland. SNC Vulnerability and Adaptation Technical Working Group. Prepared by J. Matondo. Ministry of Tourism and Environmental Affairs, Department of Meteorology, National Climate Office, Mbabane.
- GOS-NMS/SNC. 2010e. Mitigation Assessment: Energy Sector. SNC Mitigation Analysis Technical Working Group. Prepared by M. Mathunjwa. Ministry of Tourism and Environmental Affairs, Department of Meteorology, National Climate Office, Mbabane.

¹³ In this section research mostly conducted after 2009 is used as referent (last five years).

- GOS-NMS/SNC. 2010f. Mitigation Analysis and Strategies under Swaziland's Enabling Activity in the Forestry and Land Use Sector. SNC Mitigation Analysis Technical Working Group. Prepared by A.M. Manyatsi. Ministry of Tourism and Environmental Affairs, Department of Meteorology, National Climate Office, Mbabane.
- GOS-NMS/SNC. 2010g. Socio-Economic Impacts of Climate Change on Swaziland. SNC Vulnerability and Adaptation Technical Working Group. Prepared by W. S. Madonsela-Kamalandua. Ministry of Tourism and Environmental Affairs, Department of Meteorology, National Climate Office, Mbabane.
- GOS-NMS/SNC. 2010h. Vulnerability and Adaptation to Climate Change: Human Health in Swaziland. SNC Vulnerability and Adaptation Technical Working Group. Prepared by N. A. Sukati. Ministry of Tourism and Environmental Affairs, Department of Meteorology, National Climate Office, Mbabane.

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

Table 6: First eight articles listed with 'Climate Change' and 'Swaziland' in the search, with author origin

Article	Origin of first Author
Knoxa, J.W., J.A. Rodríguez Díazb, D.J. Nixon and M. Mkhwanazi. 2010. "A preliminary assessment of climate change impacts on sugarcane in Swaziland," <i>Agricultural Systems</i> , 103 (2): 63–72.	United Kingdom
Dlamini, W. 2011. "Probabilistic spatio-temporal assessment of vegetation vulnerability to climate change in Swaziland," <i>Global Change Biology</i> 17 (3): 1425–1441.	Swaziland
Matondo, J.I. "Assessing the Vulnerability of the Sector of Water Resources in Swaziland Due to Climate," American Society of Civil Engineers. Conference Proceeding Paper part of: World Environmental and Water Resources Congress 2012: Crossing Boundaries 2036-2051.	Swaziland
Oseni, T.O. and M.T. Masarirambi. 2011. "Effect of Climate Change on Maize (<i>Zea mays</i>) Production and Food Security in Swaziland," <i>American-Eurasian Journal of Agriculture and Environmental Science</i> 11 (3): 385–391.	Swaziland
A.M. Manyatsi, N. Mhazo and M.T. Masarirambi. 2010. "Climate Variability and Change as Perceived by Rural Communities in Swaziland," <i>Research Journal of Environmental and Earth Sciences</i> 2(3): 164–169.	Swaziland
Matondo, J.I. 2010. "Generating information required in climate change studies in Swaziland," <i>Water International</i> 35 (2): 223–232	Swaziland
Dlamini, W. 2010. "A Bayesian belief network analysis of factors influencing wildfire occurrence in Swaziland," <i>Environmental Modelling and Software</i> 25 (2): 199–208.	Swaziland
Salam, A., D.S. Tevera and S. Brain. 2009. "Bhembe. Climate Change and the Increase in Incidence of Malaria Cases in the Dvokolwako Area of Swaziland from 1990–2004," <i>Journal of Sustainable Development in Africa</i> 11 (4): 1520-5509.	Swaziland

A total of eight articles were found in the Google Scholar search, indicating a variety of different research publications on climate change in Swaziland, with the following focus areas:

agriculture, biodiversity, water resources, social behaviour/perception study, wildfires and vegetation, and health. It is encouraging to see that six of eight publications with the title including “climate change” and “Swaziland” were published within the last four years. Also encouraging is that all but one of the eight publications were primarily authored by researchers from Swaziland, showing that there is a strong research presence regarding climate change in Swaziland, despite the limited policy at this stage, and despite challenges with knowledge transfer and management raised in the needs analysis. The majority of the articles explore vulnerability and impact assessment, while one focuses on generating information for climate change studies and another explores the perceptions of climate change by rural communities.

It is positive to note that most of the reports on which the SNC is based, which were commissioned by the Department of Meteorology, were written by local researchers, many of whose names also appeared in the results of the Google Scholar search. This indicates that there is strong collaboration between university researchers and policy makers, at least in the development of the SNC. The SNC also drew on the following peer-reviewed article:

- Dlamini, W.M. 2010. “Management of Forest Fire Disasters: Perspectives from Swaziland,” in *Natural and Anthropogenic Disasters: Vulnerability, Preparedness and Mitigation*, edited by M.K. Jha, 366–385. New Delhi: Springerlink/Capital Publishing Co.

The step that appears to be lacking is the translation of these consultancy reports into peer-reviewed literature, with several of the researchers who had contributed to the SNC not appearing on the Google Scholar list.

The Swaziland questionnaire and workshop data shows a diversity of university faculty and department involvement in climate change related research, as shown in Table 7.

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

Faculty / School / Centre	Department	Programmes / Institutes
Social Science, UNISWA	Social Science	Research for United Nations Development Programme
Applied Science, William Pitcher College	Agriculture	Sustainable Development and Climate Change
Southern Africa Nazarene University (SANU)	–	Contextualising issues of Climate Change into Curriculum
UNISWA (Luyengo) Faculty of Agriculture	Agriculture	Joint study on climate change and community based water management
UNISWA (Luyengo) Horticulture Department	Agriculture	Collaborative community based research on indigenous forms of mitigation and sustainable land use
Faculty of Science and Engineering, UNISWA	Chemistry Department	Toxicology and environmental sustainability
Faculty of Agriculture	Student Affairs	Translating Education for Sustainable Development (ESD) into practise

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

Table 7 above shows both faculty-based diversity and departmental level diversity of participation in CCD related research and teaching at University of Swaziland, William Pitcher College and Southern Africa Nazarene University (SANU). The table also shows that between the universities and institutes, the agricultural departments have a *dedicated research programme*, and there is research underway to improve CCD related curriculums. The UNISWA Faculty of Agriculture is engaged in two studies that are both collaborative and community-based, one on climate change and community-based water management, and the other on collaborative community-based research on indigenous forms of mitigation and sustainable land use, indicating that this is an area of strength for the faculty.

The questionnaire data shows that research on mitigation focuses on energy efficiency, renewable energy and conservation agriculture – although the latter is not conducted primarily for its mitigation goals. Very little was mentioned regarding multidisciplinary research, save for a researcher, David Manyatsi in Geographical studies, who has been involved in new Education for Sustainable Development related curriculum development.

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

Table 8: Research projects currently being undertaken on climate change/ CCD

Institution, Faculty, Department	Research Project	Researcher/s or Deans / HODs	Type of Research Project
UNISWA (Kwaluseni) Department of Sociology	Research for United Nations Development Programme (UNDP) on CCD and Crop Diversification in Swaziland	Thandi Khumalo tkhumalo@uniswa.sz	Curriculum and Research Currently doing commissioned research on crop diversification and Climate Compatible Development
William Pitcher College Geography department	Sustainable Development and Climate Change in Swaziland	Mefika Dlamini, senior lecturer nollenmd@gmail.com	Geography teaching and research
UNISWA (Luyengo) Faculty of Agriculture	Joint study on climate change and water access	Musa Dube madube@uniswa.sz	Community-based water management
UNISWA (Luyengo) Horticulture Department	Climate change, conservation agriculture (CA) and indigenous knowledge systems	Mike Masarirambi mike@uniswa.sz	Research and community service, skills development regarding conservation agriculture, pesticide use and indigenous forms of mitigation

Institution, Faculty, Department	Research Project	Researcher/s or Deans / HODs	Type of Research Project
UNISWA Chemistry Department	Environmental Sustainability, Toxicology	Thabile Ndlovu thabile@uniswa.sz	Postgraduate research programme on environmental sustainability, specific focus on detection of heavy metals and pesticides

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

While individual student research projects linked to CCD-related issues could provide further insight into research on CCD in Swaziland, it was not possible to identify any of these through online searches. This could constitute a further area for exploration, should stakeholders in Swaziland wish to pursue this, and could be carried out through in-person research at the HEIs.

