climate change counts

STRENGTHENING UNIVERSITY CONTRIBUTIONS TO CLIMATE COMPATIBLE DEVELOPMENT IN SOUTHERN AFRICA

Angola Country Report

sarua
southern african regional universities association

SARUA CLIMATE CHANGE COUNTS MAPPING STUDY

VOLUME 2 COUNTRY REPORT 1 2014

STRENGTHENING UNIVERSITY CONTRIBUTIONS TO CLIMATE COMPATIBLE DEVELOPMENT IN SOUTHERN AFRICA

Angola Country Report

Series Editor: Piyushi Kotecha

Authors: Heila Lotz-Sisitka and Penny Urquhart

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Note

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

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

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

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

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Acronyms

ABA	Associação dos Biólogos de Angola (Angolan Biology Association)
AMESD	African Monitoring of the Environment for Sustainable Development Project
AQA	Associação dos Químicos de Angola (Angolan Chemistry Association)
BCC	Benguela Current Commission
BCLME	Benguela Current Large Marine Ecosystem
BESA	Banco Espirito Santo Angola
BID	Background Information Dcoument
CASSALD	China and South-South Scoping Assessment for Learning and Development
CBNRM	Community Based Natural Resource Management
CBO	Community Based Organisation
CDKN	Climate and Development Knowledge Network
CDM	Clean Development Mechanism
CEIC	Centro de Estudos e Investigação Científica of the Angolan Catholic University
CESSAF	Centre of Excellence for Science Applied to Sustainability
CNPC	National Commission on Civil Protection
CNRF	National Plant Genetic Resources Centre
CSIR	Council for Scientific and Industrial Research
CTI	National Science and Technology Innovation
CTMA	Technical Multi-sectoral Commission for the Environment
DNA	Designated National Authority
DNAPF	Direcção Nacional de Agricultura, Pecúaria e Florestas
DW	Development Workshop
EEASA	Environmental Education Association of Southern Africa
FCUAN	Agostinho Neto University - Science Faculty
FEUAN	Agostinho Neto University - Engineering Faculty
FFEWS	Famine and Flood Early Warning System
GCLME	Gulf Current Large Marine Ecosystem Programme
GHG	Greenhouse Gases
GIS	Geographical Information Systems
GoA	Government of Angola
HEI	Higher Education Institution
HEMA	Higher Education Management Africa consortium
IDRC	International Development Research Centre
INAMET	Instituto Nacional de Hidrometeorologia e Geofisica (Meteorological Institute)
INE	National Statistical Institute
IPCC	Intergovernmental Panel on Climate Change
JEA	Ecological Youth of Angola
MAT	Ministry of Territorial Administration
MINAGRI	Ministry of Agriculture
MINCO	Ministry of Commerce
MINERGA	Ministry of Energy and Water

MINFIN	Ministry of Finance
MINGM	Ministry of Geology and Mining
MINPES	Ministry of Fisheries
MINPET	Ministry of Oil
MINSCT	Ministry Science and Technology
MINTRANS	Ministry of Transport
NAPA	National Adaptation Programme of Action
NGO	Non-Governmental Organisation
NIReS	Newcastle Institute for Research on Sustainability
ODINAFRICA	Ocean Data and Information Network for Africa
REDE MAIOMB	Umbrella Environmental NGO
SADC	Southern African Development Community
SADC REEP	Southern African Development Community Regional Environmental Education Programme
SARUA	Southern African Regional Universities Association
SASSCAL	Southern African Science Service Centre for Climate Change and Adaptive Land Use
SD	Sustainable Development
SODA	Simple Ocean Data Assimilation
TDA	Transboundary Diagnostic Analysis
UAN	University of Agostinho Neto
UJES	José Eduardo dos Santos University
UNDP	United Nations Development Programme
UNFCCC	UN Framework Convention on Climate Change

1 INTRODUCTION

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

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

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

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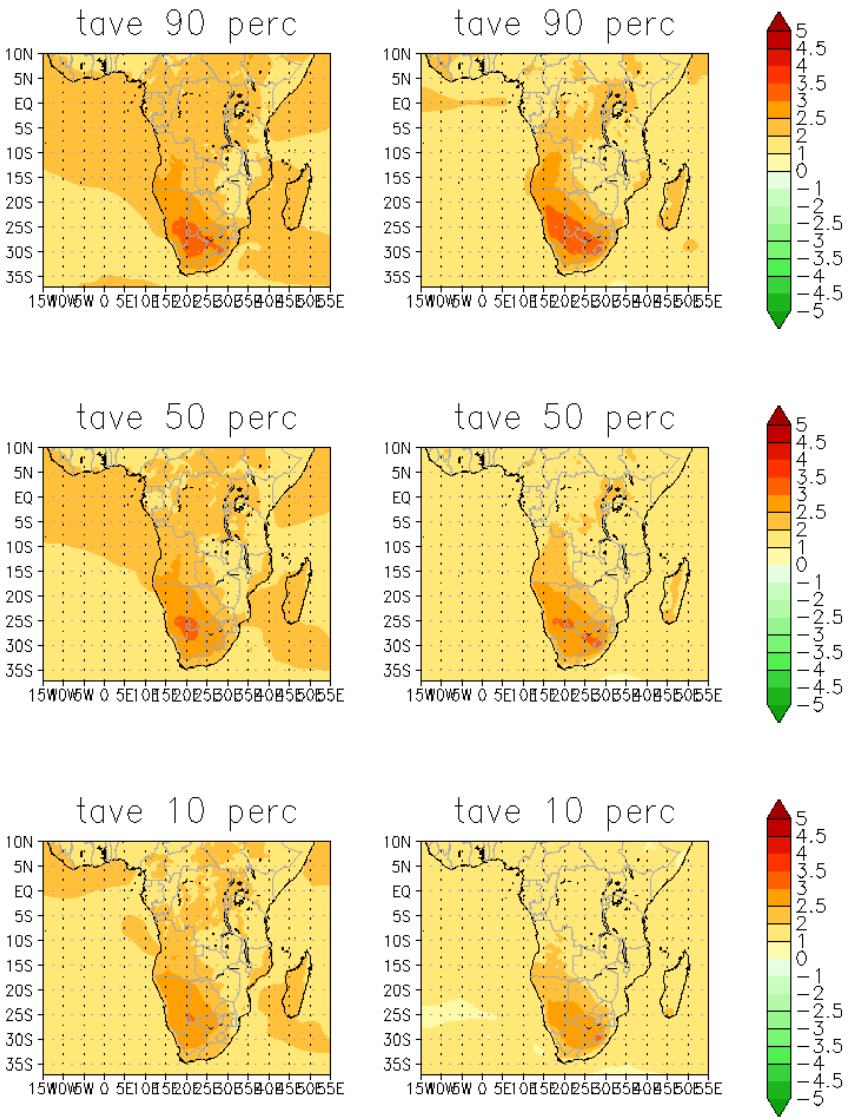
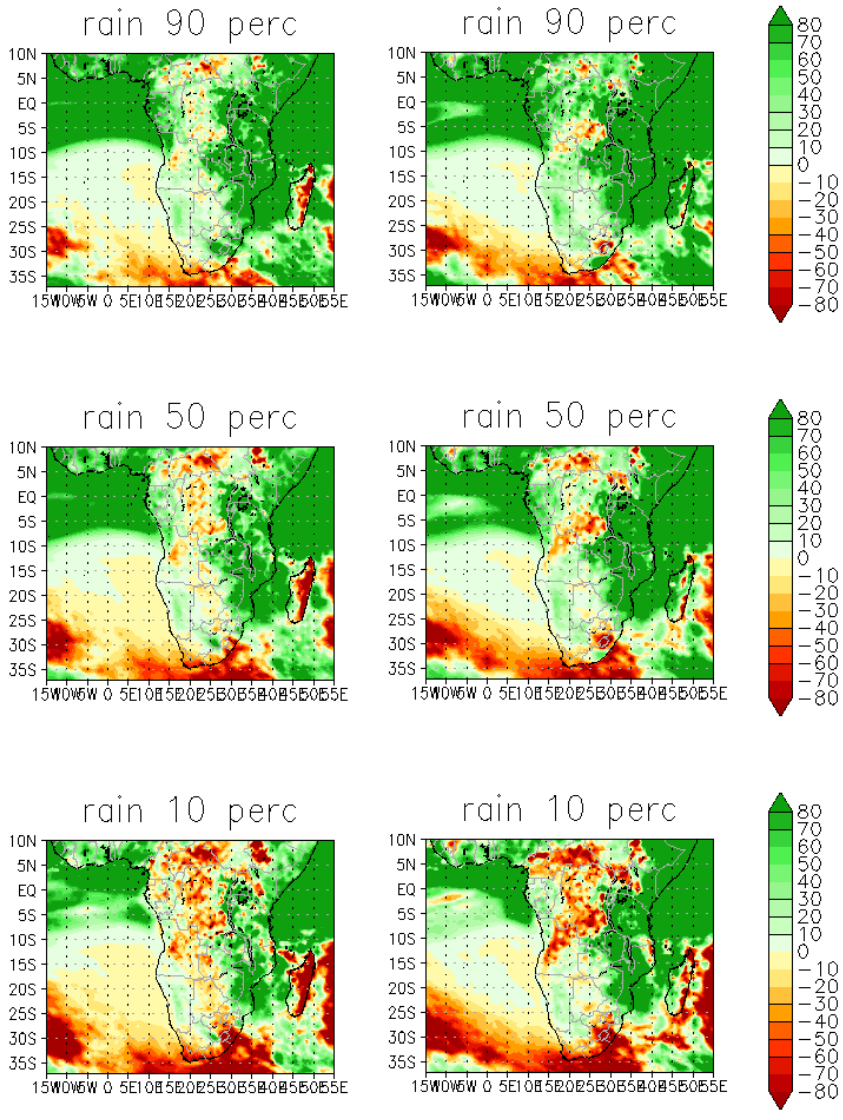
[1] IPCC. 2013. *Impacts, Vulnerability and Adaptation: Africa*. IPCC Fifth Assessment Report, draft for Final Government Review, Chapter 22.

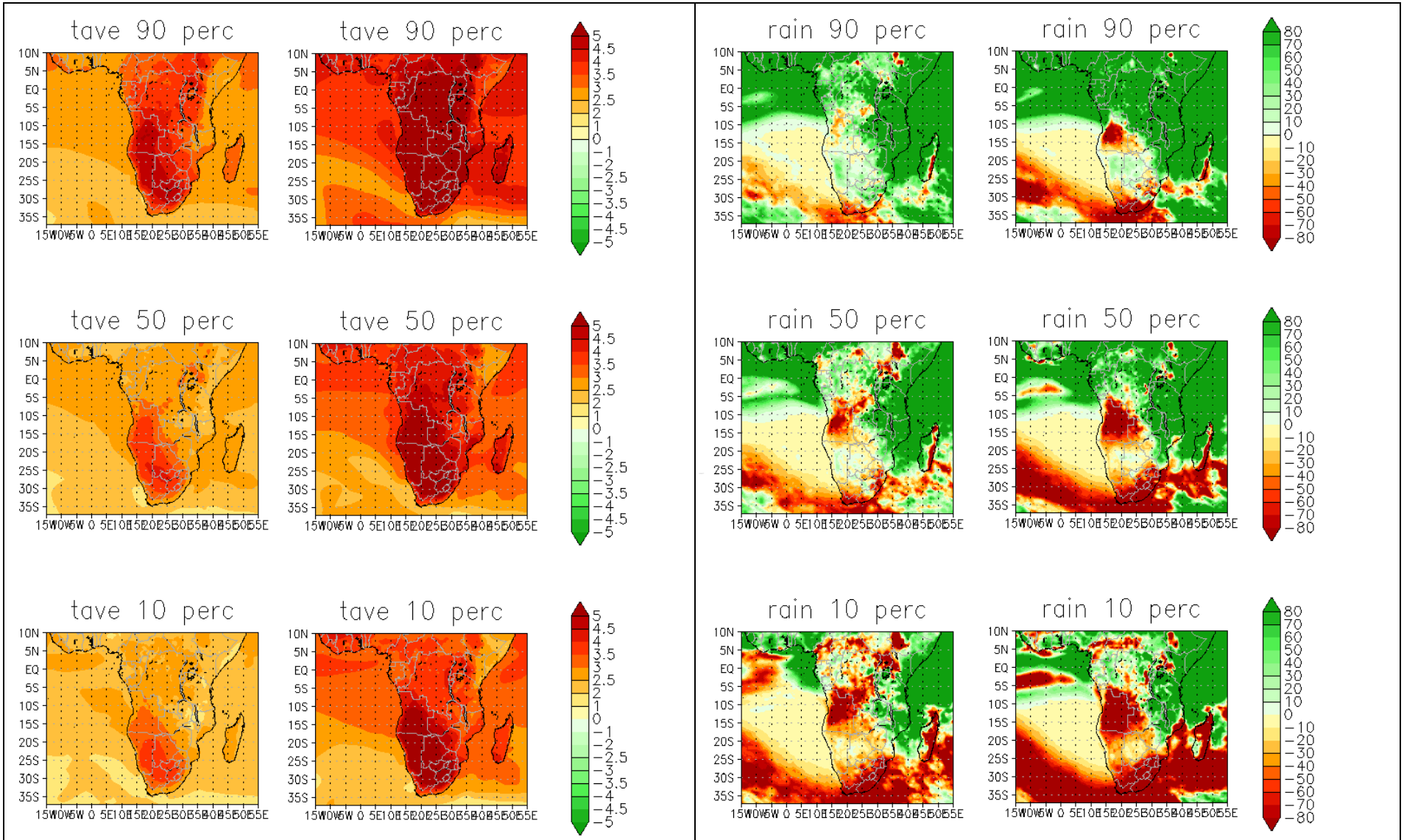
[2] The projections of future climate change displayed in Figures 1 and 2 were provided by the Council for Scientific and Industrial Research (CSIR), and have been obtained through downscaling the output of a number of coupled global models (CGCMs) to high-resolution over Africa, using a regional climate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





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

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



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

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

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

The Initial National Communication (INC) to the United Nations Framework Convention on Climate Change for Angola (GoA 2012)[4] recognises the country's high levels of vulnerability to climate change, but at the same time recognises the relationship between climate change and development. Climate change is also provided for in the National Development Plan of Angola (GoA 2011a).[5] As the advisor to the Ministry of Environment, Mr Luís Constantino, stated during the SARUA Climate Change Counts mapping study workshop opening:

> *"Climate change is not only an environmental problem, but a challenge for socio-economic development. Vulnerability to climate change and adaptation processes deeply affects our model of development, particularly in the more vulnerable sectors."*

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

[3] Climate trends and scenarios for South Africa. Long-term Adaptation Scenarios Flagship Research Programme (LTAS). Phase 1, Technical Report no. 1.

Engelbrecht et al., "Multi-scale climate modelling".

[4] GoA. 2012. Initial National Communication to the United Nations Framework Convention on Climate Change.

[5] GoA. 2011a. General (National) Plan of the Government of Angola (2010-11).

- 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 Capacity Building Programme: 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 collaborative networks);
- **Policy and community outreach**;
- **Research** (140 PhD students (average 10 per country) in at least two themed research programmes);
- **Teaching and learning** (integration of CCD into undergraduate and Masters degree programmes);
- **Knowledge management** (regional database and knowledge management systems); and
- **Institutional learning and support** (ongoing reflexive development of programme).[6]

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 Angolan Country Report forms part of the mapping study.