Associated with these research programmes and other smaller scale research initiative are a number of active researchers, who were mentioned in workshop and questionnaire data. See Appendix E for a list of these researchers. The list indicates that most researchers have only been active in the field of climate change and CCD for less than five years – even those with 20 to 30 (or more) years of experience. While the questionnaires did not probe for reasons for this, it is unsurprising given the recent elevation of climate change into the mainstream, but it does indicate little depth of research carried out with a targeted climate change lens.

Gender and PhD profile: Of those lecturers responding to the questionnaire, six were female and five male, showing that there is participation of women scientists in climate related questions in Swaziland. Those responding to the questionnaire had little CCD related experience in their disciplines. Two researchers had five years experience; four had three years experience, and the rest had less than two years experience. Research seems to be dominated by curriculum transformation and agricultural research, including on adaptation. Only two of the eleven questionnaire respondents have PhDs, indicating that Swaziland needs to increase their capacity development and support of PhD research in climate change and CCD.

Specific research networks cited were the OSSREA (Organisation of Social Science Research in Eastern and Southern Africa), IUCN, CGIAR (Consultative Group on International Agricultural Research), and ICRISAT (International Centre for Research in the Semi-Tropics). A number of broader relevant networks were identified in the workshops and through the questionnaires, as is discussed in section 4.5.6.

4.5.3 Curriculum innovations and teaching for CCD

The 11 questionnaire respondents from Swaziland, including University of Swaziland (UNISWA), William Pitcher College and Nazarene Teachers Training College (SANU), 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 high level of 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 good staff ability to get involved.

All the HEIs noted incidences of CCD issues and opportunities being incorporated into their current curriculum, with UNISWA leading the way. 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. Identification of climate change content in courses thus would require detailed engagement with those teaching the courses. Data presented is therefore limited by this factor.

While limited details were provided on courses oriented towards CCD in the workshop and the questionnaires, three courses stand out:

- David Dlamini at Southern Africa Nazarene University (SANU) is currently introducing a degree on sustainable development. He says this is still at the consultative stage. Dlamini says that greater contextualisation of CCD issues in Swaziland is needed as well as developing policies that support CCD and align programmes into such policies.
- Busi Shongwe at SANU is currently integrating some of the ESD issues in the Geography curriculum. However more needs to be done according to Shongwe who says: "*We need a review of the courses or curriculum that can focus more on CCD*".
- In the workshop it was mentioned that UNISWA has a stand-alone graduate course on climate change titled "*Climate change and environment*" within its multidisciplinary MSc on Environment and Resources Management (ERM).

This list is not exhaustive and would ideally be updated and extended through further discussions and consultations within Swaziland.

While two of these courses remain in development, there are a variety of geography and agricultural courses which touch on various aspects of mitigation and adaptation indirectly. For example, Mike Masarirambi at UNISWA (Luyengo) teaches organic farming and vegetable production in his horticulture programme. Masarirambi is also further investigating and incorporating conservation agriculture and local indigenous knowledge systems that could inform new mitigation solutions. Similarly Olusegun Oseni at UNISWA (Luyengo) is exploring waste recycling and horticulture and is interested in further developing the curriculum to focus on CCD.

Considering these findings it may be productive to examine CCD integration within *all faculties and all departments* within the university. The university-based questionnaire (especially Section C) in Appendix C can be used for this purpose. The questionnaire would, however, need to be introduced to all staff in the university, preferably at Departmental level, to obtain a clearer view of how CCD is / is not being integrated into teaching, and where the 'gaps' are for new development of CCD content into either 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 as potentially effective for CCD in courses include:

- Lecture presentation and discussion;
- Brainstorming approach;
- Active participatory approaches;
- Research and demonstration;
- Case studies/reports;
- Formal lectures on climate change;
- Participatory approach; and
- Hands-on and fieldwork and field trips.

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

4.5.4 Community and policy outreach

Participants responding to the questionnaires noted that researchers were not actively involved in policy development; however many of them felt that policy development and outreach was crucial. As noted in section 4.5.2, a number of researchers were commissioned by the government to produce reports on specific aspects of climate change, for the development of the Second National Communication to the UNFCCC (2012).

Community engagement practices were not readily discussed in the questionnaire or workshop data, although there was consensus on the need for this. One researcher stood out in this regard: Mike Masarirambi of the Agricultural Faculty at UNISWA is involved with community outreach work that explores organic farming and vegetable production, and community level research and community service, with a specific involvement in indigenous knowledge systems and contextual forms of mitigation and adaptation.

The Needs Analysis has highlighted the need for community outreach programmes to train people on climate change adaptation skills and adoption of appropriate technologies. Moreover, the knowledge base of local people about climate change is suspected to be low and needs to be improved through targeted awareness and education campaigns. Thus this is a key area for enhanced response in Swaziland.

4.5.5 Student involvement

The University of Swaziland cited higher levels of student involvement in CCD related matters, than other departments who responded to the questionnaire. The UNISWA Green Team was cited as having potential for engaging more with CCD issues.

Table 9: Student organisations focusing on CCD-related issues

Organisation	Project	Key contact	Type of project
Student Affairs Green Team UNISWA	Translating Education for Sustainable Development (ESD) into practice	Sihle Magagula (Thuli Mamba) tmamba@uniswa.sz	Project Implementation of Education for Sustainable Development

Note: This table is likely to be incomplete.

4.5.6 University collaboration and networking

In the workshop discussions the role of the university as a location for research and training place was stressed, together with a challenge that it must take leadership in technology innovation, incubation and transfer. However, workshop participants noted that innovation initiatives have been crushed previously. The university was also advised to strengthen its role in the dissemination of information and knowledge for the benefit of society and for policy and decision making processes; and to be relevant to the community through mounting outreach programmes for community empowerment.

"Why are universities not taking leadership, and in innovation? Limkokwing University is predicated on technological innovation, universities did very little in this area before. Existing universities must re-orient their curriculum now."

Senior academic, UNISWA

Researchers responding to the questionnaire and discussions in the workshop identified some research networks that university staff were either involved in, or that they could become more involved in and that also supported knowledge production and use relevant to climate change, as discussed in section 3.5.2. The workshop further identified local networks relevant for CCD, which were those dealing mostly with environment and sustainable development issues such as REASWA (Renewable Energy Association of Swaziland), SWASA (Swaziland Standard Authority) and the Campus Green Association. Other local organisations identified in this regard were Swaziland Environmental Authority and Swaziland National Technology Park, as well as the National Climate Change Coordination Committee (NCCCC), which was noted to be currently not functional, but has the role of co-ordinating all climate change issues in the country.

Regionally, participants recognised SARUA as an important regional climate change network alongside SADC REEP (Regional Environmental Education Programme), EEASA (Environmental Education Association of Southern Africa, WESSA (Wildlife and Environmental Society of South Africa), SAPP (Southern African Power Pool), SAARMSTE (Southern African Association for Research in Mathematics, Science and Technology Education), amongst others. In Africa networks mentioned include OSSREA (Organisation of Social Science Research in Eastern and Southern Africa), IUCN (International Convention Union), CGIAR (Consultative Group on International Agricultural Research), ICRISAT (International Crops Research Institute for the Semi-Arid Tropics), and the African Technology Policy Studies Network (ATPSN).

It is clear that many of these organisations are not specifically focused on climate change or CCD, and some are do not really function as networks. At the national level, the only network mentioned with a climate change focus is the NCCCC, which is currently non-functional. None of the southern African networks identified have a clear focus on climate change, with several focused on environmental education or education research. Functioning networks with a strong research focus are largely to be found at the Africa-level. There is clearly scope for a focused network in southern Africa on climate change, and specifically CCD. While participants did mention SARUA in this regard, until the mapping study SARUA has only functioned at the senior managerial (VC) level, and thus is only a newcomer from a CCD network perspective.

4.5.6.1 Potential knowledge co-production partners

"The core business of universities is reflected accurately here, research is coming out very clearly. The assumption that may be problematic is that research should remain at universities. Universities may come up also with research frameworks, which other stakeholders could take up. We at universities also rely on research that is produced outside the universities – for example, government documents, private sector sources etc."

Senior academic, UNISWA

The institutional analysis shows that while relatively little knowledge co-production partnerships for CCD exist in Swaziland, there is potential for knowledge partners to co-produce CCD knowledge, given adequate resources, policy support and other infrastructure. While the need for better collaboration between different stakeholder groups is agreed, and the above quote makes it clear that universities are not the only institutions that do, could or should produce research, the workshop interaction included a discussion on the disconnect between universities and private sector/industry, and organisations like Swaziland National Trust Commission (SNTC). As one participant noted:

"People in industry are doing research but they don't publish this, there is a lot of research going on in isolated siloes. So how do we get that information back to the institution?"

A response was that this was a question of how to build a stronger relationship with the private sector, and not simply a question of funding. The links with public sector also need to be better built, as was clear from an example provided in which the Meteorology Department had attempted to commission research from the university, but had not had any success in this regard, due to problems with a clear access point, amongst other issues. Various suggestions for improving sharing of information were provided, such as industries publishing their statistics on their websites.

During the workshop, participants discussed different roles for the different stakeholder groups which could be involved in the knowledge co-production process. This discussion included the identification of some key constraints to enhancing the role of universities, together with other partners, in addressing climate change, which are also summarised briefly in Table 10. Constraints to the knowledge co-production process are discussed in greater detail in section 5.2.

Table 10: Roles, with some existing constraints, ascribed to the different partners involved in the knowledge co-production process

Universities	Private sector and NGOs	Donors	Governments
<ul style="list-style-type: none"> ■ Give more weight to research ■ University should treat all journals in isolation and grade them according to merit ■ University promotion depends on research and publication. Need to be first author and that does not support transdisciplinary research ■ Increased collaboration between companies, NGOs and Universities ■ Promote local journals for easy access 	<ul style="list-style-type: none"> ■ Lacking in NGOs that drive the CCD agenda, who are independent ■ Research audit and database accessible to the public ■ Partner with universities to form research networks ■ Publish their information within their websites and websites up-to-date ■ Find research and work collaboratively with other institutions ■ Collaborate and fund university and government initiatives on CC ■ CSI to address specific issues on climate change and report on them ■ Should be part of research ■ Stop pursuance of profits with negative externalities ■ Engage in public-private partnership ■ Research and data collection ■ Capacity building and awareness ■ Implementation ■ Research audit and database accessible to the public 	<ul style="list-style-type: none"> ■ Donors drive their own agenda which have too many strings which limit exploration ■ Rigid timeframes that restrict research exploration ■ Develop policies that are CCD-sensitive ■ Review guidelines/ requirements to enable easier access for research ■ Funding for softer small grants e.g. research projects to be availed ■ Donors should revise their requirements to not be too prescriptive and stringent ■ Build capacity on proposal writing especially for funding ■ Facilitate innovativeness by not being prescriptive ■ Open funding – not conditional ■ Consider research agenda and outcomes in prioritising areas for funding ■ Outline key stakeholders required in research as expert informants (collaboration base) ■ Funding should be guided by country priorities 	<ul style="list-style-type: none"> ■ Government should allocate more research funding – grants and scholarships ■ Develop the enabling environment – make explicit policies and legislation to address CCD issues, and ensure implementation ■ Coordination, facilitation and dissemination of research ■ Prioritise research in develop plans ■ Prepare research agenda and feed into those of research institutions, including universities and HEIs ■ Governments should be sincere and pursue political will ■ For efficiency and effectiveness, consultancies can be tasked for policy making and reviews ■ Periodic review of policies and harmonisation of legislations ■ Develop expertise retention strategies ■ Streamline governance system - bureaucracy too restrictive ■ Government to employ qualified officers passionate about CC

Engaging with such knowledge partners in a knowledge co-production process requires building capacity for collaboration. Workshop and questionnaire data on university collaboration revealed the following status quo, and outlined possibilities for enhancing such collaboration, as captured in Table 11.

Table 11: Perspectives on different forms of university collaboration

Collaboration inside the university	Collaboration between universities in country	Collaboration with partners nationally	Collaboration regionally (in SADC region and in Africa)	Collaboration internationally
<ul style="list-style-type: none"> ■ MESA¹⁴ combines all faculties and departments. This means that inside the university there is coordination and collaboration ■ Availability of ICT and Internet; college website research sharing of information capacity building of personnel ■ Develop an action programme on climate change for curriculum ■ Faculty of Agriculture and Faculty of Social Science researchers Faculty of Science and Faculty of Social Science and Faculty of Education (and others) ■ Sharing of information and research collaboration to avoid duplication and waste of resources ■ Develop action programme/curriculum on climate change ■ Multidisciplinary research 	<ul style="list-style-type: none"> ■ MESA has had collaboration with University of Mozambique on ESD and Climate ■ Collaborative research ■ Exchange programmes ■ Sharing of infrastructure supporting research ■ Training ■ Networking on implementation of climate change initiative ■ Only the MESA linkage is active ■ Networking and information sharing ■ Partnership on initiation/implementation of the programme ■ Networking 	<ul style="list-style-type: none"> ■ We have worked with Swaziland Environmental Authority in Environment and Climate Change. We are undertaking research programmes for them ■ Publishing of research and dissemination ■ Monitoring and evaluation of programmes ■ Funding of projects and training ■ Knowledge sharing ■ Research organisations such as OSSREA (and others) ■ Funding of activities relating to CCD ■ Knowledge sharing ■ Networking ■ SEA/SEC/SWSC/ SNTC 	<ul style="list-style-type: none"> ■ We are working in collaboration with other SADC organisation in ESD e.g. SADC REEP who are funding some of our activities ■ Funding of activities ■ Exchange programmes ■ Influencing of policies ■ Information dissemination channel ■ WESSA, SARUA, MESA ■ Networking with universities in the region on CCD ■ Knowledge dissemination channels ■ Networking 	<ul style="list-style-type: none"> ■ MESA is a brain child of African universities on environment. This was a follow up to UN policies ■ Funding ■ Influencing of negotiations and conventions ■ Information assessment ■ Multiple links with universities in the North ■ Funding of researchers relating to CCD ■ Information evaluation ■ Networking ■ Sida

¹⁴ Mainstreaming Environment and Sustainability into African Universities <http://www.unep.org/training/mesa/toolkit.asp>

The table indicates the positive role played by the MESA programme in promoting collaboration on environmental issues within the university and regionally. Collaboration within the country involves research, training, contributing to policy development and other government processes, and generally sharing information with other stakeholders. While the HEIs and individual researchers do have multiple links with other universities in the global north, mapping these connections was beyond the scope of this study. Possibilities for enhancing collaboration are discussed in section 5.

4.5.7 University policy and campus management

No specific university policies that encouraged or could inform CCD were mentioned in the questionnaire responses. However, several participants mentioned an Education for Sustainable Development UNISWA policy, the Regional Centre of Expertise grouping, which had an influence on one researcher's teaching and practice. With regard to campus management that aligns to CCD, Nazarene Teachers Training College (SANU) has a programme proposal in development for education for sustainable development. UNISWA has one building that is now using solar energy, and is also involved in campus and community tree planting, as well as other greening activities.

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

4.6.1 Co-ordination, collaboration and improved partnership building

Workshop discussions and questionnaire responses highlighted that the various different threads of responding to climate change in Swaziland constituted a complex and multi-faceted process that required integrative thinking and working. Key to this is the need for enhanced coordination, collaboration and partnership development.

Regarding collaboration within the university, it was noted that collaboration could start at the individual level or at departmental levels. Departments have agendas of research but the question is who is supposed to see to it that the agenda is followed. Participants felt that the responsibility of the faculties' research committees and the deans is to ensure research agendas are followed and implemented. A key step would be to enhance the research orientation in the university strategic plan to be addressed by the Research Centre, through formulation of the university research agenda reflecting agendas pursued in the various departments and faculties.

In order to enable collaboration with other stakeholders of different stature, thus avoiding collaborating with peers only, the disciplinary and status boundaries or barriers needed to be broken with active involvement of community members regardless of age and other characteristics. Members of the community must be included in projects in a partnership format not only for purposes of collaboration but also to ensure ownership of the projects being implemented. A challenging question posed was "How long will we wait for that kind of collaboration where lecturers, researchers will involve ordinary people in the decision making exercise?"

Additional points on strengthening collaboration beyond the university, which relate specifically to knowledge co-production for CCD, are discussed in section 5.2.2.

4.6.2 Strengthen and expand understandings of CCD

A common refrain of the need for more resources to respond to climate change issues emerged when discussing strengthening understandings of CCD. Such resources should be dedicated to climate change capacity building at all levels and entities, as well as to facilitate and support research in innovative and indigenous knowledge systems. Moreover, resources need to be dedicated to formulation of policies and legislation on climate change issues.