The initiative can be diagrammatically illustrated as follows:

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

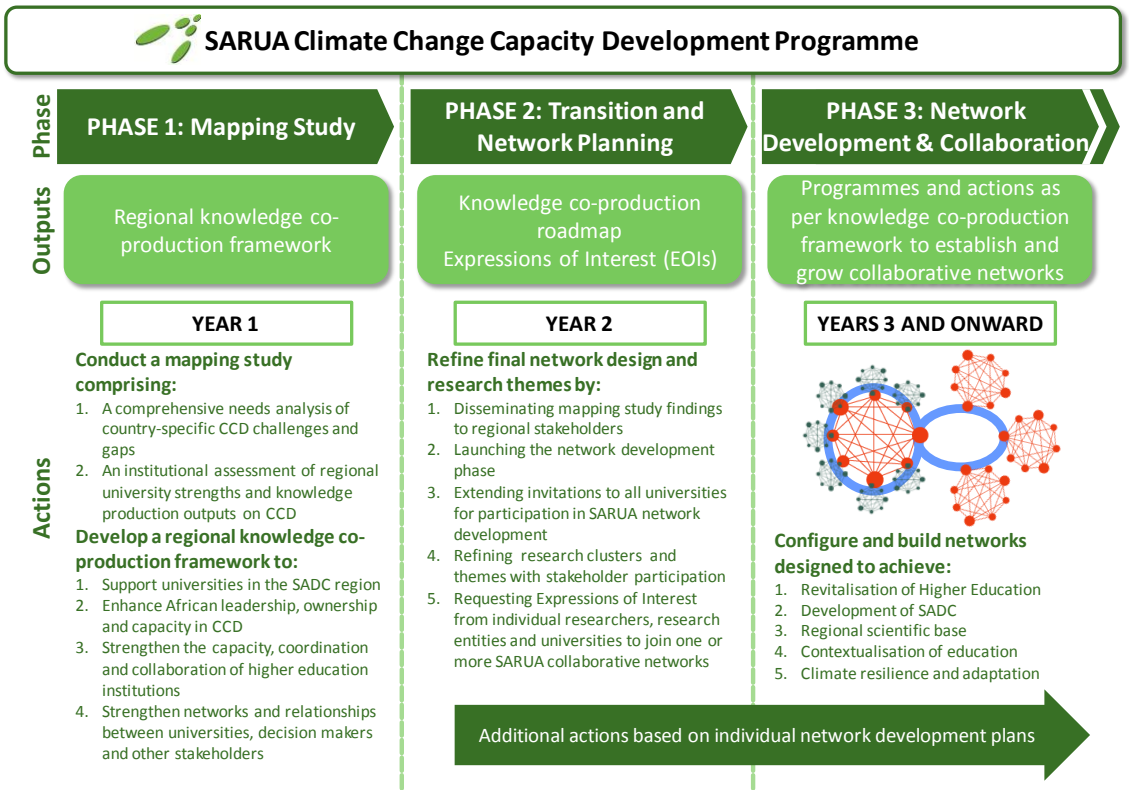


Figure 3: The SARUA Climate Change Capacity Development Programme, showing the mapping study

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

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

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

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

region, opportunities for collaboration involving higher education institutions within and between countries are yet to be fully explored.

To address these factors, the mapping study aimed to:

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

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

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

1.4 Key concepts

Climate compatible development

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

vulnerability identification and risk reduction responses are revised on the basis of continuing learning. Climate compatible development emphasises climate strategies that embrace development goals and development strategies that integrate the threats and opportunities of a changing climate.[7] Thus climate compatible development opens up new opportunities for interdisciplinary and transdisciplinary research, teaching and engagement with communities, policy makers and practitioners.

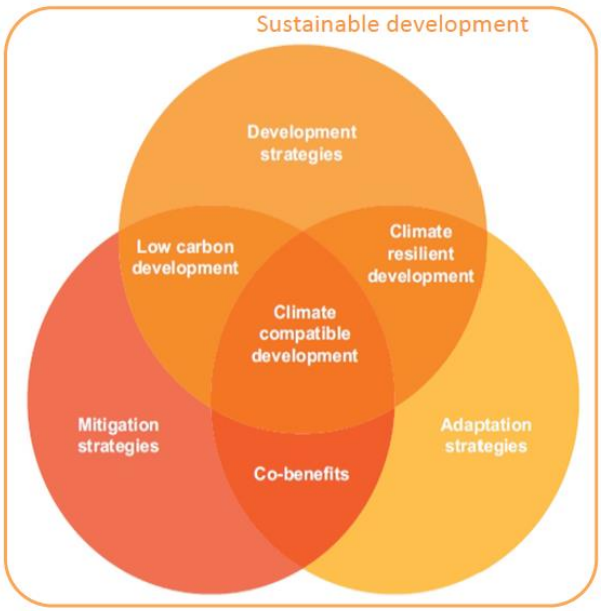


Figure 4: Conceptual framework for Climate Compatible Development (adapted from Mitchell and Maxwell, 2010)

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

Climate-resilient pathways

The following definition of climate-resilient pathways is taken from the glossary of the Fifth Assessment Report prepared by the Intergovernmental Panel on Climate Change (IPCC)[8]:

> *"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*

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

[8] IPCC. 2013. *Fifth Assessment Report: Impacts, Vulnerability and Adaptation*. Technical Summary, draft October 2013.

> *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."[9]

Sustainable development

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

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

2 METHODOLOGY, DATA SOURCES AND ANALYSIS LOGIC

2.1 Research design

This country-based study has been informed by an interactive and dialogical research design that included document analysis of key national and regional documents focusing on climate change in Angola 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 Angola, within an overall interpretive, participatory and consultative and social realist methodology[10]:

2.1.1 Document analysis

A Background Information Document (BID) based on initial document review was produced for each country. The BID provides a summary of needs, priorities and capacity gaps already identified within key country documents (see Section 3 below) for climate change, adaptation and mitigation, and in some cases, where this was available, climate compatible development. The BID documents were 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 Angolan mapping study Country Report, the following key policy and programme documents were analysed through rapid desk review of the following key policy and programme documents:

- National Strategy on Climate Change, 2007 (GoA, 2007);
- General (National) Plan of the Government of Angola (2010-11), (GoA, 2011a);
- National Adaptation Programme of Action (NAPA), (GoA 2011b); and
- Initial National Communication to the United Nations Framework Convention on Climate Change (UNFCCC), (GoA, 2012).

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

2.1.2 Stakeholder and university staff consultations (national workshop)

As part of the SARUA mapping study Initiative *Climate Change Counts*, a country consultation workshop was held in Angola on 2 October 2013 at the Camama Agostinho Neto University Campus [11], Luanda. The consultations were structured as a one-day programme, with a combined group of participants, which included university, government, private sector and NGO stakeholders as well as a second day of small group meetings with selected stakeholders. See Appendix A for the list of participants. A summary of the content of the different sessions is provided below in Table 1. From detailed workshop proceedings captured by a team of three rapporteurs a workshop report was produced, which was circulated to all who participated in the workshop for verification and accuracy. Data produced in the workshops was also verified and added to during plenary sessions. The workshop report forms a substantive basis of the data used for this Country Report, combined with document analysis and questionnaire data.

Table 1: Workshop programme outline

Time	Activity
08h00 – 08h30	Coffee and registration
08h30 – 09h00	Welcome and introductory remarks
09h00 – 09h30	SARUA Initiative overview
09h30 – 10h00	SESSION 1: ▪ Framing Climate Compatible Development (CCD)
10h00 – 10h30	Tea/coffee
10h30 – 11h30	SESSION 2: ▪ Angolan priorities and needs ▪ Knowledge and institutional gaps and capacity
11h30 – 13h30	SESSION 3: ▪ Group discussion (breakaway) ▪ Angolan priorities and needs ▪ Knowledge and institutional gaps and capacity
13h00 – 14h30	SESSION 4: ▪ What is the role of the university sector? ▪ Identifying other knowledge partners
14h30 – 15h00	Lunch

[11] The Angola consultations were made possible through the kind contribution of the University Agostinho Neto, Camama Campus, Luanda.

Time	Activity
15h00 – 16h00	SESSION 5: ▪ Breakaway groups & plenary discussion ▪ Who is doing what and where in Universities in CCD? (Research, Teaching, Community Engagement) ▪ Who is doing what and where amongst stakeholder groups? ▪ How does this respond to the needs and priorities? ▪ What are existing university plans? What are the gaps?
16h00 – 16h30	SESSION 6: ▪ Plenary discussion ▪ Knowledge co-production introduction and example of trans-disciplinary research programme ▪ Gaps in enabling environment, and needs for policy and practice support
16h30 – 17h15	SESSION 7: ▪ Opportunities for collaboration ▪ Policy implications for government, universities and donors
17h15 – 17h30	SESSION 8: ▪ Way forward and closure

2.1.3 Questionnaires

Two different questionnaires were prepared to analyse climate change and CCD knowledge co-production practice and possibilities (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. A total of nine questionnaires were completed, which included four from stakeholders and five from university professionals. Questions covered the following areas:

2.1.3.1 University staff questionnaire

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

innovation courses; assessment and examination of CCD issues; staff willingness and staff ability; actual courses and teaching methods)

E. **Policy, community engagement and student involvement**
F. **University collaboration** (inside the university; between universities in country; with partners; regional and international involvement)
G. **University policy and campus management**

2.1.3.2 Stakeholder questionnaire

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

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

2.2 Limitations of the mapping study

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

While much information could be obtained on climate change- and CCD-related knowledge gaps, research needs and capacity gaps, there is obviously more to be learned about these. Similarly, as much information as possible was obtained on 'who is doing what' and on existing research, knowledge co-construction practice and possibilities, but there is clearly also more to learn about these. This Country Report therefore presents as a useful 'initial document' and it is hoped that Angola, and in particular, University Agostinho Neto, the Methodist University of Angola 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 Appendix C and D) in a manner that would include every academic at universities in Angola, and in a way that would allow for aggregate data within and across Faculties and Departments (Appendix C). 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 Angola to understand the full scope of climate change and CCD responsiveness in Angola, and to further develop the knowledge co-production capacity for CCD in Angola. In many ways therefore the SARUA study, as reported in the mapping study Country Report, maps out the pathway forward for more detailed and ongoing reflexive analysis of CCD knowledge co-production capacity in Angola, 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 Angola.

Ministries who could take this study forward could include the Ministry of Higher Education, working in collaboration with the following ministries: Ministry of Territorial Administration (MAT); Ministry of Agriculture (MINAGRI); Ministry of Energy and Water (MINERGA); Ministry of Oil (MINPET); Ministry of Geology and Mining (MINGM); Ministry Science and Technology (MINSCT); Ministry of Transport (MINTRANS); Ministry of Commerce (MINCO); Ministry of Fisheries (MINPES) and Ministry of Finance (MINFIN). The Ministry of Environment is also a key ministry to co-operate with, as it is the National Designated Authority that implements the Clean Development Mechanism (CDM), and deals with issues such as Biodiversity. The Ministry of Environment also leads the Inter-ministerial Commission on Climate Change and Biodiversity.

2.4 Analysis logic

The analysis logic informing this mapping study 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 Angola, 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 Angola, which may also assist Angola **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 Angola's socio-economic context and a summary of the observed and projected climatic changes for the country (section 3.2) as these are key drivers for the 'need' for CCD identified by policy, in workshops and via the questionnaires (section 2.3). The needs analysis then describes **more detailed knowledge, research and capacity** needs (section 3.4) using the following differentiation of knowledge, research and capacity gaps:

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

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

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

3.2.1 Socio-economic context

Angola, located on the western coast of southern Africa, covers a surface area is 1 246 700 km², with a coastline of 1 659 km. About half the population of approximately 21 million people live in urban areas, largely due to rural-urban migration caused by the long civil war. The climate is sub-tropical to tropical, with two more or less well-defined seasons: the cool and dry "cacimbo" from June till September, and the warm and humid rainy season from October to May. The country is divided into four main ecological regions: the humid coastal areas with a mean annual rainfall of 600 mm; the inland north with high temperatures and rainfall; the inland plateau with average annual temperatures of 18°C; and the semi-arid inland southwest zone (NAPA, GoA 2011b). Mean annual rainfall ranges from less than 300 mm in the semi-arid zone to over 1 200 mm in the inland north. Inter-annual rainfall variability is high in many parts of the country. The country experienced severe drought in the 1980s. The rich natural resources include close to 57.4 million hectares of arable land, of which only between 5 and 8 million hectares are used, and abundant water resources.

Angola has experienced high levels of economic growth – an average of 9.2 percent over the past few years. Oil accounts for 55 percent of the GDP and 95 percent of exports, followed by the rural sector (8 percent of GDP), which comprises agriculture, forestry and livestock.

Fisheries contribute 7.8 percent of GDP. Large investments are being made in roads, trains and telecommunication networks, as well as the industries and food distribution networks, which were destroyed during the armed conflicts. High levels of poverty are reflected in inadequate access to food, drinking water, sanitation, education, health, electricity and other commodities. Rural populations experience higher levels of poverty. Access to education in the rural areas is of 25.1 percent, while in urban areas it is 40 percent. In 2000, the illiteracy rate for the population over the age of 15 was 58 percent. Malaria continues to be the main cause of death in Angola, mainly in children under the age of 5. Life expectancy is 49 years.

Rural poverty and reliance on subsistence agriculture, large coastal settlements, and exposure to increased malaria risk in areas already vulnerable to, and affected by malaria (amongst other factors identified below), make Angola vulnerable to climate change, and are key drivers of the need for CCD responses in Angola.

3.3 Observed and projected climatic changes, impacts and vulnerabilities

3.3.1 Observed climatic changes

Angola's INC (GoA 2012) notes a well-established warming trend in Angola, with surface temperatures having increased by between 0.2 to 1.0°C between 1970 and 2004 in the coastal areas and northern regions; and between 1.0 and 2.0°C in the central and eastern regions. Analysis of air temperature data for Luanda reveals an increasing rate of 0.2°C per decade, resulting in a cumulative total of 1.9°C between 1911 and 2005, with higher increases in the cool season. Rainfall information is unreliable as only 20 of the 500 rainfall stations are functional. Meteorological data from the central plateau of Angola, where data sets are better, does not indicate changing trends in precipitation. In southern Angola, where data is less reliable, there is an indication of less precipitation and more variability than in the past. In Luanda the pattern of rainfall since 1941 has shown increases and decreases: rising trend between 1941 and 1964; a rapid drop between 1964 and 1978; and a rising trend during the post-1978 period (NAPA, GoA 2011b).

3.3.2 Projected climate changes

Climate models indicate that there will be a rise of 3.0 to 4.0°C in the surface temperature of Angola in the east, and a slightest smaller increase in the coastal and northern regions in the next 100 years. There is no consensus about future trends concerning precipitation in the region. Apart from increased temperatures, climate models project more extreme weather events, an expansion of arid and semi-arid regions, seasonal shifts in rainfall, localised floods, increased wildfires, sea level rise, increased rainfall in the northern parts of the country, changes in river flows and changes in sea and lake temperatures. According to one source, available projections agree that there will be a decline in the length of the agricultural growing

period in southern Angola and along the coast, while areas in the north that currently benefit from two growing seasons may in the future only experience one.[12]

3.3.3 Impacts and vulnerabilities

The country's key vulnerabilities by sector include biodiversity loss, human health, infrastructure, fisheries, and agriculture and food security. While uncertainties in precipitation projections make it difficult to predict specific impacts, it is expected that climate change will make existing vulnerabilities more severe. Climate change in neighbouring countries will have implications and opportunities for Angola: dryer weather in Angola and South Africa can give regional importance to Angola's water, energy and agricultural resources.

Higher rainfall in the north is expected to cause more soil erosion and sedimentation while more intense rainfall is likely to cause more flooding, affecting human settlements and road infrastructure. Impacts could be severe: for example, the unusually heavy rains in 2006 and 2007 caused severe flooding in areas that have no record of flooding, causing millions of dollars of damage to property and infrastructure. Floods could further increase the contamination of water by waterborne diseases such as cholera. Higher temperatures are expected to result in increased incidence of malaria over a wider area. Tsetse fly populations are likely to expand under warmer conditions and cause increases in the number of people infected by the Chagas disease, especially among rural populations. Sea level rise is projected to have significant impacts on coastal settlements, where 50 percent of the country's population lives, as well as on road networks, industrial and commercial infrastructure. Sea level rise is also expected to reduce the potential for agricultural activities in coastal areas due to salinisation. Due to uncertainties in rainfall projections, it is not clear what the impact of climate change on food security in Angola will be.

All these issues are drivers of the need for CCD and CCD knowledge, research and capacity development in Angola. Angola has started to develop national policy for climate change responses to guide CCD in Angola, as can be seen in the next section.

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

3.4.1 Identified needs: Adaptation and mitigation priorities articulated in policy and strategy

Angola has identified key needs and priorities, related to the abovementioned observed and projected climate changes, impacts and vulnerabilities. According to Angola's Initial National Communication to the UNFCC (GoA 2012), a major priority that cuts across all areas/sectors is the need to generate information and knowledge.