Participants from institutions of higher education felt that the lack of public seminars and lectures is partially responsible for the current knowledge gap on climate change, especially among the citizens. They noted that such lectures would be ideal forums for dissemination of research outcomes, as well as knowledge transfer to the general public. Involvement of the media in climate change deliberations and gatherings was considered important to help garner public support, participation and awareness about the concept of climate change. It was observed that climate change is a new concept that countries are trying to adopt, yet people seem to lagging behind.

Further suggestions on the role of education and capacity building in strengthening and expanding understanding of CCD are provided in sections 4.6.3 and 4.6.4.

4.6.3 Capacity building for CCD and staffing

There was a strong call for capacity building, particularly for undertaking research but also for integrating CCD into curriculum and teaching. As this is a multidisciplinary issue, such capacity building should take both a specialist (to develop specialist research capacity) and a multidisciplinary approach that allows for knowledge exchange and the development of collaboration. UNISWA's stand-alone graduate course on climate change titled 'Climate change and environment' in its multidisciplinary MSc in the Environment and Resources Management (ERM) programme could provide a foundational platform for wider multidisciplinary CCD research and staffing. Analysis of the questionnaire data indicates that a number of the current researchers working on climate change, with research interests linked to CCD, do not have PhDs, which also reflects a clear area for enhancing staff capacity. This would also help to grow the number of researchers in the area, as it would enable staff to supervise more PhD students.

Workshop participants noted the need for establishing training institutions to help in the implementation of existing development strategies, and particularly to ensure that industrial growth was sustainable and climate-resilient. Climate change issues need to clarified and be related to national development plans for politicians to understand and enable a better response to climate change. Institutions working with communities, like municipalities, need to be capacitated with climate training especially for junior officers.

In her presentation on UNISWA's role in addressing climate change, Thandi Khumalo emphasised that capacity building amongst climate change professionals is a priority (short

courses). It was critical also to facilitate capacity building of the younger generation and communities (not only climate change specialists, but more broadly). Thus it was extremely important for universities to go beyond standard teaching, so that they could be located within key climate change dialogues.

4.6.4 Curriculum development and curriculum innovation

Discussions in the workshop on ‘who is doing what and how’ led to some in-depth reflections on the status quo, and what could be done differently regarding curriculum development and innovation.

Concerning teaching about climate change, workshop participants emphasised that the concept of climate change needs to be simplified, in order for it to be better understood in all spheres of education and among those outside the education sector. Education should expose learners to live examples of climate change impacts through observation exercises and other field-related learning experiences. As noted previously in this report, there were strong opinions expressed that climate change needs to be better integrated into the educational curriculum. However, some participants felt that climate change was already mainstreamed into the school curriculum, indicating the need for further discussion in the country on this.

As discussed above, most of the HEIs in Swaziland offer several undergraduate and graduate courses in which climate change is embedded, although it is not specifically the focus of teaching. The majority of faculties at UNISWA, affiliated colleges and SANU are currently undertaking mainstreaming of environment and sustainability as part of MESA¹⁵, which presents an opportunity to consider incorporation of climate change issues. Regarding areas of improvement, participants raised the need to include students and the public sector especially in the review of curriculum and courses. Such an involvement would respond to the observed need for collaboration and partnership between universities and sectors outside the universities. The ERM programme involving departments in the faculties of agriculture, health sciences and science and engineering provides a **local best practice** to learn from and adopt as a model to build on when it comes to structuring climate change academic programmes. The call to review and reorient curriculum programmes and courses cannot be overemphasised. Participants felt that periodic reviews of curriculum would allow for capture and inclusion of emerging issues such as climate change into existing programmes, courses, and research and community engagement.

It was noted that the review of programmes, curricula and courses in most institutions of higher education is a lengthy process which may be frustrating at times due to mundane structures to be consulted for approval. Moreover, this happens alongside old institutional policies whose review is now overdue. It was therefore concluded that periodic institutional policy and programme reviews are necessarily accompanied by streamlining of the approval

¹⁵ Mainstreaming Environment and Sustainability at African Universities, an initiative of UNEP.

processes. An opportunity to review curriculum, programmes and courses for integration of climate change issues was noted in almost all the institutions of higher education. UNISWA is currently migrating from the archaic subject major system, William Pitcher and Ngwane Teacher Training Colleges are in the process of incorporation to UNISWA, while the Swaziland College of Technology (SCOT) is being transformed into a Polytechnic to offer degrees for the first time.

As shown in the institutional analysis above, CCD is currently mainly being ‘integrated’ into existing courses, including the Master of Science in Environment Resources Management. The fields of environmental science, agriculture and horticulture, with some sociology courses, dominate the areas of the curriculum that have included CCD-related knowledge. There is also a single chemistry course offering an environmental-related curriculum. If there is to be meaningful and appropriate development and innovation in the curriculum that prepares and enables universities in Swaziland to contend with the major ecological and social changes influenced by climate change, a priority capacity gap would be to focus on the institutional structures, processes and internal leadership that create a nourishing and nurturing environment for researchers and curriculum developers.

The combination of existing courses, and the ESD direction and support that already exists, as well as the pending CCD related policy to emerge from Swaziland, offer great potential for CCD curriculum innovation and development, and should be supported and enriched as a priority.

4.6.5 Strengthening research and knowledge management

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

In a presentation made by Thandi Khumalo of the UNISWA Sociology Department, she highlighted that UNISWA should take the lead in climate change research/programmes relevant to answering questions of adaptation and mitigation, and should also promote the incorporation of indigenous knowledge on coping with climate variability into research projects.

University participants noted that public seminars and lectures would be the ideal forum for dissemination of research outcomes as well as knowledge transfer to the general public, and on pooling resources (intellectual property and facilities) to pursue research activities and programmes of common interest (see section 4.6.1).

Workshop participants recommended the establishment of a climate change institution equipped with requisite personnel, facilities and resources to work on issues and concerns on climate change. Participants also noted that more resources are required to develop responsive research on climate change issues. The resources must be dedicated to climate change capacity building in all levels and entities as well as to facilitate and support research in

innovative and indigenous knowledge systems. Moreover, resources need to be dedicated to formulation of policies and legislation on climate change issues.

Points raised on the issue of strengthening knowledge management, identified as a crucial cross-cutting gap and discussed throughout this report, included the development of ICT to enhance access to data on climate change, for research, planning and decision making. A central database on climate change knowledge, regularly updated and easily accessible to the wide range of stakeholders, is a central recommendation. Participants in this mapping study noted that this should be developed and managed with committed resources from government, while universities could assist with the design of the database.

Recommendations on strengthening knowledge co-production for CCD are included in section 5.

4.6.6 Enhancing community outreach and policy engagement

In the area of community engagement, key ways forward identified for UNISWA were to work cooperatively with government, civil society, the business community and other institutions of higher learning to contribute to global climate change actions in recognition of UNISWA's responsibility for equitable solutions; and to serve as "hubs" for communities on adaptation issues. A further critical area for UNISWA was to influence policy processes with good quality science-based knowledge.

4.6.7 The role of university leaders

The questionnaire participants had a variety of suggestions for what role university leaders should provide in preparing universities for CCD. The role that university leaders play in supporting CCD research and development mostly focused on policy development which would require university wide infrastructure (legislative, financial and capacity) to promote CCD related research across all departments and disciplines and across all universities. In connection to this it was agreed that managers and leadership have a responsibility to develop incentives for developing new study fields with regard to CCD. This includes fundraising and supporting funding applications by university staff. It was also raised that leaders in universities should play a strategic role in facilitating the development of CCD related institutes, units and centres. With regard to government and policy development, participants suggested that university leaders should influence politicians on CCD, and strengthen current university policies to cater for CCD.

In her presentation, Thandi Khumalo called on UNISWA to exercise leadership by reducing emissions of greenhouse gases in collaboration with our communities. In concrete terms, UNISWA should develop a comprehensive plan to reduce greenhouse gases by creating a planning body that includes students, staff, researchers, administrators and other partners to set emission reduction targets in accordance with the jurisdiction of each campus. The university should develop measurable targets using research and science. A comprehensive inventory of all greenhouse gas emissions on each campus should be completed, after which achievable and practical plans should be developed to achieve reduction targets. UNISWA should then put in place rigorous assessment and measurement procedures. While the

comprehensive plan is being created, the institution should immediately implement selected tangible actions to reduce greenhouse gas emissions. Finally, it should fully disclose and be accountable for the university's actions. This should include making action plans, inventories and periodic progress reports publicly available for review and comment.

Within the university specifically, participants suggested introducing climate change programmes that specifically invest in projects that conduct climate change research. In addition university leaders should assist departments financially and materially to train personnel on teaching and research regarding CCD. University leaders were seen to be responsible for encouraging research and curriculum design that are compactable with the climate change theme. One participant suggested that this should include the integration of climate change practices (as interventions) in curriculum development and mobilise participation in the rural areas of farmers. Public lecture platforms and other information transfer spaces should be established by university leaders.

University leaders were also suggested to implement university wide policies that encourage and facilitate the flow of information from the universities to communities, as well as encourage research on CCD across disciplines. This could include the development of climate compatible development strategic plan and specific direction for the university. This could be established through the not only policy development but also resources, planning committees on CCD, investing in technology to assist with achieving CCD, as well as monitoring and evaluation of impact.

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.¹⁶ 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.¹⁷

Scales of problem and approach

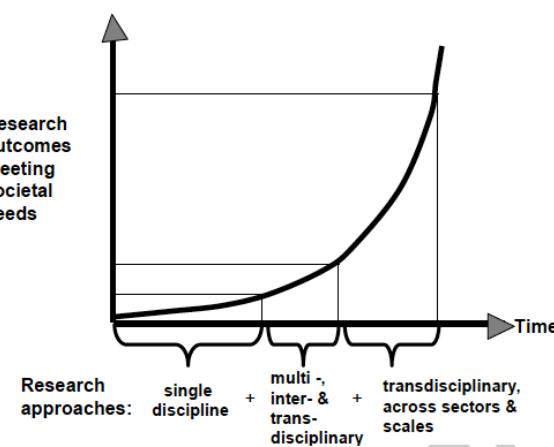


Figure 5: Research approaches

¹⁶This is because universities are organised and established around a disciplinary knowledge production structure.

¹⁷Source: 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.¹⁸

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 practice¹⁹; 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 more deeply into developing new and more complex ways of understanding and engagement in contexts where new forms of theory and practice come together²⁰ across sectors and at different scales.

¹⁸ 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.

¹⁹ 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.

²⁰ 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.²¹ 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.²² 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

During the workshop discussion that focused on knowledge co-production and the need for collaborative research to address CCD, it was emphasised that in transdisciplinary research processes, researchers develop new models and approaches from interdisciplinary synthesis work that can inform policy and that can be tested out and implemented with stakeholders in the social-ecological context.

Workshop responses indicated that there is very little transdisciplinary research taking place in Swaziland, with most research either being individual discipline based or multidisciplinary. In response to a discussion question on “examples of transdisciplinary studies in Swaziland” the following comments were made by the participants:

²¹ Max-Neef. 2005. “Commentary: Foundations of Transdisciplinarity”.

²² Adapted from the Akili Complexity Forum draft proposal, NRF South Africa (March 2010).

- NERCHA's HIV/ AIDS Programme was cited as an example of transdisciplinary research;
- SWADE's sustainable land use and land management project at the LUSIP-GEF project area at Siphofaneni led by Ms. Lynn Kota – although there has not been much research yet ;
- Commemoration of the Earth hour in the country; and
- UNISWA Environment and Resources management MSc Programme (involving several departments in the faculties of Agriculture, Health Sciences and Science and Engineering) is a good example of multi-disciplinary activity.

These examples highlight the fact that transdisciplinary research, where it does exist, is in its infancy. However there are potentially good lessons to be learned for CCD knowledge co-production from initiatives to address HIV/AIDS.

5.1.3 Multi-, inter- and transdisciplinary research possibility: Benefits and constraints

The benefits and constraints of transdisciplinary research were discussed in the Swaziland consultations workshop, and are captured briefly in the table, and elaborated on below.

Table 12: Benefits and concerns of transdisciplinary research identified at Swaziland workshop

Benefits	Concerns
<ul style="list-style-type: none"> ■ Allows researchers to complement each other ■ Transdisciplinary allows for “good” mix between indigenous knowledge and new approaches ■ Helps increase resource base for research where pooling of such is undertaken ■ Encourages a proper mix of expertise ■ Facilitates a whole coverage or address of cross cutting issues like climate change, HIV/AIDS and others ■ Result in relevant research outputs that respond to relevant community concerns ■ Cross reference and pollination of ideas and approaches 	<ul style="list-style-type: none"> ■ Dominance of one discipline over others ■ Different interest may result in conflict and competition if collaboration is not properly managed ■ Lack of funding ■ Lack of expertise to initiate and manage collaborative efforts ■ Institutional and discipline-related barriers

In general, workshop participants felt that collaborative research was largely beneficial, particularly in the sense of allowing for a holistic picture of the problem being studied, and consequently for being able to develop more integrated and effective solutions. As one participant stated “It is very interesting to see a horticultural person working with an agricultural scientist, working with a dairy person, because when they do this they come up with something that is far beyond their usual scope.” It is interesting to note the potential contribution of working in a transdisciplinary manner to the issue of how best to blend indigenous and scientific knowledge, which emerged as an important priority in the Swaziland consultations.

A presentation made by Musa Dube on the rationale for multidisciplinary research highlighted that knowledge co-production approaches could serve as a vehicle for social therapy, a means to alter power structures, a way to legitimise subsequent programmes, a means to facilitate

the teaching-learning process, a way to mobilise resources, and a means to ensure sustainability and continuity – and thus an end in themselves.

Constraints identified mainly centre around disciplinary and institutional barriers, and the problems of lack of expertise for this kind of research, as well as lack of funding. The identified concerns of collaborative research, including transdisciplinary research, highlight existing gaps or barriers to be addressed, to facilitate collaboration among individuals and institutions. Support from relevant institutions is crucial to enable universities to respond and actively contribute to CCD knowledge co-production.

5.1.4 Enabling collaborative knowledge co-production processes

Subsequent discussion in the Swaziland workshop highlighted the need for the adjustments of university policy and practice to enable collaborative research. Important aspects raised, as noted in section 4.6.1, were:

- Adjusting plans and strategies: There must be a research orientation in the university strategic plan to be addressed by the Research Centre. The formulation of the university research agenda should reflect agendas pursued in the various departments and faculties.
- Collaboration: Collaboration can start at individual level or departmental levels. Gaps in enabling environment for collaboration may be addressed through policy and legislative support, as well as political will of those in higher echelons of power and influence. There is a need for a clear coordination point for collaborative research in the university, and strategies need to be implemented – e.g. UNISWA Strategic Plan. One government participant noted that they had approached the UNISWA Research Centre before to commission some of this kind of research, but this was not effective and they became discouraged. As noted above, the relevant structures are the Faculty Research Committees, with the best avenue through the Dean. UNISWA also has a Consultancy Research Entry Point.

Regarding strengthening collaboration beyond the university, workshop discussions involving all stakeholder groups on the need for collaborative research to address wide-ranging climate change challenges highlighted the need for universities firstly to share information on the work which could or needs to be done. Beyond the need for a clear coordination point for collaborative research in the university, enabling strategies need to be implemented – e.g. UNISWA Strategic Plan. Beyond the HEIs, gaps in the enabling environment for collaboration (discussed further in section 5) may be addressed through policy and legislative support, as well as political will on the part of those in higher echelons of power and influence. The recently signed Memorandum of Agreement between the Swaziland Environment Authority and UNISWA for implementation of the plan to integrate Biotechnology and Biosafety in programmes and practices in institutions of higher education and training in Swaziland may also serve as a model for future collaboration on climate change issues. The plan will be implemented by the MESA Implementation Committee (MIC) under the Academic Development Centre at UNISWA. The MIC has gained experience in the implementation of similar projects from its on-going activities to mainstream environment and sustainability in programmes and practices at UNISWA and affiliated institutions.

Participants agreed on the need for pooling resources (intellectual property and facilities) to pursue activities and programmes of common interest and mutual benefit. This would help to address the current situation, which is characterised by lack of expertise, facilities and other resources to undertake climate change initiatives. This could be supported by taking of inventory of activities, personnel and institutions dealing with CCD-related issues, to establish what exists and who is conducting these initiatives. The findings set out in this Country Report could constitute the starting point for a comprehensive national inventory, which would also identify activities conducted by local institutions on climate change to ascertain necessary steps to steer the economy and society towards desired climate-resilient outcomes and destinations. It was appreciated that currently, a majority of HE institutions in the country are mainstreaming environment and sustainability in their programmes and practices as part of the implementation of the MESA initiative.²³ The implementation of MESA at UNISWA and affiliated colleges would provide the requisite support and approach for incorporation of CCD related issues activities in HE programmes and practices. The participation of the UNISWA Research Centre and Centre for Community Services would be important to effect integration of CCD issues in research and community engagement.