[12] http://www.adaptationlearning.net/angola/profile

Specific **adaptation** priorities and associated that have been highlighted in the Initial National Communication, and that are also included in the National Adaptation Plan of Action for Angola (GoA 2011) are:

- ***Water***: Improve levels of knowledge in hydrology, and understanding of factors that contribute to risks of rises in water levels and flooding; develop pilot projects to reduce risks caused by flooding and rises in water levels; assess the potential effects of increased water flows on hydro-electric plants; and prepare charts on areas prone to flooding.
- ***Agriculture*****:** Study the effects of climate change on agricultural systems; establish climate change and variability and associated risks based on community knowledge and experience, especially in the southern region; reduce community vulnerability in agriculture through improved provision of appropriate seed; and conduct studies on the implication of climate change on the distribution of animal diseases and the availability of water for livestock.
- ***Soil erosion*****:** Establish the human and natural factors that contribute to soil erosion risks in many areas of the country; map erosion risk areas; and create pilot projects that build local capacity to reduce erosion risks.
- ***Biodiversity and forests*****:** Gather information on the current levels of biodiversity and its state of conservation; improve management of existing reserves and establish the possibility of creating new ones; and incorporate probable climate change impact in preparing conservation plans for different regions. Expand knowledge of deforestation and energy alternatives to reduce deforestation.
- ***Coastal areas and sea level rise*****:** Study the factors that shape the maritime coast and establish the levels of erosion and sedimentation; study the possible effects of sea level rise; study the effects of coastal sedimentation and erosion; deepen studies on the Benguela Cold Current and how these may change in future; and study the implications of sea level rise, erosion and sedimentation on infrastructure located in coastal areas.
- ***Human settlements, housing, infrastructure and transport*****:** Study the effects of higher temperatures and more intense rainfall on housing; improve housing designs; map human settlements that are vulnerable to flooding and erosion; review and adapt climate parameters in the design/construction of roads, railroads and hydro-electric plants; study the possibilities for adapting current infrastructure to climate change; and implement infrastructural maintenance plans.
- ***Health*****:** Study the implications of climate change on the (re)distribution of human diseases and their occurrence in relation to rainfall, temperature and extreme events; and improve the healthcare system's level of preparedness to handle extreme events.
- ***Meteorology***: Organise and analyse meteorological data from 1975 to 2005; use various media such as agricultural bulletins, food security bulletins and newspapers to report on extreme climate occurrences; establish past extreme events from community knowledge and experience; partner with regional meteorological research centres to develop climate change models that include Angola; and study inter-annual rainfall and temperature variations and a system of seasonal predictions for different regions of the country.

Some adaptation measures already being implemented in Angola include: capacity building, policy formulation, research and community based adaptation in the agriculture, water and

policy fields. Current projects are focused at community, national as well as regional levels, thereby improving awareness of adaptations across a range of stakeholders.

The key Angolan sectors that have been identified for **mitigation** are energy and transport, waste and forestry.

The Initial National Communication to the UNFCC (GoA 2012) identifies the following **mitigation** measures:

- ***Energy and transport*:** Upgrade the electricity distribution network; develop renewable energy, especially from water and wind and use natural gas in place of oil; promote more energy efficient technologies; improve the transport system (e.g. cargo transport grid, reviving the railway system and use of new generation cars that use renewable energy); access and use clean technology.
- ***Waste*:** Collection and treatment of urban solid waste; and creation of landfill sites; introduction of taxes on waste; regulation of waste management; composting and recycling measures.
- ***Forestry*:** Reduce deforestation; increase use of butane gas; community-based and private sector participation in forestry management; protect and conserve forestry and wildlife; and strengthen legislation.

3.4.2 Identified CCD priorities and needs articulated in workshop interactions

Participants provided a range of responses during the workshop session dedicated to identifying climate change and CCD-related needs, which indicated a strong level of engagement with the issue. The vulnerable areas which are reflected by the participants included:

- CCD development and implementation of **renewable energy** programmes (wind and solar power);
- Low carbon initiatives and programmes;
- Deforestation and forest management; and
- Biodiversity and Water resources management.

Participants also recommended specialised CCD support for the **Climate Change and Tropical Ecology Research Centre**.

Discussions around these specific identified needs, led participants to highlight the following key aspects:

- Information on climate change in Angola is scarce and when available is not adequately used in the decision making processes;
- Lack of trained and experience human resources is one of the main obstacles for the implementation of climate change related programmes;
- Poor cross sectoral institutional coordination leading to the duplication of efforts and misuse of financial resources;
- Inadequate documentation and publications on climate change adaptation and mitigation particularly in Portuguese;

- Poor vulnerability and variability mapping particularly in areas more prone to extreme events such as the Cunene province; and
- Insufficient research institutions and research projects on climate change related projects.

Participants felt that there is sufficient legislation on environmental issues that could be used to promote CCD across the government structures. However, the **lack of skilled human resources and insufficient funding hinders potential research on CCD**. The main recommendation was that the government, through the Ministry of Environment, should invest more time and resources on environmental awareness programmes for governmental and higher education institutions as well as for the general public. There is no concerted environmental awareness programme, only some ad hoc activities. Another general feeling from the participants was that most of the information, data and climatic models are developed in English and thus more investment needs to be made in developing such products in Portuguese.

3.4.3 Identified needs for CCD articulated in questionnaire data

Questionnaire data did not show any specific relationship between institutional interest / mandate and/or disciplinary interest / mandate and the definition of priority needs. Due to limitations in the response from university participants, only two participants explored what they considered specific identified needs for Angola. These included **the reduction in fossil-based fuels**, and considerations of the **types of agriculture** adopted. These researchers had institutional interests in engineering and chemistry respectively.

Angolan stakeholders however offered further insight into the relationship between institutional/mandated interests with their critical priorities with regard to responding to climate change in Angola. A stakeholder with an institutional and mandated interest in ***meteorology*** prioritised **poverty reduction, food security, education and deforestation** as key action areas. Another stakeholder in the Poverty Reduction Department in the UNDP, prioritised **renewable household fuel/energy, management of water resources, sanitation, waste management and public health**, which relate strongly to her mandated interest.

Although no specific trends reveal the relationship between institutional/mandated interest on priority climate change or CCD priorities, it is however possible that different institutions / disciplines and levels of inter-disciplinary management could shape the perceptions of what the most important climate compatible development 'needs' are for Angola. If this is the case, it is important to identify and recognise these different perspectives in knowledge co-production processes and approaches.

The responses that were received show the inter-disciplinary and multi-sectoral nature of climate change. *How to harness such perspectives, and the associated expertise that informs such perspectives is the ultimate challenge of a knowledge co-production framework and process.*

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

Building on the identified needs for CCD priorities in Angola (discussed in section 3.2 above) are identified needs for CCD research, knowledge, and capacity. This section reports on these as found in key national documents, and as articulated by stakeholders and university staff attending the workshop and completing questionnaires.

3.5.1 Research needs and knowledge gaps

As noted above in section 3.3.1 all areas identified for adaptation and mitigation require research and knowledge production. Specifically, as stated in the Initial National Communication to the UNFCC (GoA 2012) some of the specific research needs include:

- ***Water***: Hydrological research to understand factors leading to water levels and flooding, including mapping flood prone areas, and impacts of flows on hydro-electric plants.
- ***Agriculture*****:** Study the effects of climate variability on agricultural systems and access community knowledge for adaptation to climate changes; analyse implications of climate change on the distribution of animal diseases and the availability of water for livestock.
- ***Soil erosion*****:** Map erosion risk areas and causes.
- ***Biodiversity*****:** Incorporate probable climate change impact assessments into conservation plans for different regions.
- ***Coastal areas and sea level rise*****:** Study the possible effects of sea level rise; study the effects of coastal sedimentation and erosion; deepen studies on the Benguela cold current and how these may change in future; and study the implications of sea level rise, erosion and sedimentation on infrastructure located in coastal areas.
- ***Human settlements, housing, infrastructure and transport*****:** Map human settlements that are vulnerable to flooding and erosion; review and adapt climate parameters in the design/construction of roads, railroads and hydro-electric plants; study the possibilities for adapting current infrastructure to climate change.
- ***Health*****:** Study the implications of climate change on the (re)distribution of human diseases and their occurrence in relation to rainfall, temperature and extreme events.
- ***Meteorology***: Organise and analyse meteorological data from 1975 to 2005; partner with regional meteorological research centres to develop climate change models that include Angola; study inter-annual rainfall and temperature variations and a system of seasonal predictions for different regions of the country.
- ***Energy and transport*****:** Expand research into and knowledge of renewable energy technologies and options; and conduct research on clean energy production. Promoting alternative energy options to reduce deforestation was also identified as a research need that is linked to research on soil, biodiversity, forestry and alternative energy options.

Other research needs noted in the Initial National Communication to the UNFCC (GoA 2012) and in other sources, that are related to the above include:

- ***Assessing vulnerability:*** There is need for quantitative and qualitative vulnerability assessments to understand the impacts of climate change on public health; water resources management and hydro power set-ups; agriculture and rural livelihoods; coastal settlements (vulnerability to sea level rise); infrastructure; and food security.
- ***Meteorological information and projections:*** There is need for increased capacity for producing reliable information on climate and weather, including sea level rise to support decision making. Little capacity exists for measuring the impacts of climate variability and extreme meteorological events on key socio-economic sectors. This would rely on specific research into rainfall changes, temperature change, general climate variability and on further relating this to specific vulnerability levels in different regions. Another research interest related to the mapping of meteorological information and projections is the influence of the Benguela cold current on climate change in Angola.
- ***Accessing and drawing on community knowledge:***[13] Sharing community knowledge of climate change through oral histories in post-conflict Angola, with specific reference to the following knowledge needs:
  - Codifying indigenous knowledge;
  - **Focal areas:** agriculture, fisheries and food security, energy, forestry, gender, poverty and vulnerability, water;
  - Gathering oral histories on local-level memories of climate variability and climate change as a proxy to obtaining meteorological and other environmental data.

Related to the above, and to this mapping study overall, is the emphasis placed in Angola's Initial National Communication to the UNFCC (GoA 2012) on ***inadequate CCD knowledge*** as a major barrier to climate change adaptation and mitigation. The same document notes that there is limited understanding of and technical capacity in climate change issues and limited data availability; and inconsistencies in available data.

Workshop and questionnaire data also identified knowledge and research needs related to development and implementation of renewable energy programmes, low carbon initiatives and programmes, deforestation and forest management, biodiversity management, climatalogical conditions, and water resources management, as shown in Table 2 below. Here the following important research gaps were identified:

- Early warning processes and approaches; and
- Deforestation – to assess existing deforestation practices, develop a forestry inventory, and analyse the relationship between deforestation, renewable energy options, and climate change mitigation and adaptation.

[13] http://www.africa-adapt.net/projects/145/

Table 2: 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
1. Development and implementation of renewable energy programs (wind and solar power)	▪ Inadequate knowledge among municipalities and constructing companies on the advantages of renewable energies	▪ Lack of research on the appropriate areas for wind and solar projects	▪ Inadequate education and training on environmental issues and renewable technologies ▪ Lack of practice associated with the theory	▪ Lack of cross sectoral coordination ▪ Lack of funds to implement National Strategy on Environmental Technologies ▪ Lack of weather stations and meteorological data
2. Low carbon initiatives and programmes	▪ Lack of knowledge on the impact of traffic on climate patterns and air quality at local level ▪ Inexistence of green areas (parks and gardens)	▪ Lack of research on impact of greenhouse gas emissions on health	▪ Lack of understanding of the positive impact of low carbon initiatives ▪ Lack of specialisation in environmental landscaping	▪ Local institutions (at communal and municipality level) work in isolation and have limited funding and human resources capacity. ▪ Inadequate implementation of environmental legislation ▪ Lack of cross sectoral coordination
3. Deforestation and forest management	▪ Inadequate knowledge on the implications of deforestation for human health and pollution ▪ Lack of dissemination of the biological importance of the forests ▪ Lack of awareness of the impacts of climate change on forest resources	▪ Inadequate research on the deforestation practices ▪ Lack of forestry inventory ▪ Inadequate licensing process for timber production	▪ Lack of trained staff and awareness programmes ▪ Lack of practice ▪ Insufficient forestry development experts	▪ Inadequate funding for forestry inventory ▪ Inadequate cross sectoral and provincial coordination ▪ Insufficient participation of local institutions in the national decision making process ▪ Lack of awareness programmes

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
4. Water resources management	▪ Inadequate knowledge of vulnerability assessment tools ▪ Outdated climate change and water basin-related data	▪ Lack of understanding of the different regional vulnerabilities ▪ Lack of data on precipitation and temperature for the whole country	▪ Inadequate trained staff on early warning, forecast and agro-meteorologists ▪ Insufficient understanding of renewable energies ▪ Lack of statistical training	▪ Insufficient hydro-meteorological and weather stations ▪ Lack of institutional funding for research and implementation of weather stations ▪ Insufficient resources for hydro-meteorological stations in the main rivers
5. Study on the climatological conditions	▪ Lack of knowledge of the main adaptation techniques	▪ Insufficient surveys and research projects in the areas affected by extreme events such as droughts and floods	▪ Lack of trained staff and awareness programmes on adaptation	▪ Inadequate cross sectoral and provincial coordination
6. Biodiversity management	▪ Lack of full understanding of Angola's biodiversity ▪ Lack of mapping of biodiversity resources ▪ Inadequate understanding of land use with respect to climate variability and vulnerability	▪ Lack of knowledge on climate variability and climate change ▪ Lack of understanding of the different levels of vulnerability according to the country's regions ▪ Deficient understanding of the impact of climatic variability and extreme events on the biodiversity (fauna, flora and ecosystems) ▪ Insufficient climate models and approaches to biodiversity management	▪ Lack of individual awareness about climate change and climatology ▪ Deficient data and statistical climate sources on weather aspects	▪ Insufficient use of the climate data for decision making – i.e. systems for integration of climate data into decision making are needed, particularly at provincial level ▪ Deficient training and professional development policies that are linked to the needs for biodiversity management and climate change ▪ Lack of adequate and misuse of financial resources ▪ Lack of biodiversity management plans with climate change components

The workshop data offers a more nuanced perspective of the key capacity and knowledge needs for Angola, with the key priority areas explored. The workshop data outlined above, provides useful insight into how the CCD priorities are linked to knowledge gaps, research needs and individual and institutional capacity concerns. This analysis is taken further in section 3.3.2 and 3.3.3 below, which reflect in more detail on individual and institutional capacity gaps.

3.5.2 Needs analysis: Individual capacity gaps

Angola's National Adaptation Programme of Action (NAPA, GoA 2011b) identifies specific capacity building needs in the areas of:

- **Hydrology and Hydro-meteorology** – to assess water flows, flooding impacts and implications;
- **Geology** – to assess climate risks and adaptation responses – in areas of energy, water and soil;
- **Agro-meteorology** – to assess climate variability on agriculture
- **Epidemiology** – to assess health related risks associated with climate change
- **Meteorology and Climatology** – improved climate data collecting and weather monitoring systems;
- **Maritime Meteorology** – to understand changes in the cold Benguela stream;
- **Disaster Risk Reduction and Management and Early Warning Specialists** – to provide insight into regional vulnerabilities, and to provide adequate early warning forecasts and appropriate response approaches;
- **Coastal Zone Management** – assessments, infrastructure, sea-level rise analysis and projections;
- **Agriculture** – address vulnerability to climate change in the smallholder agriculture sector;
- **Sociology, Education and Communication** – to strengthen use of, and engagement with community knowledge in climate adaptation processes; and
- **Technology and Engineering** – to strengthen renewable energy technology use, production and expansion, as well as clean energy development approaches.

Workshop discussions also highlighted individual capacity gaps in the following areas:

- **Municipal officials / local government managers** – to understand implications of CC and advantages of renewable energy technologies;
- **Engineers and construction company project managers** – to understand the implication of CC and advantages of renewable energy technologies;
- **Environmental landscapers** – to create 'green areas' and to assist with carbon sequestration activities;
- **Forestry development experts** – to address lack of knowledge, policy and strategies for addressing deforestation;
- **Biodiversity scientists** – with expertise to map biodiversity, and analyse the impact of climate variability and extreme events on the fauna, flora and ecosystems;
- **Environmental Education / Education for Sustainable Development** – to strengthen and broaden capacity in all sectors for climate change adaptation and CC, develop

transformative teaching and learning approaches, and to engage in curriculum innovation; and

- **Statisticians –** to help with forecasts and assessments in all CCD related areas.

As the NAPA (GoA 2012) notes:

> *"Today, the need for adaptation is a fact and so there has to be a human and technical capacity to respond to the problem and it requires intervention from everybody to ensure the survival of future generations is not put at risk."*

3.5.3 Needs analysis: Institutional capacity gaps

The Initial National Communication to the UNFCC (GoA 2012) identifies a number of institutional capacity gaps in Angola for CCD. These include:

- ***Political and institutional capacity gaps*:** Limited technical cooperation between different institutions; insufficient integration of climate change into the country's legislation and plans; lack of an information management system that pulls together national data on different sectors;
- ***Socio-cultural barriers and capacity gaps***: Extreme poverty, and low levels of education and health; low levels of community awareness;
- ***Financial barriers and capacity gaps*:** Absence of economic instruments for the implementation of mitigation such as access to the Clean Development Mechanism; and low levels of investment in environmentally friendly technology development and transfer;
- ***Effective and efficient legal framework:*** that is based on an adequate understanding of GHG emissions challenges in the country; and
- ***Clean Development Mechanism project establishment and management***: Lack of capacity in the Designated National Authority (DNA) to prepare Clean Development Mechanism (CDM) projects.