In response to a question raised on “how will we know that we are on track pertaining to collaboration?” participants emphasised the importance of monitoring systems to track progress on collaborative programmes and activities. However, it was considered very important to first further unpack the barriers to collaborative research, so that these could be systematically tackled.

Workshop discussions in Swaziland thus highlighted the following policy and practice steps to enable the emergence of transdisciplinary knowledge co-production processes in response to CCD concerns:

Policy:

- Improved government policy supporting CCD;
- Improved university-wide policy supporting CCD; and
- A national research foundation (or equivalent).

Practice:

- Re-assessment of curriculum approval mechanism;
- Incentives for inter- and transdisciplinary research;
- Financial and resource support for research and curriculum development;
- Publishing support;
- Strengthening of research collaboration;
- CCD friendly research cultures and knowledge transfer platforms; and

²³ University of Swaziland, alongside Universities of Botswana and Zambia, was accorded the SADC MESA Chair which was accompanied by seed funding to support environment and sustainability activities at UNISWA. The MESA chair has supported a number of activities within and outside UNISWA including in Mozambique. In its existence, the UNISWA MSA Chair collaborated with other entities, especially the SADC Regional Environmental Education Programme to host national and regional meetings and workshops.

- Emphasising the importance of management issues within the CCD framework.

The Swaziland consultations confirmed the need for such research, and that multiple research partnerships would be possible within the stakeholder networks that are interested in CCD research. There is an understanding of the societal benefit of such approaches to research. However, research systems and cultures of practice in universities are not in place to support such research innovation.

In the next section, some possible CCD knowledge co-production pathways will be mapped out based on the analysis in sections 2, 3 and 4. These may assist in developing a broad-based research agenda for CCD in Swaziland, which will need to be refined at a local level by participating organisations and groups.

6 SUMMARY AND CONCLUSION

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

Swaziland's observed annual mean temperature has already increased by more than 3 °C in the period from 1961 to 2000 in all agro-ecological zones (SNC 2012)²⁴ which is considerably above the regional average for southern Africa (which is itself above the global average). The country is already feeling the impacts of climate change, and urgent action is needed on many fronts. As workshop participants noted, "This concerns our **survival!**".

Within this context, the mapping study needs analysis for Swaziland 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 development of Swaziland's Climate Change Strategy and Action Plan. Consistent with the socio-economic context, overarching barriers to adaptation indicated in all three data sources include low levels of awareness of the threats and opportunities of climate change; limited human resources in a small country; low technological capacity; and availability of the financial resources to address climate adaptation. The workshop and questionnaire responses further identified a range of cross-cutting needs for responding better to CCD; key amongst these were capacity development, training, enhanced and better resourced research, technology development and innovation, and mainstreaming climate change into policy and ensuring implementation through awareness raising and enforcement.

6.1.1 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, terrestrial ecosystems, biodiversity and forestry, and water resources; with some additional emphasis in the questionnaire responses on health and on infrastructure.²⁴ This is not surprising given that Swaziland's key climate vulnerabilities lie in these areas. The data sources also agree on *broad mitigation priorities and needs*, which encompass industry and energy, and Land Use, Land Use Change and Forestry (LULUCF). 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 industrial policy and development to reduce greenhouse gas emissions, without specifically noting desired technologies to achieve this. Both policy documents and workshop data emphasise the need to

²⁴ It is assumed that this refers to climate-proofing infrastructure against climate risks such as more intense rainfall and increased flooding.

strengthen and promote renewable energy sources. While the policy documents note the need for mitigation to gradually contribute to moving Swaziland from a carbon source to a carbon sink after 2030, this issue was not mentioned in other data sources.

6.1.2 Specific knowledge and research gaps

In the SNC, research capacity gaps were mainly focused on agricultural adaptation, while workshop discussions and questionnaires raised a broader range of specific knowledge and research gaps related to Swaziland's projected key impacts. While no significant change in the total precipitation is projected for Swaziland, distributional changes will be key drivers of risk and vulnerability; thus there will be more flooding and drought events, and increased trends in impacts that have already been observed: wild fires, dry weather, storms, floods and strong winds. Thus, consistent with these projected impacts, workshop and questionnaire data highlighted the need for observational data to underpin climate assessments of impacts and vulnerability on water resources, agriculture, biodiversity and the health sector; as well as data to underpin such assessments in the energy, industry and waste sectors. Local-level vulnerability mapping is a key knowledge/research gap; as is testing of relevant technologies for climate adaptation and mitigation. Specific research gaps highlighted in the areas of agriculture and forestry included the development of drought-resistant crops, exploration of agricultural technology for climate change adaptation, afforestation technologies and sustainable forest management. Other prioritised research gaps included tropical disease control and the effects of climate change on this; and climate change compatible building technology and town planning methods, as well as the use of indigenous knowledge systems in addressing climate change challenges.

Key further points concern the need for urgent action on the ground to enhance the climate resilience of many marginal livelihoods, in which indigenous knowledge systems (IKS) are felt to have an important role to play; and the importance of integrated adaptation/ mitigation approaches – e.g. conservation agriculture, which are already being tested and implemented in some parts of Swaziland, with some research, teaching and outreach activity in this regard.

6.1.3 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 programs 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. Specific points included developing adequate data capture, storage and information on climate change in Swaziland, and methods for using data to establish baselines, that could be developed through observational data and linked to indigenous knowledge.

6.1.4 Notable themes

Emerging from the Swaziland workshop and questionnaire data were the importance of exploring the *potential contribution of indigenous knowledge*, integrated with scientific methods, for responding to climate change; that the response to climate change should be demand driven, location specific and participative – thus there is a need for *localisation of data and research*; and the need not only for awareness raising and capacity development but also *empowerment* of Swazis to become more resilient to current and future climatic changes.

6.1.5 Individual capacity gaps

The Needs Analysis has shown that while the SNC focused largely on the needs of the Meteorological Department as National Focal Point for Climate Change, an overall point in workshop and questionnaire data was the need for a broadened understanding of climate change and its impacts, with concerns 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. Gaps clustered around the area of community outreach and education included targeted training of extension officers and building capacity at the community level, especially of community leaders who are the land allocators. 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.

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 for a small country with a limited skills base. 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. Lack of postgraduate research and an ill-equipped National Research Council, together with insufficient research funding, may contribute to the situation noted in which policy development does not seem to be informed by research. *Financial resourcing* was a priority gap highlighted, specifically to improve the distribution of the country's weather observation station network. 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. A lack of *clearly defined mandates and responsibilities* as well as *consolidated framework for coordination of education, training and public awareness activities* in different sectors on climate change is needed. Overall participants felt that a *mainstreaming 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*.

"We need specialists trained on climate change issues, adaptation and mitigation in each and every Ministry or organisation. Universities need to introduce programmes on climate change long term or short term in order to capacitate communities. Communities must be well informed on issues of climate change and survival skills."

Ministry of Agriculture spokesperson

6.2 Synthesis perspective on the institutional assessment

This mapping study has identified existing initiatives amongst the Higher Educational Institutions (HEIs) in Swaziland 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 HEIs in Swaziland 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. However, these areas of capacity for work on CCD will need to be supported through strategic and sustained programmes to enhance, deepen and expand this capacity and expertise. 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. A critical point highlighted in the study is 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. Key areas are policy response, behaviour changes, and better interactions such as between communities and researchers, and between policy and praxis.

Student-based centres with potential for enhancing knowledge and awareness of climate change and CCD in Swaziland were identified as being:

- **UNIGEP:** University of Swaziland Geography, Environmental Science and Planning Society – an environmental organisation for University of Swaziland students (both current and former) in the Department of Geography, Environmental Science and Planning.
- **UNISWA's Green team:** A university-wide student initiated organisation aimed at educating, improving knowledge and understanding sustainability through diverse programs with the aim of increasing awareness about the space we live in and general health.

Stakeholders in Swaziland firmly located climate compatible development (CCD) within the umbrella of sustainable development. They identified a critical role for transdisciplinary, multidisciplinary and interdisciplinary research, and other forms of knowledge co-production, in mediating between scientific and other knowledge systems, such as IKS. Universities and training colleges classified CCD-related activities according to areas of teaching, research and service. UNISWA has a stand-alone graduate course on climate change titled 'Climate change and Environment' in its multidisciplinary MSc. Environmental Resources Management (ERM) programme. Moreover, UNISWA, its affiliated training colleges and SANU (Southern Africa

Nazarene University) have several undergraduate and graduate courses in which, though climate change is embedded in the course, the specific focus of teaching is not climate change.