In addition, the China and South-South Scoping Assessment for Learning and Development (CASSALD) (2012) identifies the ***absence of an energy policy and strategy*** that seeks to integrate energy from different sources and forms in the country.

In addition to these specific barriers mentioned in national government documents, the workshop and questionnaires identified the need for **institutional capacity** building in a range of key areas. As shown in Table 2 above, of specific concern was the issue of ***inadequate cross sectoral coordination***. Local institutions (at communal and municipality level) were seen to **work in isolation** and have limited funding and human resources capacity. In addition to this ***insufficient training programmes*** *and* ***curricula development*** at a tertiary level on climate related issues as well as the lack of **awareness programmes** were seen to reduce the wider institutional capacity in Angola, leading to other systematic gaps in management of research centres and the expansion of policies that encourage professional development in climate change and CCD. ***Insufficient financial resourcing*** was observed in the noticeable lack of implementation of National Strategies for the establishment of Environmental Technologies, weather stations and systems for capturing meteorological data, for example.

Additionally, workshop discussion revealed that while Angola has a recently established **Climate Change and Tropical Ecology Centre** established at the José Eduardo dos Santos University in the Huambo province, this centre currently lacked adequate knowledge resources, as well as adequate personnel with climate research and curriculum development skills. It also had insufficient funding and its focus and priorities were said to be insufficiently defined. It was said that the Climate Change and Tropical Ecology Research Centre tended to focus more at provincial level, and that it lacked training programmes and curricula at tertiary level on climate related issues. In addition, there was insufficient institutional capacity and experience in managing research centres, which affected the Centre's effective functioning.

4 INSTITUTIONAL ANALYSIS

4.1 Introducing the institutional analysis

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

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

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

4.2 Policy and institutional arrangements

4.2.1 Policy and institutional arrangements governing higher education in Angola[14]

Due to the protracted civil war that not only limited the development of higher education but also forced many academics to leave the country, higher education in Angola can be considered to be in its defining phase. A significant milestone is the importance that the current government is placing on higher education and the level of growth the sector has experienced (and continues to experience) in less than a decade. At the practical level, Angola has witnessed a significant rise in the number of secondary and post-secondary or vocational colleges. Starting with only two universities in 1998 – the University of Agostinho Neto (UAN) and the Catholic University – the Angolan President recently highlighted the fact that there are over 17 universities and 44 higher education institutions across the country. This has been supported with government spending over US$480 million in the establishment and running of

[14] This short summary is derived from a SARUA Country Profile compiled by Samuel N. Fongwa. 2011. "Chapter 2: Angola," in *A profile of Higher Education in Southern Africa, Volume 2* – www.sarua.org.

53 new schools and technical professional training colleges (SARUA 2009[15]). In 2012, more spending is expected by the Angolan government through the provision of student scholarships and bursaries to support the growth of higher education. The Minister of Higher Education, Science and Technology, announced that 'the Angolan government is to create 6000 new bursaries in 2012 as part of its policy to promote education'. This new figure will add to the 2 405 students who are already studying abroad (1 965 studying towards Bachelor's degrees, 146 for Masters and 294 for Doctoral degrees in different countries). On 12 September 2012 a media report indicated that the government had identified an urgent need for all Angolan citizens to participate in higher education, as this plays a pivotal role in 'harmonious' sustainable development in the country. According to the report[16], a top official at José Eduardo dos Santos University stated that:

> *"… the quality of wealth and poverty alleviation depends on the quality of education … The economic and social development of a country requires firstly to develop university education, based on a strong scientific and academic performance of students."*

He argued that the development of higher education is the responsibility of every Angolan citizen, and not merely some executives. With gender being a significant factor in higher education access and throughput, the Angolan government has taken significant policy initiatives not only to increase access for women in higher education, but also to facilitate access to scientific research and innovation. On the occasion of the 28th National Science and Technology Innovation (CTI) policy, the Minister of Higher Education, Science and Technology emphasised that the specific objective of the policy was to address "issues related to promoting and ensuring women's participation in the activities of the CTI", reiterating that this policy and new path will "open the road to increasing the number of Angolan women in scientific careers, producing scientific knowledge and enriching national scientific community at regional and international levels".

Still in a bid to situate higher education in its development efforts, Angola is hosting **the newly established Centre of Excellence for Science Applied to Sustainability** (CESSAF) (as from 2011, with the first intake of students in 2013; see institutional analysis below) which aims to graduate 100 PhDs in a ten-year period. The University of Agostinho Neto, based in Luanda, will be hosting this first African Centre for Sustainable Development research. The centre is expected to provide research and training opportunities for scientists throughout sub-Saharan Africa through expert training and sharing of cutting-edge knowledge between different countries (see further discussion below).

The Minister of Higher Education, Science and Technology also recently inaugurated a new Polytechnic in the Southern Huíla Province. Over and above the huge oil, gas and natural

[15] SARUA Handbook. 2009. *A Guide to the Public Universities of Southern Africa* http://www.sarua.org/?q=publications/sarua-handbook-2009-guide-public-universities-southern-africa

[16] http://www.sarua.org/files/Country%20Reports%202012/Angola%20country%20profile%20Eng.pdf

minerals with which the country is endowed, the Angolan government and the higher education system have made significant efforts to align their development and reconstruction process to knowledge, higher education and innovation. However, most of these efforts are initiated by different ministries and sectors and there is little co-ordination by the government through a central body or framework.

4.2.2 Policy context for climate change

Angola's National Plan of 2010-2011 (GoA 2011a) makes provision for climate change in national development. Some of its provisions are: the development of a national system of awareness raising, meteorological observation networks covering all provincial capitals, and the creation of a National Centre for awareness raising of Experts in Meteorology and Environment. The National Plan further provides for adaptation and mitigation measures in the areas of agriculture, fishing, water resources, biodiversity, construction, energy and waste management. Angola has a National Implementation Strategy for the UNFCCC and the Kyoto Protocol, with seven aims, five of which include to:

- Prepare inventories and reports about GHG emissions and their impacts on the environment and public health;
- Develop programmes and projects to mitigate the effects of climate change;
- Develop action plans to create awareness on climate change among professionals and technical people;
- Foster international knowledge and technological transfer on climate change; and
- Coordinate actions for the implementation of the UNFCCC and Kyoto Protocol commitments.

Angola's policy framework for disaster management includes the National Calamity and Natural Disaster Preparation, Contingency, Response and Recovery Plan; and the Strategic Disaster Risk Management Plan.

The new activities that have been initiated at policy level by the Ministry of Environment in 2013 include the following: second National Communication; updating the National Strategy on Climate Change; and establishment of a Technical Task Force for the development of the National Emissions Plan.

4.2.3 Institutional arrangements for climate change

The Technical Multi-sectoral Commission for the Environment (CTMA) is the Government agency with overall responsibility for all climate change policy decisions. It is chaired by the Minister of Environment and has representation from all ministries that have an impact on the environment policy. These Ministries are: Ministry of Territorial Administration (MAT); Ministry of Agriculture (MINAGRI); Ministry of Energy and Water (MINERGA); Ministry of Oil (MINPET); Ministry of Geology and Mining (MINGM); Ministry of Science and Technology (MINSCT); Ministry of Transport (MINTRANS); Ministry of Commerce (MINCO); Ministry of Fisheries (MINPES) and Ministry of Finance (MINFIN).

The Ministry of Environment is also the National Designated Authority that implements the Clean Development Mechanism (CDM). The National Commission on Civil Protection (CNPC),

which is chaired by the Minister of the Interior and is also inter-ministerial has representation of Provincial Governors, and focuses on disasters and national emergency matters. Members of the CNPC are Directors of: National Service of Civil Protection; Civil Aviation; Meteorology Institute; and Merchant Marine and Ports. The General Commander, Major General, and General of the Police, Armed Forces, and Fire Department are also part of the CNPC.

A Co-ordination Unit for Climate Change was established in 2012 by the Ministry of Environment, and the Ministry of Environment also hosts a National Commission on Climate Change and Biodiversity. The Ministry of Environment has also approved five projects as part of the Clean Development Mechanisms (CDM) which include the Angola LNG Plant, hydro power projects and reducing greenhouse gas emissions by replacing normal bulbs with more energy efficient bulbs.

***Stakeholder engagement*:** The Angolan NAPA preparation process (which was concluded in 2011) included a participatory vulnerability assessment, in which visits were made to six provinces. In each province the populations were consulted at four different levels, i.e. authorities, non-governmental organisations, private sector and the population of specific locations where greater evidence of the type of vulnerability was noticed.

4.3 Research and development frameworks

In Angola, the Ministry of Superior Education, Science and Technology is primarily responsible for research and technological developments and runs the National Technical Centre. The National Scientific and Technological Development Fund provides financial support for scientific projects and innovations. Angola is a member of the recently inaugurated Southern Africa Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL).

4.4 Some current CCD initiatives and programmes

There are a number of CCD initiatives and programmes active in Angola. This institutional analysis was only able to identify *some* of these (see Table 3 below). More comprehensive national analysis would be able to expand the insights into existing active programmes.

Table 3: Some CCD initiatives and programmes in Angola

Programme / Initiative	Driving agency / department	Focus	Status / additional comments
Promote alternative renewable energy to reduce deforestation	National Directorate on Renewable Energy and Ministry of Agriculture	Forestry, renewable energy and soil conservation	
Clean Development Mechanism projects	Approved by Ministry of Environment	Angola LNG Plant, hydro power projects, project to reduce greenhouse gas emissions by replacing normal bulbs with more energy efficient bulbs	

Programme / Initiative	Driving agency / department	Focus	Status / additional comments
Adaptation strategies, responding to the most vulnerable in rural communities	IFPR (leading); in partnership with ASARECA, FANRPAN, PIK, ZALF	2008: 2012 capacity building, community based development, policy formation and Interaction, focusing on rural areas, Agriculture Government	
Sharing community knowledge of climate change through oral histories in post-conflict Angola[17]	AfricaAdapt Development Workshop Angola	Gather oral histories on local-level memories of climate variability and climate change as a proxy to obtaining meteorological and other environmental data	Codifying indigenous knowledge Focal areas: agriculture, fisheries and food security, energy, forestry, gender, poverty and vulnerability, water
Southern Africa Regional Climate Change Programme	One World Sustainable Investments, funded by DFID and Sida	2009-2014 The programme is a synthesis of relevant climate change science, develop strategic research and strengthen science-policy and governance- finance dialogue. The programme builds an evidence base for transboundary responses to climate change.	

Note: The list in Table 3 is not comprehensive but is more illustrative of how some of the issues identified above are already being addressed.

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

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

At present, and as noted above in Section 3, climate change issues are addressed in some sectors through specific climate mitigation and adaptation priorities that are outlined in the National Strategy on Climate Change (2007; currently being updated); the General (National) Plan of the Government of Angola (2010-11, GoA 2011b); and the National Adaptation Programme of Action (NAPA 2011a). Within these, there is a clear understanding that climate change adaptation and mitigation interventions are closely tied to socio-economic development of the country.

[17] http://www.africa-adapt.net/projects/145/

Even with these policies in place, there is a need in Angola to develop a common understanding of the core issues of Climate Compatible Development (CCD) that are necessary for knowledge co-production. Discussion on the meaning of climate compatible development in the workshops centred on the core definition provided by the facilitators:

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

Contextual meanings of CCD in the daily lives of selected participants in the workshop showed some understanding of CCD yet the iterative integrative aspects of CCD were not mentioned. A representative from the UNDP defined CCD as "*Support developing initiatives that are embedded in a low carbon technologies";* A MINAMB representative understood CCD as *"Development programmes that consider a combination of adaptation and mitigation measures with a view to improving people's quality of life.*" In a similar manner, an INAMET participant considered CCD to be the *"Incorporation of resilient mechanisms to address climate change issues in all development programmes and initiatives."*

Within the Private University of Angola and the Agostinho Neto University, there were somewhat different understandings of CCD, as shown by these extracts from the questionnaire data obtained from nine university respondents:

- "Producing the minimum carbon emissions as possible. Establishing conditions for adaptation to climate change"
- "Development compatible with the climate can bring benefits and damages. Low agricultural yield due to water levels rising in the areas of fertile agricultural land, which could cause changes in the soil, which could be very clay-like, and this will hinder the production of food, etc. benefits: arid and fertile land for production"
- "Development compatible with the climate consists of development which is adapted to climate change and which does not affect the environment negatively"

Some stakeholder perceptions of CCD taken from questionnaire data, include:

> *"This is development that maintains environmental balance, or sustainable development."*
>
> *"Climate compatible development is developing while taking into account the climate and the effects on climate change."*
>
> *"Sustainable development where the impact can be outweighed by a similar investment in the environment is one example of climate compatible development."*

From this it is possible to see that although understandings of CCD differ amongst and between stakeholders and university staff involved in CCD related work, there is generally a close conceptual association between climate compatible development and **adaptation and mitigation**, and climate compatible development and **sustainable development**. It is also apparent that **the concept of CCD is relatively new** to some of the stakeholders. **Context** may also have an influence on how CCD is understood, and influences meaning making and understanding of the concept. This has important implications for knowledge co-production processes, and will require careful engagement in development of mutual understanding in such processes.

4.5.2 Current research related to climate compatible development

4.5.2.1 General view

A detailed database search of all research published on climate change / sustainable development research in Angola would provide substantive detail on what research is already being conducted in Angola. As this fell outside of the scope of this study, it is only possible to show ***some*** of the research that is currently being published on climate change in Angola.

A rapid review of published research available on Google Scholar (first ten articles listed with 'climate change Angola' in the search) shows the following research conducted on climate change in Angola. A total of six publications were found.

Table 4: First six articles listed from Google Scholar search with 'Climate Change' and 'Angola' in the search and the origin of the first author

Article	Origin of first author
Mills, Michael S.L., et al. 2011. "Mount Moco: its importance to the conservation of Swierstra's Francolin Pternistis swierstrai and the Afromontane avifauna of Angola," *Bird Conservation International* 21(2): 119-133.	South Africa
Beck, L. and T. Bernauer. 2011. How will combined changes in water demand and climate affect water availability in the Zambezi river basin? *Global Environmental Change* 21(3): 1061-1072.	South Africa
Alo, C.A. and G. Wang. 2010. Role of dynamic vegetation in regional climate predictions over western Africa. *Climate dynamics* 35(5): 907-922.	USA
Weinzierl, T. and J. Schilling. 2013. "On Demand, Development and Dependence: A Review of Current and Future Implications of Socioeconomic Changes for Integrated Water Resource Management in the Okavango Catchment of Southern Africa," *Land* 2(1): 60-80.	Germany
Speranza, C. I. 2010. "Flood disaster risk management and humanitarian interventions in the Zambezi River Basin: Implications for adaptation to climate change," *Climate and Development* 2(2): 176-190.	Angola/Germany
González-Dávila, M., J.M. Santana-Casiano and I.R. Ucha. 2009. "Seasonal variability in temperature the Angola-Benguela region," *Progress in Oceanography* 83(1): 124-133.	Spain

Only one of the primary authors listed above is from Angola, however the work itself was published from Germany. The publications focused mainly on biodiversity, water resources, temperature changes, vegetation and disaster risk management. These papers are being published in international journals, but not by Angolan authors (in the majority), and some are linked to wider, cross national macro level analyses.

Literature used to inform the Initial National Communication (GoA 2012) shows that many of the sources used for national environmental and climate change reporting, are provided by government and associated international organisations. Few sources are independently produced and published by local researchers or research groups, and where these exist, they are in the form of unpublished consultancies, often conducted with or for government departments. Within the scope of this mapping study, it was also not possible to establish how many of these research consultants are from academic institutions and/or consultancy organisations. The Initial National Communication (GoA 2012) shows the following recent[18] research-based initiatives for climate change in Angola (taken from the reference list of the INC, 2012):

- Etnias e Culturas de Angola, Associação das Universidades Portuguesas, 2009; IEA, 2011. International Energy Agency. Prospect of limiting the global increase in temperature to 2ºC is getting bleaker. IEA 30 May 2011.
- Instituto Nacional de Estatística, Inquérito Integrado Sobre o Bem Estar da População (Integrated Survey about Well-being of the Population) (Ibep) 2008-09 – Principais Resultados Definitivos, Versão Resumida, Ministério do Planejamento, 2010.
- The Need for Improvement of Mitigation and Adaptation Options on Angolan Institutions, Ministério do Ambiente, Angola, 2010.

This shows the important role that government plays in supporting climate compatible development research at present in Angola, especially to inform policy and practice responses for CCD.

4.5.2.2 University-based research

The above findings can be explained by a) the fact that climate compatible development is, in general, a new area of research, b) universities in Angola have not been established for long given the civil war history, and c) by insights from the workshop discussions where representatives from higher education institutions explained that to their knowledge there are no research projects on climate change at university level. There are a number of research programmes that deal with environmental issues but none have a focus on climate change issues specifically.

According to the participants in the workshop, governmental institutions particularly the Ministry of Environment undertake most of the climate change research work and this is

[18] In this section research conducted after 2009 is used as referent (last five years).

primarily related to policy development and implementation of the UNFCCC recommendations such as for the production of the national communications, and for NAPA.

The general comment from the participants was that little was being done in terms of research and the projects being implemented that include research initiatives are not well disseminated. Criticism was also raised due to the fact that there are very few scientific publications and reports. Participants requested incentives for publishing articles and research findings, and using electronic media (e.g. websites) when possible. Electronic copies of the questionnaire were sent to the participants so as to obtain feedback of each institution, however this did not result in any new climate change or CCD related research projects being identified.

4.5.2.3 Centres of Excellence, Centres of Expertise and Research Networks

TERMINOLOGY USED IN THIS SECTION:

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

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

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

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

Centre of Excellence

Perhaps significantly as a future mechanism for taking forward the outcomes of this mapping study, is the fact that Angola is hosting a newly formed Centre of Excellence for Sciences Applied to Sustainability (CESSAF). The centre is based at the University of Agostinho Neto which is based in Luanda. The Centre is headed by Professor Joao Sebastião Teta, and it will work closely on the project with the Newcastle Institute for Research on Sustainability (NIReS), based at Newcastle University in the United Kingdom. The two universities, the Planet Earth Institute[19] and the Ministry of Higher Education, Science and Technology will define the

[19] The Planet Earth Institute is an international NGO dedicated to building local scientific capacity and excellence in Africa and across the Global South. (www.planetearthinstitute.org). Their model of HEI support involves twinning African universities with leading universities across the world to create the skills and environment needed for advanced, PhD level training, and then establishes South-South academic axis, to leave in place a cutting edge and sustainable research centre. Plans are to link the Angolan centre with pioneering research centres in Brazil and India.

centre's academic strategy, according to the project proposal. The Centre is also backed by UNESCO.

The CESSAF's special focus will be on problem areas such as water, energy, food, natural resources and urban affairs including sustainable transport and consumer goods. It would also be a hub for research into mitigating impacts of natural disasters, and would foster scientific co-operation across Africa. These areas are aligned with the research needs for CCD outlined in section 3 above.

The NIReS centre in the UK, would work with Agostinho Neto University for ten years to develop capacity amongst African experts. The first phase involves a five-year capacity building programme to support a group of highly trained Angolan and African specialists who within five years could form a core of experts based permanently at the centre. The director of the NIReS centre at Newcastle University is Professor Paul Younger. The programme involves five to ten postgraduate scholars per year using a split-site approach to training and aims to train 100 PhDs in the next ten years, making this Angola's first major PhD programme.

Significant too for the SARUA mapping study overall, is the regional interest of the CESSAF. The CESSAF plans to set up a central database of information on African earth sciences research, and promote networking and collaboration between research centres in Africa. The Banco Espirito Santo Angola (BESA) is partnering with CESSAF to promote training and research into earth sciences in Africa.[20]

The supervision model planned for CESSAF is also interesting from a knowledge co-production perspective. The centre supervision model is one in which every PhD scholar will have three supervisors and mentors: 1) from the host university in Africa; 2) from the international support university and 3) from the corporate sector, who provide both funding for the scholarships and also a number of work placements and opportunities. Students will be pro-actively linked into relevant knowledge networks in sub-Saharan Africa, and internationally.

Centres of Expertise

There were no specific centres of expertise for CCD research identified in the workshop or the questionnaire. However a web-based search[21] and workshop discussions revealed that the José Eduardo dos Santos University (UJES) is establishing a Climate Change and Tropical Ecology Research Centre in central Huambo province, aimed at boosting the educational process of the country. The chancellor, Cristóvão Simões, announced this in February 2012 and assured that the centre will include the participation of all national academic institutions as well as foreigners who have links with the institutions of scientific research and technological development of research centres in the country.

[20] Summarised from Munyaradzi, M. and W. Sawahel. 2011. "Angola: New centre for sustainable development," *University World News. Issue 00295*, 10 November 2013.

[21] http://allafrica.com/stories/201202211296.html

Further analysis of the proposed UNDP climate resilient development programme in the Cuvelai Basin revealed that the National Plant Genetic Resource Centre (CNRF) at Agostinho Neto University as a centre of expertise. It is one of the six investigation centres of the UAN and the only one in the country that is dedicated to the recollection, classification, and collection of national germoplasm. At the national level it is linked with Research Institutes for Agriculture for the multiplication of OPV seeds, and linked with MINADERP (extension services) for distribution of already multiplied seed. At an international level, it is part of the SADC network of genetic resources centres. It has been identified as an important partner in undertaking research on climate resilient crop varieties in the Cuvelai Basin Climate Resilience project.

Development Workshop Angola (an NGO) was also mentioned repeatedly as being involved in CCD research and although they are not based at a university, they have links to a number of universities. They have offices in Luanda, Huambo, Cabinda and Lunda Norte, and they have worked in Angola since 1981. They continue to have a strong NGO presence in Angola and are involved in various forms of climate change research. They have also been identified as an important research partner in the UNDP Cuvelai Basin Climate Resilience Project, and are currently engaged in climate change research funded by the Canadian IDRC into Water and Climate Risks in Angola's Coastal Settlements. In this project they are investigating the impact of climate change and variability on water resources and infrastructure in urban informal settlements to inform policy, governance and capacity development. They also have expertise and experience in using participatory GIS in demographic and environmental risk mapping.

Research Networks

It was noted that expansive and specifically dedicated knowledge networks for climate compatible development are almost non-existent in Angola. Most of the work on CCD is done through government institutions and project platforms such as the National Adaptation Plan of Action and First National Inventory. These two projects have enabled high levels of consultation at both a provincial and national level allowing stakeholders to discuss climate change issues and engage in policy development. The work done by higher education institutions on climate change is seen to be very 'small'. This said, the workshop discussions revealed the following existing knowledge networks related to CCD that were considered accessible nationally to Angolans:

Table 5: Angolan CCD-related knowledge networks

Abbreviation	Name
REDE MAIOMBE	Umbrella Environmental NGO
ABA	Associação dos Biólogos de Angola – Angolan Biology Association
AQA	Associação dos Químicos de Angola – Angolan Chemistry Association
CEIC	Centro de Estudos e Investigação Científica
DNA	Designated National Authority for Angola
DW	Development Workshop
JEA	Ecological Youth of Angola

In addition to this the following regional CCD related research networks are also available to Angolans (not all are dedicated to CCD, but do include aspects of CCD in their overall aims):

Table 6: Angolan CCD-related research networks

Abbreviation	Name
BCC	Benguela Current Commission
EEASA	Environmental Education Association of Southern Africa
GCLME	Gulf Current Large Marine Ecosystem Programme
ODINAFRICA	Ocean Data and Information Network for Africa
SADC REEP	Southern Africa Development Community Regional Environmental Education Programme
SADC	SADC Remote Sensing Centre
SADC	SADC Drought Monitoring Centre
SASSCAL	Southern African Science Service Centre for Climate Change and Adaptive Land Management

4.5.3 Curriculum innovations and teaching for CCD

There was no information provided in the workshop or questionnaire for curriculum innovation or teaching in CCD. One respondent mentioned a Geo-physics course, however specific climate change related development was not covered in this course.

4.5.4 Community and policy outreach

Similarly no community or policy outreach was mentioned in discussions in the workshop or the questionnaires. It was noted, however, that those that had an interest in climate change and CCD were networked into the national processes of NAPA and the National Communications, but specific information was not provided.

4.5.5 Student involvement

The questionnaires and workshop data revealed no specific community involvement in climate change and CCD related outreach. Web searches[22] revealed that students at Methodist University of Angola participate in some climate change related activities such as arranging lectures on climate change and participating in activities around World Environment day.

[22] http://allafrica.com/stories/201106061219.html

4.5.6 University collaboration and networking

Researchers responding to the questionnaire and discussions in the workshop did not identify any **research networks** or examples of university collaboration. Instead they highlighted the noticeable lack of collaboration with regard to climate change research and networking. SADC REEP and SASSCAL were, however, seen to be two of the more active regional networks in Angola.

The African Monitoring of the Environment for Sustainable Development Project (AMESD) has helped to strengthen African National Meteorological and Hydrological Services to provide accurate weather forecasts, monitor extreme weather phenomena and improve disaster management. AMESD is helping to extend the use of remote sensing data to environmental and climate monitoring applications which also provides useful data and support for university researchers. They are also active in Angola, and their support is being sought for the UNDP Cuvelai River Basin Climate Resilience Programme (see Box 2 below), along with similar support from the Climate Systems Analysis Group at the University of Cape Town in South Africa, who were said to be working to provide relevant, appropriately framed downscaled projections for the entire African continent by mid-2012.

It would therefore seem that the newly formed CESSAF and the proposed climate research centre will have an important role to play in strengthening university collaboration and networking on key issues of sustainable development such as CCD.

4.5.6.1 Potential knowledge co-production partners

No specific knowledge co-production partners were mentioned in the questionnaires; however the workshop discussions mentioned the Transboundary Diagnostic Analysis (TDA) which was developed for the Okavango Basin in order to plan the future use of the water resources. For the development of this TDA a number of expert reports were developed including reports on the effects of climate change (temperature and precipitation) on the water availability. Four priority emerging transboundary areas of concern were identified by the participating countries (Angola, Botswana and Namibia) during the TDA process. The TDA recognised that there is insufficient long-term policy formulation, particularly with respect to climate change adaptation and inadequate basin-wide climate change adaptation and mitigation strategies. An important recommendation of the TDA process which fits into a CCD knowledge production framework is the development of basin-wide information management system and filling of knowledge gaps (data and information). It has also been recommended that a common methodology for assessment of reliable surface and groundwater yields be established, to include climate change scenarios and the revision of climate change scenarios and impacts.

Furthering this discussion in the workshop, although no noticeable contemporary knowledge co-production partners in Angola were identified through the mapping study, an exercise to identify the different roles of the potential different partners involved in the knowledge co-production process was undertaken. With regard to universities, the following roles were assigned:

- Produce information to support decision-making processes;
- Partner with government institutions in climate change related programmes;
- Develop contextualised approaches to adaptation and mitigation of extreme events;
- Promote linkages with government institutions by providing solutions to climate change challenges;
- Promote the integration of climate change aspects into the curricula to include impact assessment and climate change related aspects;
- Promote information dissemination and sharing on climate issues;
- Develop scientific research centres focusing on applied research and publication and sharing of research findings;
- Implement CCD programmes at provincial and regional level;
- Encourage and conduct specialised training programmes on CCD;
- Undertake ongoing collaborative research with a view to providing solutions for environmental problems; and
- Contribute to the effective implementation of CCD.

Other stakeholders and their role in working with the university sector were also explored in the workshop (see Table 7 below).

Table 7: Other stakeholders and their role in working with the university sector, as explored in the workshop

Other knowledge partners	How they can work with the university sector
Non-Governmental Organisations and Civil Society Organisations (e.g. Development Workshop, Action for Rural Development and Environment, Ecological Youth of Angola)	▪ Implement CCD projects and supporting research projects at community level ▪ Develop and implement awareness campaigns on climate change
Private sector and donor agencies (e.g. GEF, UNDP, USAID, NORAD)	▪ Provide funding for CCD projects ▪ Collaborate in awareness raising activities ▪ Introduce good environmental practices ▪ Promote knowledge transfer
Technical Commissions and Inter-sectoral Technical Groups (e.g. Biodiversity and Climate Change Commission, Civil Protection Commission, Multisectoral Technical Environmental Commission)	▪ Strengthen inter-sectoral coordination and priority identification (e.g. projects, human and financial resources) and support policy development ▪ Develop proposals to obtain funding
Government ministries and institutions (institutes) (e.g. INAMET – Meteorological Institute; INIP – Research Fisheries Institute; INE – National Statistical Institute)	▪ Develop and approve adequate legislation and policies ▪ Undertake scientific research and share the findings and results ▪ Publish and share national climate data
Higher education and research centres (e.g. public and private universities, Tropical Ecology and Climate Change Centre)	▪ Undertake scientific research and sharing the findings and results ▪ Provide valuable and accurate data for decision-making ▪ Support teaching and learning activities and curricula review by establishing partnerships with other research institutions

4.5.7 University policy and campus management

Participants from the workshops and those that completed questionnaires did not mention any university policy or campus management processes that align with climate change and climate compatible development. A web search did not surface any specific university policy nor campus management procedures in Angola.

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

4.6.1 Allocation of resources for CCD and CCD policy and policy implementation

Participants felt that specific attention should be given to building sufficient legislation on environmental issues that could be used to promote CCD across the government structures. However, to achieve this, a reskilling of human resources and sufficient funding is needed. The main recommendation was that the government, through the Ministry of Environment, should invest more time and resources in environmental awareness programmes for governmental and higher education institutions, as well as for the general public. By developing a multi-facetted process, an integrated approach would be adopted over time. Currently there are no concerted environmental awareness programmes on CCD, only some ad hoc activities, an integrated approach that brings together a variety of different stakeholders and researchers could begin to develop a more robust and accessible CCD environment.

4.6.2 Co-ordination, collaboration and improved partnership building

As indicated above, there was much discussion in the workshop on collaboration, and how collaboration could be improved, participants focused on knowledge transfer opportunities, in which publication and sharing of results and research was promoted by the university and the wider research, policy and development communities. Improved dissemination and sharing of knowledge in this way was seen to be a vital step in improving government decision making, and steps to further partnerships between universities and government departments are vital. This was also identified in the context of research partnership building, especially with larger regional research programmes.

4.6.3 Strengthen and expand understandings of CCD

As shown in section 4.2 above, CCD is a relatively new concept to some stakeholders and university researchers. Particularly the iterative approach between understandings of climate risk and development needs to be established and explored by those exploring CCD. This, as identified in the workshops and in national policy, requires new knowledge development and improved data production, sharing and management. There is a need for alternative development options that are continually responsive to changing climate change and emerging global and regional development paradigms related to climate that take into account what is happening in the region in and around Angola. Linked to this was the need to see CCD as not a static concept, but rather an emergent and evolving research area that needs to include indigenous forms of mitigation and adaptation. Vladimir Russo, former advisor to the Ministry

of Environment in Angola, and Director of Holisticos Environmental Consultancy, highlighted the following key points with regard to expanding CCD understandings:

- CCD is inextricably linked to Sustainable Development (SD);
- The emphasis of CCD is low carbon and climate-resilience development;
- CCD is framed in different ways based on local and national specific development priorities;
- CCD opens up new opportunities for new kinds of research and ways of generating new knowledge on Climate Compatibility Development;
- It is crucial to mainstream or integrate CCD teaching and research in Higher Education Institutions (HEIs); and
- Individual and community engagement for CCD are essential.

The key lesson from engagements with the concept of CCD in the mapping study, was that CCD should respond to various spatial contexts and practices but also needs to be a cross-cutting response throughout government and private sector policies. CCD should be framed based on local needs and priorities, as well as valued practices and human and technological capacities. The lack of CCD related teaching and training programmes in Angola presents an important opportunity for expanding CCD knowledge and understanding.

4.6.4 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 multi-disciplinary issue, such capacity building should take both a specialist (to develop specialist research capacity) and a multi-disciplinary approach that allows for knowledge exchange and the development of collaboration. Currently there is still an absence of institutional leadership that could provide guidance and mentorship towards improving multi-disciplinary research in this context. However, the two initiatives identified – namely the new plans to develop a climate change centre at José Eduardo dos Santos University, and the emerging programme at the Centre of Excellence (CESSAF) – provide important opportunities for CCD capacity building in future.