The institutional assessment has revealed that capacity development of the wider CCD related research community in Swaziland is needed. 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 UNISWA include curriculum development and innovation, research, 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.

6.3 A broad map of Swaziland CCD knowledge co-production pathways

Considering the workshops and questionnaires, as well as other data sets *in relation to each other*; one can begin to map out CCD capacity development pathways for Swaziland. Three examples of key CCD priority areas in Swaziland are offered here (Tables 13, 14 and 15). Table 13 focuses on food security, which has a largely adaptation focus, but would include mitigation actions too if activities like conservation agriculture were to play a strong part. Table 14 focuses on developing appropriate mitigation technologies – but clearly the inclusion of conservation agriculture would bring in the adaptation element as well. Thus both of these examples would have the required CCD integration of adaptation and mitigation, at least to some extent. This would need to be enhanced in the design of specific activities. Table 15 sets out a possible CCD capacity development pathway for some of the important cross-cutting issues identified through this mapping study. These provide three synthesised perspectives of key knowledge, research, individual and institutional capacity gaps for Swaziland, per priority area, providing insight into the research, capacity building and institutional development pathways needed for enhancing future contributions to CCD.

Table 13: CCD Knowledge, research, capacity building and institutional capacity gap analysis for one of the Swaziland adaptation priorities: Food security

CCD PRIORITY	Knowledge and Research Gaps (Research agenda)	Individual Capacity Gaps (Education and Training agenda)	Institutional Capacity Gaps (Institutional Development agenda)
ADAPTATION: <ul style="list-style-type: none"> ■ Food security 	<p>Contextual research:</p> <ul style="list-style-type: none"> ■ Examine the extent of the climate change impact on crop production ■ Contextualised research for specific agricultural zones ■ Investigate local areas either vulnerable or prone to climate change impacts are not mapped ■ CCD research in the context of other assessment tools such as environmental risk assessment and environmental impact assessment ■ Draw from indigenous knowledge systems <p>Adaptation technology:</p> <ul style="list-style-type: none"> ■ System that will be proactive in detecting crop failure ■ Research on the variety of maize which can withstand harsh conditions ■ Relevant technologies for climate adaptation need to be tested and examined ■ Shifting planting periods involving research for planting dates and other management factors ■ Drought resistant crops: selection, testing and introducing crops such as cassava, pigeon pea, sisal, hemp, sorghum, oil seeds such as cotton, sunflower and groundnuts and leguminous crops 	<p>Rural communities:</p> <ul style="list-style-type: none"> ■ Capacity building for subsistence farmers to address their own localised agro-climatic problems ■ Strengthen information sharing on resilient seeds for climate change adaptation <p>Community leaders:</p> <ul style="list-style-type: none"> ■ Capacity development on climate change and land use issues, especially community leaders as they are the ones allocating land <p>Local government:</p> <ul style="list-style-type: none"> ■ Rural development area programmes should address the needs of the people. There is a need for an integrated rural development strategy <p>Management:</p> <ul style="list-style-type: none"> ■ Lack of leadership skills on climate change at management levels. It was observed that some of the climate change issues are actually due to poor management of our natural resources and climate change only exacerbates them 	<p>Policy development:</p> <ul style="list-style-type: none"> ■ Policy and legislative framework to coordinate and consolidate climate change activities in the country ■ Clearly defined mandates and responsibilities. ■ Improved institutional framework to coordinate food security climate change adaptation <p>Agricultural extension:</p> <ul style="list-style-type: none"> ■ Ministry of agriculture should increase the capacity of existing extension officers by training them and availing resources ■ Localise extension officers so that they know the details of the area under their jurisdiction

Table 14: CCD Knowledge, Research, Capacity Building and Institutional Capacity Gap Analysis for one of the Swaziland Mitigation Priorities: Appropriate technology in mitigation strategies within CCD context

CCD PRIORITY	Knowledge and Research Gaps (Research Agenda)	Individual Capacity Gaps (Education and Training Agenda)	Institutional Capacity Gaps (Institutional Capacity Development Agenda)
Appropriate technology in mitigation strategies in relation to CCD	<p>Baseline and context research</p> <ul style="list-style-type: none"> ■ Insufficient data and data storage capacities to establish climate change baselines ■ The country's mitigation efforts need to be supported by research pinpointing the sources (for instance the greenhouse gas emissions)and ascertain the amounts emitted <p>Technology development:</p> <ul style="list-style-type: none"> ■ Relevant compatible building technology and other technologies for climate mitigation need to be tested ■ Research into contextualising and customising CCD mitigation technology for Swaziland ■ Examine the difference between CC mitigation and conventional impacts and mitigation; potentially a cost benefit analysis ■ Agricultural technology needs include identification of suitable crops, solar crop dryers, sustainable pest management, effective land use management, alternative irrigation methods, rainwater water harvesting <p>Knowledge management:</p> <ul style="list-style-type: none"> ■ Improve knowledge transfer, translation and cohesive research agendas ■ Document and capture the lessons learnt, meaning the existing knowledge possessed by individuals 	<p>General:</p> <ul style="list-style-type: none"> ■ Insufficient appropriately trained and skilled people on climate change at a country level ■ Champions at all levels to engender a dominant paradigm of sustainability <p>Researchers:</p> <ul style="list-style-type: none"> ■ Lack of understanding of models and use of estimate values for national conditions (e.g. LULUCF sector) <p>Technical expertise:</p> <ul style="list-style-type: none"> ■ Enhanced technical competence of key officials involved in assembling and interpreting climate data and information. <p>Teachers:</p> <ul style="list-style-type: none"> ■ Training of teachers, facilitators and other trainers in Climate Change, new mitigation technology, CCD practice etc. ■ We do not have enough written material to which people can refer e.g. manuals 	<p>Government:</p> <ul style="list-style-type: none"> ■ Government is promoting conservation agriculture (CA) but people implementing are at different levels of understanding of the concepts ■ Climate change compatible Town Planning methods <p>Policy and legislation:</p> <ul style="list-style-type: none"> ■ Policy and legislative framework to coordinate and consolidate climate change activities in the country ■ Clearly defined mandates and responsibilities ■ Improved institutional framework to coordinate climate change <p>Collaboration:</p> <ul style="list-style-type: none"> ■ Improved collaboration within and between sectors and disciplines

Table 15: CCD Knowledge, Research, Capacity Building and Institutional Capacity Gap Analysis for one of the Swaziland Cross Cutting CCD issues: Education, training and knowledge management

CCD PRIORITY	Knowledge and Research Gaps (Research Agenda)	Individual Capacity Gaps (Education and Training Agenda)	Institutional Capacity Gaps (Institutional Development Agenda)
<ul style="list-style-type: none"> ■ Courses/ curriculum addressing climate change 	<p>Curriculum and policy:</p> <ul style="list-style-type: none"> ■ Policy development is not informed by research ■ Curriculum is too much inclined to theory rather than practice(Praxiological theory) <p>Knowledge management and transfer:</p> <ul style="list-style-type: none"> ■ Research expertise in CCD that can develop a comprehensive research bank for Swaziland. ■ No platform and regulation where CC research is easily accessible <p>Collaboration:</p> <ul style="list-style-type: none"> ■ Need for collaboration among researchers in order to make a meaningful contribution ■ Information flow between practitioners and researchers is lacking. Information doesn't reach all the people it should reach. 	<p>CCD professionals:</p> <ul style="list-style-type: none"> ■ Lack of experts <p>Technical and financial capacity:</p> <ul style="list-style-type: none"> ■ Human and technical capacity to mobilise financial support ■ Project preparation skills to access international funding for climate change ■ Human and technical capacity to mobilise financial support <p>Education professionals:</p> <ul style="list-style-type: none"> ■ No expertise or appropriate training of extension officers on climate change issues ■ Need for community outreach programmes to train people on climate change adaptation skills and adoption of appropriate technologies ■ Lack of general personnel trained on climate change ■ Ability to translate and transmit expert knowledge to local communities 	<p>National research:</p> <ul style="list-style-type: none"> ■ The national research council doesn't effectively work, and will need to support CCD related research. <p>Institutions:</p> <ul style="list-style-type: none"> ■ Have very few Post Graduates (Masters and PhDs) students that can carry out researches that can contribute to the society meaningfully ■ Lack of funding for research at post graduate level (a lot of people have to fund themselves or they are funded by South Africans hence will carry out research for South Africa). <p>Research networks:</p> <ul style="list-style-type: none"> ■ Improved research networks and collaboration is needed, institutions are not in networks at global level. <p>Institutional frameworks:</p> <ul style="list-style-type: none"> ■ Consolidated framework for coordination of education, training and public awareness activities in different sectors on climate change ■ Removal of institutional barriers to energy efficiency improvements <p>Management and human resourcing:</p> <ul style="list-style-type: none"> ■ Reduce high staff turnover and a limited pool of human resources

The analyses such as the ones modelled above, can be developed for all major CCD priorities, and should ideally form part of national climate change policy development. Such analyses provide a starting point for knowledge co-production at a national level. Key is also to integrate mitigation, adaptation and development priorities into the CCD knowledge co-production pathways, as per the CCD framework. While the examples above are broadly categorised as mitigation and adaptation, they address both, and are also set up within a development framework.