4.6.5 Curriculum development and curriculum innovation

As shown in the institutional analysis above, CCD does not appear to exist in university courses, although wider access to university curriculum details may reveal a different picture. Climate change does not seem to be a part of the current curriculum in universities in Angola although there are signs that it is beginning to be introduced (e.g. through interest in the establishment of the CC centre, and the CoE). There seems to be limited expertise in climate change and CCD adaptation research and subsequent curriculum development which is of great concern for Angola and needs to be addressed urgently.

Although there was no mention of this, it seems the absence of discussion regarding Angola's universities in recognising that every discipline can contribute towards issues of addressing climate change, is of concern and will need to be explored and addressed. Curriculum development was continuously repeated as a key knowledge, research, individual and institutional capacity gap for HEIs in Angola; even NAPA (2011) stresses the importance of

climate change related curriculum development and associated capacity needs required. This must be placed as a priority in future planning and strategy building for the country.

4.6.6 Research and research capacity building (including for management of research centres)

It was generally agreed in the workshops that more skilled and trained researchers at higher education level are needed in Angola, and that more research centres were needed, with adequate research management capacity. In addition to this, the identification of fora or platforms to share research methodologies, approaches and findings is desperately needed to improve knowledge transfer and the nourishment of wholesome active and engaged climate change and CCD research communities in Angola. Another major recommendation was to improve the cross sectoral coordination and partnerships between government institutions and research organisations while also improving networking opportunities with SADC centres of excellence. What is clear from this picture of Angola's overall research concerns is for a more integrated, collaborative approach, which is working towards some form of unified policy and action plan. Another general feeling from the participants was the fact that most of the information, data and climatic models are developed in English and thus there is a need for time and financial resources for developing products in Portuguese to aid local research participation, and expansion of research networks and knowledge co-production possibilities as well as use of research knowledge in curriculum innovation, policy and practice.

4.6.7 The role of university leaders

The role that university leaders play in supporting CCD research and development mostly focused on policy development which would require university wide infrastructure (legislative, financial and capacity) to promote CCD related research, and in turn improve information sharing with government as to decision making processes. University leaders were seen to be important for focussing on contextualising climate change adaptation and mitigation issues in Angola (as much research on CCD was being done by international organisations such as the UNDP who, for example, use the Tyndall Research Centre at Oxford University to produce the climate change profile of Angola[23]), and to promote linkages between other institutions (government and non-governmental) to provide workable applied solutions from this research.

As mentioned above one of the key roles assigned to university leaders was the importance of promoting the integration of climate change aspects into the curricula to include impact assessment and climate change related aspects. University leaders were seen to play a vital role in developing scientific research centres focusing on applied research and publication. Human resources skills development and capacity development was also highlighted as a core responsibility of university leaders.

[23] www.geog.ox.ac.uk/resarch/climate/projects/UNDPreports

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.[24] 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.[25]

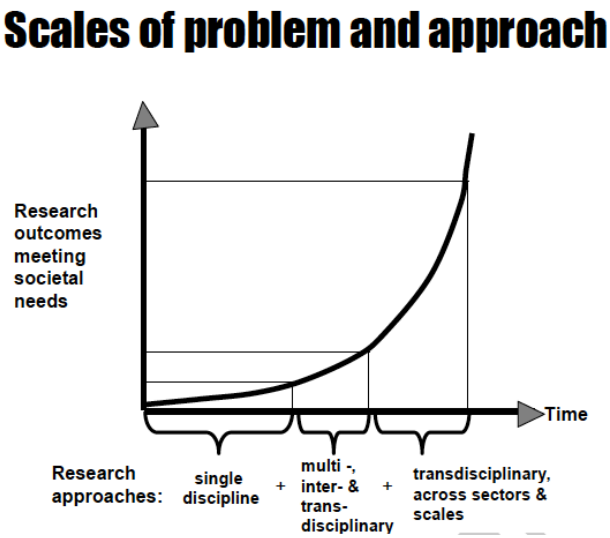


Figure 5: Research approaches

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

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

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

Researchers working with these approaches argue that research outcomes that are generated in this manner have a greater chance of meeting societal needs.[26]

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

Transdisciplinarity

This entails using strategies from interdisciplinary research, but it also involves taking this further into development of new theoretical understanding and new forms of praxis that are needed across sectors and at different scales. These are based on an inter-penetration of disciplinary perspectives or understandings, and a 'creative re-deployment' of these in contexts of practice[27]; 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 deeper into developing new and more complex ways of understanding and engagement in contexts where new forms of theory and practice come together[28] across sectors and at different scales.

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[26] 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.

[27] 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.

[28] 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.[29] 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[30]. 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

In terms of the multi-, inter- and trans-disciplinary research in Angola, participants indicated that there is very little climate change research taking place within universities that uses this approach. The workshop facilitator, Vladimir Russo, provided some examples of knowledge co-production in Angola, but noted that these approaches tended to be driven more by international organisations, NGOs, the private sector and government, and not by universities, although some university institutes are involved in these larger projects and programmes. These examples are included in Boxes 1 and 2 below.

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

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

Box 1: Ecosystem approaches to Fisheries – quotas and productivity supported by the Benguela Current Large Marine Ecosystem (BCLME) programme funded by GEF

The National Research Fisheries Institute (INIP) has been using an ecosystem approach in their research on fish quotas and productivity, particularly as part of the research activities developed under the Benguela Current Large Marine Ecosystem (BCLME). BCLME was a GEF-funded programme that was designed to improve the structures and capacities of Namibia, Angola, and South Africa to deal with the environmental problems that occur across their national boundaries, so the Benguela Current Large Marine Ecosystem can be managed as a whole. One of the most important actions of the BCLME programme with respect to environmental impact assessments is the harmonisation of national environmental policies and legislations for offshore petroleum exploration and production, dredging and mining-related activities in the BCLME region. There were a few studies on the impacts of climate change in the fish productivity and coastal economies. The outstanding issues, gaps in knowledge and steps that should be taken in order to ameliorate the potential effects of climate change were prioritised as follows:

- On the issue of inadequate data: reanalysis data-sets (e.g. SODA: Simple Ocean Data Assimilation), in which data from models, satellite and in situ observations are combined, need to be easily accessible. Global warming will require that we embrace models as well as other sources of data. A model can be thought of as a tool for integrating the data that we already have, to help reconstruct the past 50 years.
- Patterns and theory need to be brought closer together. In order to do this we need to develop the theoretical understanding, which will be elucidated by the observation of patterns.
- Integrating meteorology and oceanography more fully by coordinating the atmosphere and ocean weather/climate services will assist in resolving the bigger picture. It needs to be made known that they depend closely on one another (e.g. atmospheric/ocean interaction via heat transfer is important and the whole global warming debate rests on the different albedo and absorption effects of different types of clouds).
- Increasing the focus on research looking for thresholds, with an emphasis on biology.
- Existing data sets need to be collated, reviewed and compared with model output so as to improve and refine modelling capabilities.
- The importance of oceanography for not only fishing resources, but also for climate change (and the subsequent effects on biodiversity conservation) needs to be stressed, thereby widening the purpose of oceanography.

The BCLME programme has also recommended that a regional programme should be developed with the aim of reducing vulnerability and increasing adaptive capacity of the social-ecological fisheries systems of the BCLME, primarily focusing on: (i) establishing and/or improving national and regional interagency collaboration and communication to facilitate responses and action in relation to climate change; (ii) developing and implementing a holistic and coherent methodology for vulnerability assessment of fisheries; and (iii) developing and implementing pilot projects to develop and test anticipatory and responsive actions, providing for lesson learning/sharing and improvements. This study shows a clear need for ongoing inter- and transdisciplinary research as set out by the BCLME programme.

Box 2: Climate Resilient Development and Enhanced Adaptive Capacity for Disaster Risk in Angola's Cuvelai Basin (supported by UNDP and the Ministry of Environment in Angola)

The United Nations Development Programme (UNDP) in Angola in collaboration with the Ministry of Environment is preparing a programme focusing on climate-resilient development and enhanced adaptive capacity for disaster risk in Angola's Cuvelai River Basin. This programme is to be funded by GEF and will deal with the theme of climate adaptation and resilience in Angola and strengthening adaptive capacities to reduce risks to climate-induced economic losses and to the ongoing disaster risks associated in the Cuvelai River Basin, where populations on the Angolan side of the river are particularly vulnerable. This project will involve the following inter- and transdisciplinary knowledge production activities (in addition to a variety of implementation interventions, not listed here), and will include multiple partners including the Ministry of Environment, the National Directorate of Hydrological Resources in the Ministry of Energy and Water, the Ministry of Agriculture, Civil Protection, the National Plant Genetic Resource Centre (CNRF) at Agostinho Neto University, the National Institute of Meteorology and Geophysics, UNDP, the World Bank, and Development Workshop Angola (a local NGO):

- Establishment of a comprehensive famine and flood early warning system (FFEWS) which will require downscaled seasonal forecast delivery systems that take into account climate change induced drought and flood events in the basin;
- Procurement and installation of satellite monitoring equipment to receive real time climate and environmental information (via a geospatial flood map) for authorities in the Basin;
- Procurement or rehabilitation of at least two hydrometric stations in the Basin;
- Livelihoods assessments conducted of the spatial density and location of all smallholder farming communities on the Angolan side of the Basin that are vulnerable to climate impacts;
- Establishment of online registry of vulnerability data and population density from assessments noted above;
- Identification of locally appropriate, climate-resilient germplasm resources for the basin from the National Plant Genetic Resources Centre (CNRF) database;
- Establishment of at least three demonstration plots in the Basin for climate-resilient crop varieties;
- Case studies developed and disseminated that capture traditional knowledge about climate change at the local level; and
- Development and annual dissemination of micro-seasonal maps of adaptability of different climate resilient crops to all Provincial rural extension agents.

The programme also includes capacity building plans for Provincial Government Officers, and all Civil Protection officials in the province; and village level awareness raising campaigns in 300 sites. The project aims to respond to some of the data gaps and a finding from one USAID/Southern Africa report which states that the Cuvelai Basin is likely to be more vulnerable to climate disasters (mainly increased flooding) than any other area in the entire SADC region. The Cunene province (in which the Cuvelai basin is located) is one of the poorest provinces in Angola, with the great majority of livelihoods in the province being subsistence-oriented, dependent on rain-fed agriculture.

The Government of Angola is currently supporting a range of baseline analyses for this programme which include:

- Investments into Disaster Risk Reduction staff and longer-term infrastructure;
- Development Workshop (NGO) and International Development Research Centre (IDRC) project on water and climate risks in Angola's coastal settlements; and
- Angola Water Sector Institutional Development Project (funded by World Bank).

This project therefore presents an excellent opportunity for Angolan researchers to develop in-depth understanding of the processes and content of inter- and transdisciplinary approaches to research. It potentially also provides an excellent site for such study at a SADC regional level too.

As can be seen from the above examples in Boxes 1 and 2 (presented here in summary only) these research programmes can provide important national case studies of inter- and transdisciplinary approaches to CCD knowledge co-production in Angola. In reading the documentation on the projects and programmes it was noticeable however, that much of the expertise for the projects and programmes is 'brought in' via the large scale donors and the UN organisations, and that while capacity building is given attention, it is normally direct implementation capacity. Not much attention is given to building lasting capacity within the higher education system for taking forward the innovations in data production and management for CCD that are used and established via the large scale development project. To address this, the Ministry of Higher Education, Science and Technology could potentially establish a 'CCD knowledge transfer / capacity building project' in which knowledge and new forms of capacity for CCD produced by other sectors and large scale development partner initiatives are explicitly transferred and shared into the national system of education and training in ways that support research development and curriculum innovation.

Workshop stakeholders indicated that there are several constraints that need to be overcome in order for such approaches (inter- and transdisciplinary) to be successfully used in Angolan universities, and there needs to be a focus on:

- Developing more skilled and trained researchers at higher education level;
- Identifying a fora or platform to share research methodologies, approaches and findings;
- Improving cross sectoral coordination and partnerships between government institutions, donor organisations that are driving research innovations such as those reported on in Boxes 1 and 2, and research organisations; and
- Improving networking opportunities with SADC centres of excellence.

It was also agreed that an important way to foster multi-, inter- and trans-disciplinary research is through regional research programmes such as the Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL), and through learning from and with the large scale development programme initiatives such as the UNDP Cuvelai River Basin Programme, as these are knowledge intensive programmes, that are informing direct adaptation actions and capacity building.

SASSCAL is a joint initiative of Angola, Botswana, Angola, South Africa, Zambia, and Germany, responding to the challenges of global change. The establishment of a Southern African Science Service Centre for Climate Change and Adaptive Land Management is being proposed to create added value for the whole southern African region. It was noted that SASSCAL initiatives, and initiatives such as the one promoted via the UNDP / Ministry of Environment in the Cuvelai basin, should be embedded in regional and national research activities. SASSCAL's mission is to conduct problem-oriented research in the area of adaptation to climate and change and sustainable land management and provide evidence-based advice for all decision-makers and stakeholders to improve the livelihoods of people in the region and to contribute to the creation of an African knowledge-based society. The UNDP programme mentioned above in Box 2 has the intention of producing new knowledge, data and information relevant to inform on-the-ground adaptation and DRR practices. It is clear that such large scale research

initiatives can provide a platform for enriching university engagement with CCD knowledge production processes.

The following recommendations were agreed by all the participants and were directed to Governmental institutions in order to meet the challenges of CCD. Government should provide support to CCD by defining policies on the implementation of mitigation and adaptation measures as well as by providing funding more scientific research, and should also have a clear strategy to enhance national research capacity to contribute to its development programmes and plans. This approach will result in positive implications such as:

- Poverty reduction;
- Regional integration of different CCD programmes;
- Strengthening of the multisectoral capacity and coordination;
- Improvement in the education system policies; and
- Optimisation of resource use between the different sectors.

6 SUMMARY AND CONCLUSION

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

6.1.1 Context that frames needs

Angola has an already well-established warming trend, with surface temperatures having increased by between 0.2 to 1.0°C between 1970 and 2004 in the coastal areas and northern regions; and between 1.0 and 2.0°C in the central and eastern regions. Rainfall information is unreliable as only 20 of the 500 rainfall stations are functional. Climate models indicate that there will be a rise of 3.0 to 4.0°C in the surface temperature of Angola in the east, and a slightly smaller increase in the coastal and northern regions in the next 100 years.

Within this context, the mapping study needs analysis for Angola revealed that while some progress has been made in identifying research and capacity needs in broad terms, the status of CCD knowledge and research is inadequate for the responses that are required. According to Angola's Initial National Communication to the UNFCC (GoA 2012), a major priority that cuts across all sectors is the need to generate information and knowledge for all adaptation and mitigation priorities that have been identified so far. In this regard, the findings of the needs analysis could be helpful in the updating of the National Strategy of Climate Change (currently in process) and in preparation of the Second National Communication to the UNFCC (also currently in process).

Consistent with the socio-economic context and Angola's post-conflict status, overarching barriers to adaptation indicated in all three data sources include poor quality information and knowledge of the nature of climate change risks and appropriate adaptation, mitigation and CCD responses; limited research engagement with these issues; low levels of technical capacity; and insufficient financial resources to address climate change adaptation and mitigation challenges. The workshop responses identified a range of cross-cutting needs for responding better to CCD, amongst which are capacity development, enhanced and better resourced and managed research institutions, curriculum innovation, and mainstreaming of CCD into national policy and implementation practices. Additionally a need was identified to create platforms where climate change research and development initiatives undertaken by the UNDP and donor organisations could be shared into the higher education system to inform curriculum innovations. A further need was for more climate related information in Portuguese, as most climate information is being produced in English.

6.1.2 Broad adaptation and mitigation needs

There is broad agreement amongst the data sources used to compile this mapping study report (mainly documents and workshop data as questionnaire responses were limited) on the *broad priority focus areas for adaptation* – namely, water resources management, agriculture and soil erosion management (as these relate to food security, especially in rural areas), sea level rise, biodiversity and forests, human health, and human settlements. Core to all these is the need for improved meteorological data and capacity. These reflect the climate

vulnerabilities of Angola, especially for its majority rural populations. The data sources also agree on *broad mitigation priorities and needs,* which encompass measures related to improved transport systems, use of renewable energy resources, waste management and forestry to reduce deforestation. Policy emphasises energy and transport, waste and forestry mitigation measures. In particular, workshop data emphasised renewable energy development (wind and solar) and forestry practices that reduce deforestation. Angola is an oil rich country, and workshop participants identified the need for clean technology development as a further mitigation need, a need that is also articulated in policy. Policy also suggests the need to seek ways of developing renewable energy technologies and of developing use of natural gas in place of oil.

6.1.3 Specific knowledge and research gaps

Workshop participants felt that there was sufficient legislation on environmental issues that could be used to promote CCD across government, business and civil society structures. However the lack of skilled human resources was repeatedly noted in CCD areas such as water management, climate related health risk assessment and management, infrastructure adaptation planning and implementation, disaster risk reduction and management, and biodiversity assessment and management (in both workshop and policy data). These were the most regularly cited areas requiring specific research and knowledge development related to adaptation. Mitigation knowledge and research needs focused primarily on renewable energy and clean technology research, transport and forestry research and development. Underpinning these adaptation and mitigation research and knowledge needs are additionally critical research and knowledge gaps. These include: assessing vulnerability (especially local-level vulnerability mapping) and providing more accurate and expansive meteorological information and projections (observational data to underpin climate assessments and vulnerability on water resources, agriculture, biodiversity, sea level rise and infrastructure planning, and human health). Accessing and drawing on community knowledge was identified as an important adaptation and CCD priority, given the high dependence on subsistence production in rural areas, and the high levels of poverty experienced in these areas.

6.1.4 Cross-cutting needs

Key cross-cutting needs are the need for improved co-ordination across sectors within government and implementation partners, improved awareness raising and capacity development, and platforms for knowledge sharing, and production of climate knowledge in accessible languages and forms (Portuguese knowledge resources were emphasised a number of times). Inadequate funding for responding to CCD priorities was also repeatedly noted. Cross-cutting educational concerns involved the lack of climate change education programmes in universities, and the lack of curriculum innovation for CCD related concerns. Similarly there was concern about the lack of postgraduate programmes that focus on CCD issues, and very little professional development of existing university lecturers and educators to engage with CCD concerns. Low levels of research capacity for CCD-related issues also reflect a need for research capacity development.

6.1.5 Individual capacity needs

Individual capacity needs were identified in policy documents and in workshop discussions as a lack of specific skills related to: Hydrology and Hydro-meteorology; Geology; Agro-meteorology; Epidemiology; Meteorology and Climatology; Maritime Meteorology; Statisticians; Disaster Risk Reduction and Management and Early Warning Specialists. All of these are related to observation, modelling, and analysis of climate related data. Other individual capacity gaps were relevant to environmental management activities such as Coastal Zone Management; Agriculture and Climate Risk Management; Local Government Environmental Management; Environmental Landscapers and Forestry Development Experts and Biodiversity Scientists. Technology development related scarce skills were identified in the following areas: Clean Technology and Engineering; and Engineers and Construction Company Project Managers with climate resilience knowledge and skills. From a social change perspective, the following scarce skills were identified: Sociology, Education and Communication specialists with special reference made to Environmental Education / Education for Sustainable Development specialists.

6.1.6 Institutional capacity gaps

Specific institutional capacity gaps emerging from documentation and the workshops show an overall lack of institutional capacity on climate change issues, which is not surprising for a post-conflict country in which few people were able to access tertiary education. There is consensus across the data that there is a need to substantively strengthen capacity for information and research development for CCD, and to develop appropriate knowledge sharing platforms between universities and other research-based stakeholders, especially international organisations supporting innovative forms of CCD research. The lack of an adequate national research infrastructure, and research funding is another issue that urgently needs attention to expand climate change research capacity in Angola. There was a need identified for improved political and institutional capacity for enabling technical cooperation between different institutions; and for integrating climate change into the country's legislation and plans. There is also a lack of an information management system that pulls together national data on different sectors; and there are socio-cultural barriers and capacity gaps, especially related to communications and learning in and from rural areas. Financial barriers and capacity gaps as well as insufficient financial resourcing were also identified as a key institutional capacity gap. Lack of an effective and efficient legal framework; and lack of capacity in the designated national authority to prepare Clean Development Mechanism (CDM) projects were also identified as institutional capacity gaps. It was further noted that Angola does not have an energy policy and strategy. Additionally, local institutions were said to work in isolation, and that in general, there were insufficient training programmes and education and training expertise to develop curricula and teach new programmes related to CCD.

Co-production of knowledge and its reliance on improved cross-sectoral institutional capacities can be seen as a significant area of concern for Angola. How this knowledge is shared, and how research is responded to by decision makers, was of particular concern among workshop participants. These specific knowledge and research gaps pose particular relevance for the implementation of the future National Climate Change Strategy and Action Plan for Angola (in

development in 2013/14), which relies on research and knowledge (co) production processes, and this section of the mapping study for Angola has shown that it would be important that the diversity of these knowledge needs should be well articulated in such policy at a suitable level of detail. As indicated by a policy advisor to the Minister of Environment:

> *"Climate change is not only an environmental problem, but a problem for socio-economic development."*

6.2 Synthesis perspective on the institutional analysis

As noted above, there are numerous, complex knowledge, research, individual and institutional capacity needs expressed by stakeholders and university staff themselves. Of greatest significance is the obvious lack of institutional capacity for CCD in the country which, as mentioned above can be explained by the fact that the country is in a post-conflict period, CCD research is a new area of research, and universities have not been established for long in Angola as a result of the disruptions created by the war. The institutional assessment has shown that climate change research is a very new area of research and development in Angola, and that most progress so far has been in initial policy development. The institutional analysis shows that very few Angolan university professionals appear to be engaging in CCD research. It was said that more established forms of research related to CCD could be found in environmental sciences and related fields, but even within these more established fields, little CCD related research was taking place. The Government is playing an important role in initiating and also conducting CCD related knowledge, but this is not 'carrying through' into HEI research programmes or curriculum innovations at present. The general comment from the workshop was that very little was being done in terms of research for CCD, those projects that were being undertaken are not well disseminated or shared, and the number of scientific reports and publications are very limited.

The institutional assessment revealed that there were few courses focusing on CCD in teaching programmes, and this was linked to a lack of curriculum innovation capacity, and lack of appropriate and adequate materials in Portuguese, as well as professional capacity of university staff members who were generally also overloaded with large undergraduate teaching programmes. It was further noted that expansive and specifically dedicated knowledge networks for CCD are almost non-existent in Angola as most of the work on CCD is done through government institutions and project platforms such as the National Adaptation Plan of Action and the First National Inventory. Encouraging however, is the fact that these platforms have allowed for high levels of consultation at both provincial and national levels, allowing stakeholders to discuss climate change issues and engage in policy development. There are, however, a range of affiliated or associated knowledge networks that can form a basis for CCD related knowledge networking (outlined in the table in Appendix E).

The Angolan institutional assessment also revealed that there are *new institutions and programmes emerging* that can potentially provide strong platforms for CCD knowledge co-production in future. These are the newly established Centre for Climate Change and Tropical Ecology, a newly established Centre of Excellence for Sustainable Development Research and a newly funded large scale UNDP climate resilience development programme (that is research-

led, linked to the university, using knowledge co-production approaches) – see table in Appendix E. However, these institutions require capacity building, as indicated by research participants who commented on the lack of resources, capacity, research planning and scope and focus of the Climate Change and Tropical Ecology Research Centre which is only newly established.

No active student based centres with potential for enhancing knowledge and awareness of climate change and CCD were identified in Angola, except for the NGO Ecological Youth of Angola (JEA) which works with some university students, but in an independent NGO capacity.

Stakeholders and university professionals in Angola showed a clear understanding that CCD was closely related to both adaptation and mitigation and sustainable development. The institutional analysis also revealed that amongst the university community no examples of transdisciplinary research could be identified. However, at a broader level two examples of transdisciplinary research were identified but these were being spearheaded by international organisations and large research networks (Benguela Current Commission and the UNDP). A key finding of the institutional analysis was that there was a need for knowledge exchange platforms between universities and such large scale programmes. Workshop participants recognised the potential role of regional organisations such as SASSCAL and SADC centres for providing capacity building support in Angola.

The institutional assessment has shown that there is an urgent need for capacity building in CCD related matters amongst the Angolan research community. As shown above very little is happening in the area of CCD teaching, research, community and policy outreach in universities in Angola, and there is a strongly and clearly articulated need for support in this area, both from within policy which emphasises the need for research, and amongst stakeholders and practitioners. There is a need for basic disciplinary capacity development for CCD research, as well as for more innovative and expansive forms of transdisciplinary research and teaching.

The institutional assessment has also highlighted that it is extremely important for universities in Angola to become more strongly engaged with issues of CCD knowledge co-production concerns, so that they can be located within key climate change dialogues, and so that they are able to better support and inform policy and CCD practice. Key areas identified for Angola include curriculum development and innovation, research institution capacity development, individual professional development and research competence development, knowledge sharing, and community and policy outreach.

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

Considering the workshops and questionnaires, as well as other data sets *in relation to each other,* one can begin to map out a CCD capacity development pathway/s for Angola. **One example** is offered here (Table 8). More examples associated with CCD priorities can be further developed based on the identified CCD needs in this mapping study and in national policy.

Additional knowledge, research and capacity development pathways can be developed as also shown in the UNDP Cuvelai River Basin Climate Change Adaptation Programme (Box 2), and the BCLME programme (Box 1), where a situational focus is taken as starting point, and from where knowledge and research gaps, individual capacity gaps and institutional capacity gaps are used to develop integrated frameworks for knowledge co-production and use.

Table 8: CCD Knowledge, Research, Capacity Building and Institutional Capacity Gap Analysis for one of the Angola's CCD priorities: Water resources management

CCD priority	Knowledge and research gaps (research agenda)	Individual capacity gaps (education and training agenda)	Institutional capacity gaps (institutional development agenda)
Water resources management	Observation, modelling and hydro-meteorological research: ▪ Consolidate and produce data on precipitation and temperature for the whole country ▪ Mapping and modelling of areas affected by extreme events such as droughts and floods ▪ Improve water basin related monitoring data Vulnerability assessments: ▪ Conduct vulnerability assessments in areas identified as being affected by extreme events and droughts ▪ Assess the potential of increased water flows on hydroelectric plants Adaptation research: ▪ Identification of appropriate adaptation responses ▪ Early warning systems research ▪ Disaster risk reduction research Technology and Infrastructure research: ▪ Engineering research to inform improved infrastructure development and management of hydroelectric plants in areas prone to flooding	Research scientists: ▪ Inadequate trained staff on early warning, forecast and agro-meteorologists, hydrology, geology and Integrated Water Resources Management (including trans-boundary water management) ▪ Few water engineers that have CCD knowledge ▪ Lack of statistical training and modelling capacity Rural communities: ▪ Lack of awareness and capacity for disaster risk reduction and adaption to extreme events such as droughts and flooding Government officials: ▪ Training in CCD data interpretation, sustainable development planning, and cross-sectoral and provincial co-ordination University leaders / university professionals and curriculum developers: ▪ Lack of training programmes and curricula a tertiary level on climate related issues; integrated water resources management; CCD related engineering ▪ Research centre management and institution building	Observational and monitoring infrastructure: ▪ Expand existing hydro-meteorological and weather stations, especially on main rivers Resourcing: ▪ Allocate institutional funding for research, regular observation, monitoring and modelling, and for capacity building for these research activities ▪ Provide adequate resources for implementation of programmes of work in the hydro-meteorological weather stations, especially on main rivers Cross-sectoral co-ordination and systems management: ▪ Improve cross-sectoral and provincial coordination ▪ Engage in systematic approaches to priorities identification ▪ Expand provincial level focus to include broader systems view Research centre development ▪ Government to invest in capacity building for research centre management

The analysis such as the one modelled above, can be developed for all major CCD priorities, and should ideally form part of national climate change policy development. Such an analysis provides a starting point for knowledge co-production at a national level.

Angolan researchers are beginning to engage with CCD, although most research is funded and initiated and supported by government (there is very little evidence of independent research). New institutions are forming for this purpose however, and stakeholders and researchers participating in this mapping study have identified the possibilities that lie in regional partnerships for CCD research with southern African institutions such as SASSCAL, and the SADC REEP although these are not as yet particularly strongly developed. The strongest influence in CCD research in Angola at present – other than government research – appears to be donor funded initiatives, especially those supported by UNDP and GEF. A key finding of this mapping study is that the existing expertise base needs to be significantly expanded and supported in more strategic ways – also in ways that can strengthen HEI participation in CCD research – since the knowledge co-production challenges for CCD are vast and complex, and the responding capacity for research is clearly inadequate at present.

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

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

- Further consolidate the national knowledge co-production analyses based on the needs and institutional analyses in this Country Mapping Study, and as modelled in the example above (Table 8), to guide further action at country level.
- Support and expand the capacity of the CESSAF Centre of Excellence and other research institutions. Develop a 'capacity pathway' for strengthening individual research competence, so that individual interest and research capacity can grow into a 'node of expertise' and then into a 'centre of expertise', and potentially in future, a Centre of Excellence. Strategic policy support from the climate compatible development policy community, and the Higher Education community will be needed to facilitate such capacity building pathways in Angola, especially to build research capacity, and curriculum innovation capacity, and to link up various CCD research initiatives that are occurring under the auspices of government and development programmes with university research and research capacity building.
- Improve co-operation, communication and shared access to data at all levels and maximise potential knowledge exchange and co-operative research opportunities with national and regional research organisations that are focusing on CCD.
- Develop motivation and incentives for researchers, especially for engaging in multi-, inter and transdisciplinary research approaches. Support capacity development of researchers in these areas and create mechanisms that allow existing researchers to learn from new approaches to inter- and transdisciplinary research as modelled in national development case studies (e.g. UNDP programme).

- Strengthen research partnerships and research infrastructure, including research funding and incentives for students.
- Support curriculum development capacity, and curriculum innovation to mainstream CCD into existing courses and programmes.
- Strengthen existing policy and community outreach activities within a knowledge co-production framework and develop monitoring tools to make the impact of such work visible within the university system, and seek ways of incentivising engagement with policy systems and communities.
- Develop campus management policies and practices that engage students in CCD issues, and that also model solutions and provide demonstrations of CCD learning pathways.

The large scale research and development programmes being undertaken with support from UNDP, GEF, USAID and other major donors in partnership with various Ministries and development organisations potentially provide a significant platform for enhancing knowledge of CCD related issues, and knowledge co-production processes, as the research being undertaken within these large scale projects is inter-disciplinary, and is also tied to application and implementation programmes and processes. However, platforms will need to be explicitly created for such knowledge sharing to take place. Many of the institutions that are set to strengthen university capacity for CCD research are still in their infancy e.g. the proposed climate research centre at José Eduardo dos Santos University, and the emerging programme at the Centre of Excellence (CESSAF). These, however, provide important opportunities for CCD capacity building in future.

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

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

Climate Change and CCD research and teaching in Angola seem to currently be insufficient and under resourced. While there are also some interesting networks accessible in Angola and emerging centres such as the Centre for Climate Change and Tropical Ecology Research, there do not seem to be any specific areas of 'major' strength identified in Angola as yet, although the CESSAF at UAN promises to become an important Centre of Excellence that can support CCD research and knowledge co-creation as this relates to sustainable development. The National Plant Genetic Resource Centre, also at UAN, potentially offers expertise that can be shared and/or learned from at a regional level, especially related to crop diversification research for improved resilience.

Another important programme taking place in Angola, will be the UNDP / Ministry of Environment Cuvelai River Basin Climate Change Adaptation Programme as it offers a 'model

project' for other SADC states concerned with adaptation, vulnerability and disaster risk reduction amongst rural subsistence communities. Especially the knowledge production systems, data production and management, and capacity building initiatives will be of wider value for CCD knowledge co-production at a regional level. Other regional knowledge exchange initiatives that are already taking place (e.g. via SASSCAL and SADC REEP) should also be strengthened and expanded.