Critical issues to be addressed for Swaziland 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 examples above (Tables 13, 14 and 15), to guide further action at country level.
- Expand the capacity of the research institutions that have been identified as having some capacity and expertise for research, teaching and learning on CCD. Develop strategies for strengthening individual research competence, so that individual interest and research capacity can grow into a ‘node of expertise’ and then into a ‘centre of expertise’, and potentially a Centre of Excellence. 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 Swaziland.
- Improve co-operation, communication, knowledge management and shared access to data at all levels.
- Develop motivation and incentives for researchers, especially for engaging in multi-, inter and transdisciplinary research approaches. Support capacity development of researchers in these areas.
- Strengthen research partnerships and research infrastructure, including research funding and incentives for students.
- Support ongoing processes of curriculum innovation to mainstream CCD into existing courses and programmes, and engage in development of Masters degree curriculum design, potentially in partnership with other southern African universities.
- Strengthen existing policy and community outreach activities within a knowledge co-production framework, building on promising activities such as the collaborative community-based research and engagement on conservation agriculture and IKS; and develop tools for monitoring and dissemination to make the impact of such work visible within the university system.
- Develop campus management policies and practices that demonstrate commitment to CCD at the institutional level, and support student organisations that are beginning to tackle CCD-related matters.

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

Climate change and CCD related strengths identified in Swaziland consist of:

- **Climate change vulnerability and adaptation research:** Conservation agriculture, crop diversification, community-based water management

- **Integrated adaptation/mitigation research:** Collaborative community-based research exploring contribution of indigenous knowledge to local-level adaptation and to mitigation; role of conservation agriculture; analysis of mitigation strategies in forestry and land use; renewable energy viability studies (mini-micro hydro, wind, solar and bio fuels)
- **Climate change and ecological approaches:** Wetland rehabilitation and land degradation rehabilitation, biodiversity conservation
- **Cross-cutting issues/institutional development research:** MESA Chair as a mechanism for mainstreaming environment and sustainability issues provides model for mainstreaming climate change within and across institutions
- **Systems of social change research:** Indigenous knowledge systems and climate change
- **Teaching and curriculum innovation:** Dedicated undergraduate course on sustainable development; UNISWA multidisciplinary MSc on Environment Resources Management with dedicated climate change component; various institutions working on curriculum reform and integration of climate change

APPENDIX A: WORKSHOP ATTENDANCE LIST

List of participants at the Swaziland workshop, 6 June 2013 (Day 1)

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

Table 16: Active researchers contributing to CC/CCD research related activities in Swaziland

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David Manyatsi (MEd)	Curriculum and Teaching	27 years : 5 years	UNISWA: Faculty of Education, Curriculum and Teaching Department dman@uniswa.sz
Thandi Khumalo (MA)	Sociology	23 years : 5 years	UNISWA: Faculty of Social Science, Department of Sociology tkhumalo@uniswa.sz
Thuli Mamba (MEd)	Student Affairs	35years : 3 years	UNISWA, Faculty of Agriculture, Student Affairs. tmamba@uniswa.sz
Olusegun Oseni (PhD)	Horticulture	32 years : 3 years	UNISWA, Faculty of Agriculture, Horticulture toseni@uniswa.sz
Abahle Thwala (Masters in Library and Information Science)	Library	21 yrs: 3 yrs	UNISWA, Administration, Library abahle@uniswa.sz
Busi D Dlamini-Shongwe (BEd)	Social Sciences	12 years : 3 years	Nazarene Teachers Training College (SANU), Social Science busidshongwe@yahoo.com
Nomsa Matsenjwa (MA)	Education	6 years : 2 years	Nazarene Teachers Training College (SANU), Education nomsamatsenjwa@yahoo.com
Ntombifuthi Mhlongo (MSc)	Applied Science	4 years: 1 year	futhi78@yahoo.com
Dambuza Dlamini (BSc Agric Edu/Hons)	Applied Science	6 years: <1 year	Southern African Nazarene University, Applied Science, Agriculture Dambuza.Dlamini@yahoo.com
Thabile Ndlovu (PhD)	Chemistry	4 years: <1 year	UNISWA, Chemistry thabile@uniswa.sz
Celumusa Doctor Khumalo (BSc)	Geography Environmental Science	unknown	UNISWA, Geography and Environmental Science ckdoctor623@gmail.com

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

APPENDIX C: UNIVERSITIES QUESTIONNAIRE

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

A: GENERAL INFORMATION

A1: NAME	
A2: GENDER	
A3: HIGHEST QUALIFICATION	
A4: JOB TITLE	
A5: YEARS OF EXPERIENCE	
A6: YEARS OF EXPERIENCE WITH CLIMATE CHANGE / COMPATIBLE DEVELOPMENT RELATED ISSUES	
A7: NAME OF UNIVERSITY	
A8: COUNTRY	
A9: NAME OF FACULTY	
A10: NAME OF DEPARTMENT	
A11: 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?

C4: 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 SWAZILAND

Table 17: Identified sources of expertise for CCD in Swaziland

University	Nodes of expertise	Centres of expertise	Centres of excellence ²⁵	Active CCD related research networks
UNISWA	<p>Faculty of Science:</p> <ul style="list-style-type: none"> ■ Staff associated with the multi-disciplinary MSc in Environment Resources Management, which includes a dedicated climate change component in the Department of Geography, Environmental Science and Planning: research on various CCD-related matters, including management of forest fires <p>Faculty of Agriculture:</p> <ul style="list-style-type: none"> ■ Organic farming and vegetable production in horticulture programme; investigating and incorporating conservation agriculture and local indigenous knowledge systems that could inform new mitigation solutions <p>Faculty of Social Science, Sociology Department:</p> <ul style="list-style-type: none"> ■ Doing commissioned research on crop diversification and climate change for UNDP; broader interest in range of CC-related issues 	<p>RCE Swaziland:</p> <ul style="list-style-type: none"> ■ Regional Centre of Expertise (RCE) in Education for Sustainable Development Coordinating ESD activities and processes in the country; ESD training and capacity building; Developing innovative methods of education in all sectors and levels of education; Reviewing and reorienting curricula towards ESD; Developing a resource facility for storage and retrieval of information on ESD; and Providing a forum for the sharing of ideas, expertise and experiences on ESD implementation. Working on SADC REEP: SADC Regional Environmental Education Programme 		<ul style="list-style-type: none"> ■ Renewable Energy Association of Swaziland (REASWA) ■ EEASA (Environmental Education Association of Southern Africa) ■ OSSREA (Organisation of Social Science Research in Eastern and Southern Africa) ■ CGIAR (Consultative Group on International Agricultural Research) ■ ICRISAT (International Crops Research Institute for the Semi-Arid Tropics) ■ African Technology Policy Studies Network (ATPSN) ■ Swaziland Educational Research Association (SERA)

²⁵ No relevant formal SADC Centres of Excellence located in Swaziland could be identified via web searches.

University	Nodes of expertise	Centres of expertise	Centres of excellence ²⁵	Active CCD related research networks
William Pitcher College	<p>Geography Department:</p> <ul style="list-style-type: none"> ■ Teaching and research on sustainable development and climate change 			
Southern African Nazarene University (SANU)	<ul style="list-style-type: none"> ■ Curriculum development – currently integrating ESD and CC issues; at the consultative stage of introducing a degree on sustainable development 			

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

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