APPENDIX A: WORKSHOP ATTENDANCE LIST

List of participants at the Angola Workshop, 2 October 2013
University Campus, Camama: Agostinho Neto University

Name	Department/ Faculty/ Organisation	Designation	Contact number	Email address
Januário André	UKB – Instituto S.CEB - Sumbe	Nature Science – Head of Department	923704717	januario1973@gmail.com
Eduardo Ferdinand	Holísticos	Environmental engineer	925753914	eduardo.ferdinand@holisticos.co.ao
Botha Kruger	HEMA	Director	+27834637045	botha@futurelead.co.za
Amaya Olivares	PNUD	Programme specialist – GEF	925214084	amaya.olivares@undp.org
Laura Devos	PNUD	Programme officer	919118081	laura.katirayi.devos@undp.org
Fernanda Neves	UPRA	Civil engineer – Head of Department	923602416	nandoneves@hotmail.com
Nelson Lopes	MINAMB	Staff	923378759	nelsonlopes@hotmail.com
Maida Luís Gomes	INARH	Staff	+244925608582	maia_luia@msn.com
Bomba B. Sangolay	INIP/Min. Pescas	Head of Department	+244930000416	bsongolay2001@yahoo.com.br
Luís Constantino	MINAMB	Advisor	923735952	luconsta@hotmail.com
Marcial Catinda	Faculdade de Ciências	Professor	929300999	marcialcatinda@gmail.com
Georgina Van-Dúnem	Universidade Católica de Angola	Professor	927177624	georginav_27@yahoo.fr
Lopes Baptista Morais	Reitoria/UAN	Staff	923895287	lopesbaptista08@gmail.com
Nádia Afonso	Holísticos	Staff	928227455	laricias@hotmail.com
Edna Ilídio	Holísticos	Staff	916530482	edna.ilidio@msn.com
Manuela Pedro	Centro de Botânica	Researcher	923512749	manuelapedro1@hotmail.com
Mário Pedro	UMA	Professor	923418390	mario@hotmail.com
Sebastião António	UAN	Professor	925604836	sebastiao_antonio@yahoo.com.br
Domingos Nascimento	INAMET	Head of Department	923600138	donascy@yahoo.com.br

Name	Department/ Faculty/ Organisation	Designation	Contact number	Email address
Jonês Mazumbua António	Faculdade de Ciências	Student	923630789	primomazumbua@hotmail.com
Miguel da Rocha Lango	Faculdade de Ciências	Student	923797058	miguel_iango@hotmail.com
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Bage Famorosa	Faculdade de Ciências	Student	923383110	BAGE-ENIGIMAS87@hotmail.com
André José António	Faculdade de Ciências	Student	917076683	
Maria António	Faculdade de Ciências	Lecturer	923804157	
Gregório Catraio	Faculdade de Ciências	Student	926552104	
Domingos Ventura	Faculdade de Ciências	Student	934197124	
Aldair Tala	Faculdade de Ciências	Student		
Sílvio Massango	Faculdade de Ciências	Student	924254439	
Muanda Bernardo	Faculdade de Ciências	Student	921499068	
Belarmina E. Paxe	DNA/MINAMB	Staff	923272942	belarminapaxe@yahoo.com
Adriano Jorge	DEI: Química	Student	932551895	
Alves N. Carlos	DEI: Engenharia Geográfica	Student	921880050	alves-loalves@hotmail.com
Domingos Vezua	DEI: Geofísica	Student	927383945	
Adilson Samba	Engenharia de Minas	Student	947602652	
Domingos Cadete	Engenharia Geográfica	Student	931609853	
Alcino Jorge	Engenheira Geográfico	Student	935315497	alcinoclauvithes@hotmail.com
Amilton S. Gaspar	Engenharia Geofísica	Student	929825742	Amiltongaspar@hotmail.com
Damião Miranda	Engenharia Geofísica	Student	927777526	
Mfinikina C. Paulo	Engenharia Mecânica	Student	935079682	mfinikinacapitao@hotmail.com

Name	Department/ Faculty/ Organisation	Designation	Contact number	Email address
Helga Silveira	Development Workshop	Researcher	923685713	sofiahelga@gmail.com
Domingos Utari	Faculdade de Ciências	Student	939350674	
Job Alexandre	Faculdade de Engenharia	Student	949930204	
Catarina Dias	MINAMB	Staff	923316976	cdiascand@angola.net
Vladimir Russo	Holísticos	Facilitator	939401303	roquerusso@nexus.ao
Sílvio dos Prazeres	Engenharia	Student	923038365	silviodosprazeres@hotmail.com
Africano Agostinho	Engenharia	Student	936862507	cabuloy@hotmail.com
João Ananias	Engenharia	Student	929394038	
Simão Jorge	Staff superior	Staff	923333618	sinfjorge@hotmail.com

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

Note: This list is based on information provided in the country workshop and from completed questionnaires, and is possibly incomplete.

Table 9: Active researchers contributing to CC/CCD related research activities in Angola

Name of person	Department/ Area of expertise	Institution	Email
CLIMATE			
Domingos Nascimento	Climate monitoring and change assessment	Instituto Nacional de Hidrometeorologia e Geofisica (INAMET)	Domingos.nascimento @inamet.gov.ao
Francisco Osvaldo	Climate monitoring and change assessment	Instituto Nacional de Hidrometeorologia e Geofisica (INAMET)	Francisco.neto@inamet .gov.ao
Vladimir Kiluange Agria Russo	Impact of fire on climate change	Holístico-Ambiente	vladimir.russo@holistic os.co.ao
Miguel José	Scenario development	Instituto Nacional de Hidrometeorologia e Geofisica (INAMET)	Miguel.jose@inamet. gov.ao
Lopes Ferreira Baptista	Improved data base on water quality and quantity (incl. maps)	Agostinho Neto University- Science Faculty (FCUAN)	lfmaioral@yahoo.es
Manuel Quintino	Improving hydrological and hydro-geological monitoring network and exploration (also on transboundary resources)	Direcção Nacional de Recursos HÍdricos	quintinos@nexus.ao
Helder André de Andrade e Sousa	Remote sensing application for floods and water resources	Agostinho Neto University- Science Faculty (FE)	helderdandradesousa@ gmail.com
Ana Bela Leitão	Recycling, sanitation and water treatment	Agostinho Neto University- Science Faculty (FE)	
João Sebastião Neto	Improving water use efficiency (leakages management)	University José Eduardo dos Santos - FCA-UJES	amfor_2000@yahoo.es
FORESTRY			
Domingos de Nazaré da Cruz Veloso	Improving forest (including dryland forests) resource assessment including socio-economic baseline data	Direcção Nacional de Agricultura, Pecúaria e Florestas (DNAPF)	

Name of person	Department/ Area of expertise	Institution	Email
José Mutula	Improving forest monitoring programme (incl. field assessments; vegetation productivity) (of functional changes: rates of deforestation, afforestation, re-afforestation of different forest types)	Direcção Nacional de Agricultura, Pecúaria e Florestas (DNAPF)	
Carlos Avelino Manuel Cadete	Socio-economic and environmental value of natural forest for rural livelihoods (incl. wood consumption, non-timber products)	GEPE-Ministério do Ambiente	carloscadete@hotmail.com
Virginia Lacerda Quartin	Forest regeneration, growth rates, threats and trends in different forest types	University José Eduardo dos Santos - FCA-UJES	vmalacerda@hotmail.com
Mateus Sidónio	Impacts on forest ecosystems (fire, wildlife, invasive plants, pests, pathogens, anthropogenic impacts, climate change)	Direcção Nacional de Agricultura, Pecúaria e Florestas (DNAPF)	
AGRICULTURE			
Domingos Lucano	Developing and improving integrated national and seamless regional land use assessment (spatial, socio-economic, land use, soils, vegetation)	Direcção Nacional de Agricultura, Pecúaria e Florestas (DNAPF)	domingoslucano@hotmail.com
António Manuel Teixeira	Monitoring agricultural ecosystems with regards to climate change effects (land degradation, crop phenology, soil, pests	University José Eduardo dos Santos - FCA-UJES	ateixeira33@yahoo.com.br
Ambrósio Furtunato de Almeida	Processing understanding and dynamics in agriculture (e.g. temperature-related pest migration)	University José Eduardo dos Santos - FCA-UJES	amfor_2000@yahoo.es

Name of person	Department/ Area of expertise	Institution	Email
Rodrigues de Oliveira Major	Impacts on agricultural ecosystems (pests and pathogens, climate, tenure, management strategies, floods)	University José Eduardo dos Santos - FCA-UJES	gjgpereira@gmail.com
Aderito Cunha	Developing models and prediction in relation to sectoral development activities and land use changes	ISPKS- High Politechnick Institut of Kwanza Sul	gjgpereira@gmail.com
Guilherme José Gonçalves Pereira	Food security	University José Eduardo dos Santos - FCA-UJES	gjgpereira@gmail.com
Imaculada Conceiçao Ferreira Henriques	Socio-economic framework for sustainable land management	University José Eduardo dos Santos - FCA-UJES	cussaa@yahoo.com.br
	Integrated Natural Resource Management (incl. communal areas)	University José Eduardo dos Santos - FCA-UJES	
Manuel André Francisco	Conflicting land use (agriculture vs. wildlife)	University José Eduardo dos Santos- FCA-UJES	manuelas2003@yahoo.com.br
Ginhas Alexandre Manuel	Improved soil fertility management (incl. micro-organisms)	University José Eduardo dos Santos- FCA-UJES	ginhasmanuel@hotmail.com
BIODIVERSITY			
Filomena Livramento	Biodiversity - undifferentiated	Agostinho Neto University - Science Faculty (FCUAN)	filomenalivramento@hotmail.com
Miguel Morais	Biodiversity - undifferentiated	Agostinho Neto University - Science Faculty (FCUAN)	dikungi@yahoo.com
Amândio Gomes	Biodiversity - undifferentiated	Agostinho Neto University - Science Faculty (FCUAN)	amandiogomes2@hotmail.com
Fernanda Lages	Biodiversity - undifferentiated	Bird and Museum Laboratory -ISCED (Lubango, Huíla)	f_lages@yahoo.com.br
Maria de Lourdes Sardinha	Biodiversity - coastal and marine	INIP. Instituto de Investigação Pesqueira	milu_sardinha@yahoo.com mariadl@unops.org

Name of person	Department/ Area of expertise	Institution	Email
Fernanda Lages	Establishing and improving baseline inventories for spatial data on biodiversity (fauna, flora, re-classifying ecological zones, vegetation structure etc.)	Herbário - ISCED - Huíla	herbario.lubango@gmail.com
João Francisco Cardoso	Inventory of the genetic diversity of plants and animals (crop and livestock varieties) (explore existing gap)	University José Eduardo dos Santos - FCA-UJES	joaofca@yahoo.es
Fernanda Lages	DNA barcoding of grasses as a tool	Herbário - ISCED - Huíla	herbario.lubango@gmail.com
Carmen Santos	Impacts on biodiversity (climate, land use, mining, ecotourism, other stressors)	Agostinho Neto University- Science Faculty (FCUAN)	camyvandunem@gmail.com
Agostinho da Silva	Improved strategies for biodiversity conservation	Biology Section - ISCED-Huíla	
Elizabeth Matos	Vulnerability and resilience of ecosystems	Center of Fitogenetic Resource - CRF	fitogen@ebonet.net lizmatos@netcabo.co.ao
Pedro António Moçambique	Habitat fragmentation and destruction	Center of Fitogenetic Resource - CRF	pedmocamb@hotmail.com
CROSS CUTTING			
António Valter Chissingui	Development of innovative ICT tools for natural resource management (forest, biodiversity, rangelands, fires)	Herbário - ISCED - Huíla	vachissingui@gmail.com
Manuel Enock e Giza Martins	Quantification of carbon pools in forests and agro-forest landscape (incl. sequestration potential), country specific expansion factor, REDD	IDEF/MINISTÉRIO DO AMBIENTE - AND	
Alexandre Costa	Governance, policies, issue of compliance to regional and international protocols	MESCT	acosta03@sapo.ao

Name of person	Department/ Area of expertise	Institution	Email
José Neto	Governance, e.g. community based natural resource management (CBNRM), REDD	ACADIR	josenetotwr@ netangola.com
Gabriela Pires Teixeira	National and Regional risk and vulnerability mapping	Agostinho Neto University - Science Faculty (FCUAN)	gabrielagptpires@ gmail.com
ACADEMIC EDUCATION PROGRAMMES			
António Valter Chissingui	Remote sensing and Geoinformatics	Herbário - ISCED - Huíla	vachissingui@gmail. com
António de Carvalho Jerónimo	Earth system sciences	Agostinho Neto University- Science Faculty (FCUAN)	
Suzanete Nunes da Costa and Carlos Pinto	Further academic programme proposals	Agostinho Neto University - Science Faculty (FCUAN), Herbário - ISCED - Huíla	costasuzanete@yahoo. com.br and calypinto@yahoo.com
SERVICES			
Carmen Santos and Carlos Pinto	Biodiversity	Agostinho Neto University - Science Faculty (FCUAN), ISCED-Huíla	camyvandunem@gmail .com and calypinto@yahoo.com
CAPACITY DEVELOPMENT			
Ana Bela Leitão	Water	Agostinho Neto University - Engineering Faculty (FEUAN)	
Carlos Pinto	Biodiversity	ISCED - Huíla	calypinto@yahoo.com
Professor Joao Sebasiao Teta		Centre of Excellence for Sciences Applied to Sustainability (CESSAF)	
Professor Lauriano		Centre for Climate Change and Tropical Ecology Research at Jose Eduardo dos Santos University	lauriano@uevora.pt
Dr. Allan Cain		Development Workshop Angola	allan.cain@gmail.com
Dr. Gabriel Luis Miguel		Coordinator of the SASSCAL programme	gabrielmig@gmail.com

APPENDIX C: UNIVERSITY QUESTIONNAIRE

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

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

B: GENERAL VIEWS

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

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

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

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

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

C: CAPACITY, KNOWLEDGE AND RESEARCH GAPS

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

University	
Faculty	
Department	
Programme / Centre / Institute	

	Rate the contributions of your university / faculty / department / programme using 1-5 with 1 being non-existent, and 5 being very active or well developed	1	2	3	4	5
C1	Involvement in research in the area of climate change and/or climate compatible development					
C2	Involvement in **local** climate change and/or climate compatible development research					
C3	Involvement in **national** climate change and/or climate compatible development research					
C4	Involvement in **international** climate change and/or climate compatible development research					
C5	Involvement in single discipline approaches to climate change and/or climate compatible development research					
C6	Involvement in **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 below)	

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 are relevant to climate compatible development in your context? If possible, provide a contact name and email address for the person responsible for the network:

D: CURRICULUM, TEACHING AND LEARNING

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

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

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

E: POLICY / COMMUNITY ENGAGEMENT AND STUDENT INVOLVEMENT

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

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

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

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

F: UNIVERSITY COLLABORATION

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

F1: Inside the university

F2: Between universities in country

F3: With partners

F4: Regionally

F5: Internationally

G: UNIVERSITY POLICY AND CAMPUS MANAGEMENT

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

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

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

APPENDIX D: STAKEHOLDER QUESTIONNAIRE

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

A: GENERAL INFORMATION

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

B: GENERAL VIEWS

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

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

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

C: CAPACITY, KNOWLEDGE AND RESEARCH GAPS

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

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

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

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

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

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

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

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

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

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

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

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

APPENDIX E: IDENTIFIED SOURCES OF EXPERTISE FOR CCD IN ANGOLA

Table 10: Identified sources of expertise for CCD in Angola

University	Nodes of expertise	Centres of expertise	Centres of excellence	Active research networks that could develop CCD expertise links
Agostinho Neto University José Eduardo dos Santos University	Early establishment of a Climate Change and Tropical Ecology Research Centre at José Eduardo dos Santos University None other identified in the mapping study	National Plant Genetic Resource Centre (CNRF) at Agostinho Neto University as a centre of expertise for germoplasm research ▪ Linked with Research Institutes for Agriculture and MINAGRI (extension services) ▪ Part of the SADC network of genetic resources centres Development Workshop (NGO) with cross-country research projects and links focusing on CCD – also linked to universities and major international organisations and funders	Newly established: Centre of Excellence for Sciences Applied to Sustainability (CESSAF) ▪ Head: Professor Joao Sebastiao Teta. Linked with Newcastle Institute for Research on Sustainability (NIReS), UK ▪ Also partnered and supported by the Planet Earth Institute and the Ministry of Higher Education, Science and Technology ▪ First intake of students, 2013	▪ REDE MAIOMB Umbrella Environmental NGO ▪ ABA Associação dos Biólogos de Angola – Angolan Biology Association ▪ AQA Associação dos Químicos de Angola – Angolan Chemistry Association ▪ CEIC Centro de Estudos e Investigação Científica of the Angolan Catholic University ▪ DNA Designated National Authority for Angola ▪ DW Development Workshop ▪ JEA Ecological Youth of Angola ▪ BCC Benguela Current Commission ▪ EEASA Environmental Education Association of Southern Africa ▪ GCLME Gulf Current Large Marine Ecosystem Programme ▪ ODINAFRICA Ocean Data and Information Network for Africa ▪ SADC REEP Southern Africa Development Community Regional Environmental Education Programme ▪ SADC Remote Sensing Centre ▪ SADC Drought Monitoring Centre ▪ SASSCAL Southern African Science Service Centre for Climate Change and Adaptive Land Management

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 Angola.