climate change counts

STRENGTHENING UNIVERSITY CONTRIBUTIONS TO CLIMATE COMPATIBLE DEVELOPMENT IN SOUTHERN AFRICA

Seychelles Country Report

sarua
southern african regional universities association

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SARUA CLIMATE CHANGE COUNTS MAPPING STUDY

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Seychelles Country Report

Series Editor: Piyushi Kotecha

Authors: Penny Urquhart and Heila Lotz-Sisitka

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Note

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

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

BEd	Bachelor of Education
BID	Background Information Document
CAAI	Climate Affairs, Adaptation and Information
CCAM	Conformal-Cubic Atmospheric Model
CCD	Climate compatible development
CDKN	Climate and Development Knowledge Network
CGCMs	Coupled Global Climate Models
CSIR	Council for Scientific and Industrial Research
DRDM	disaster reduction division
EbA	Ecosystem based adaptation
EEASA	Environmental Education Association of Southern Africa
EIA	Environmental Impact Assessment
ENGOs	Environmental Non-Government Organisations
FFEWS	Famine and Flood Early Warning System
GCM	General Circulation Model
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	GreenHouse Gases
GIVRAPD	Global Islands' Vulnerability Research, Adaptation, Policy and Development
GoS	Government of Seychelles
HEI	Higher Education Institution
HEMA	Higher Education Management Africa consortium
INC	Initial National Communication
IPCC	Intergovernmental Panel on Climate Change
MFF	Mangroves for the Future
MSc	Master of Science
MSV	Many Strong Voices
NCCC	National Climate Change Committee
NCCS	National Climate Change Strategy
NCSA	National Capacity Self-Assessment
NHRDC	National Human Resource Development Council
S4S	Sustainability for Seychelles
SAFIF	Seychelles Agriculture and Fisheries Insurance Fund
SCCI	Seychelles Chamber of Commerce and Industry
SIA	Social Impact Assessment
SIDS	Small Island Developing States
SNMS	Seychelles National Meteorological Services
SNPA	Seychelles National Parks Authority

SSDS	Seychelles Sustainable Development Strategy
SST	Sea Surface Temperature
SSTL	Seychelles Sustainable Tourism Label
UNFCCC	UN Framework Convention on Climate Change
UniSey	University of Seychelles
WCS	Wildlife Clubs of Seychelles

1 INTRODUCTION

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

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

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

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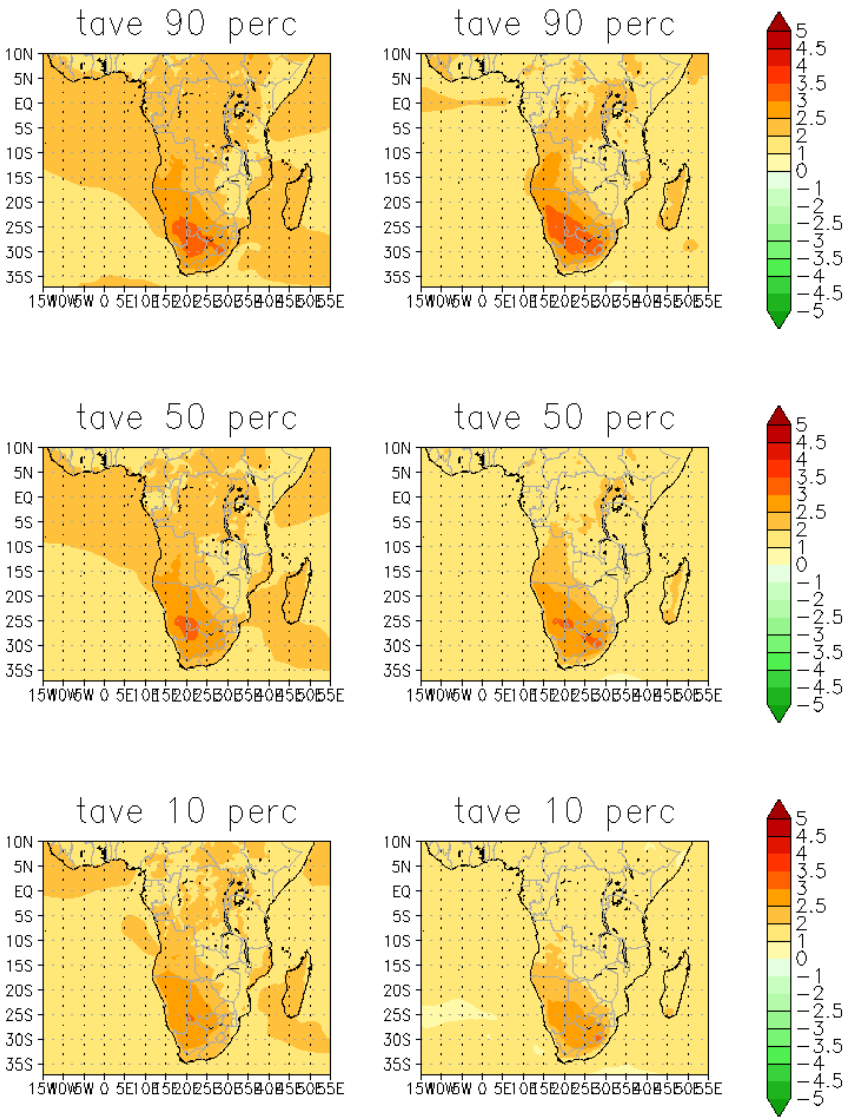
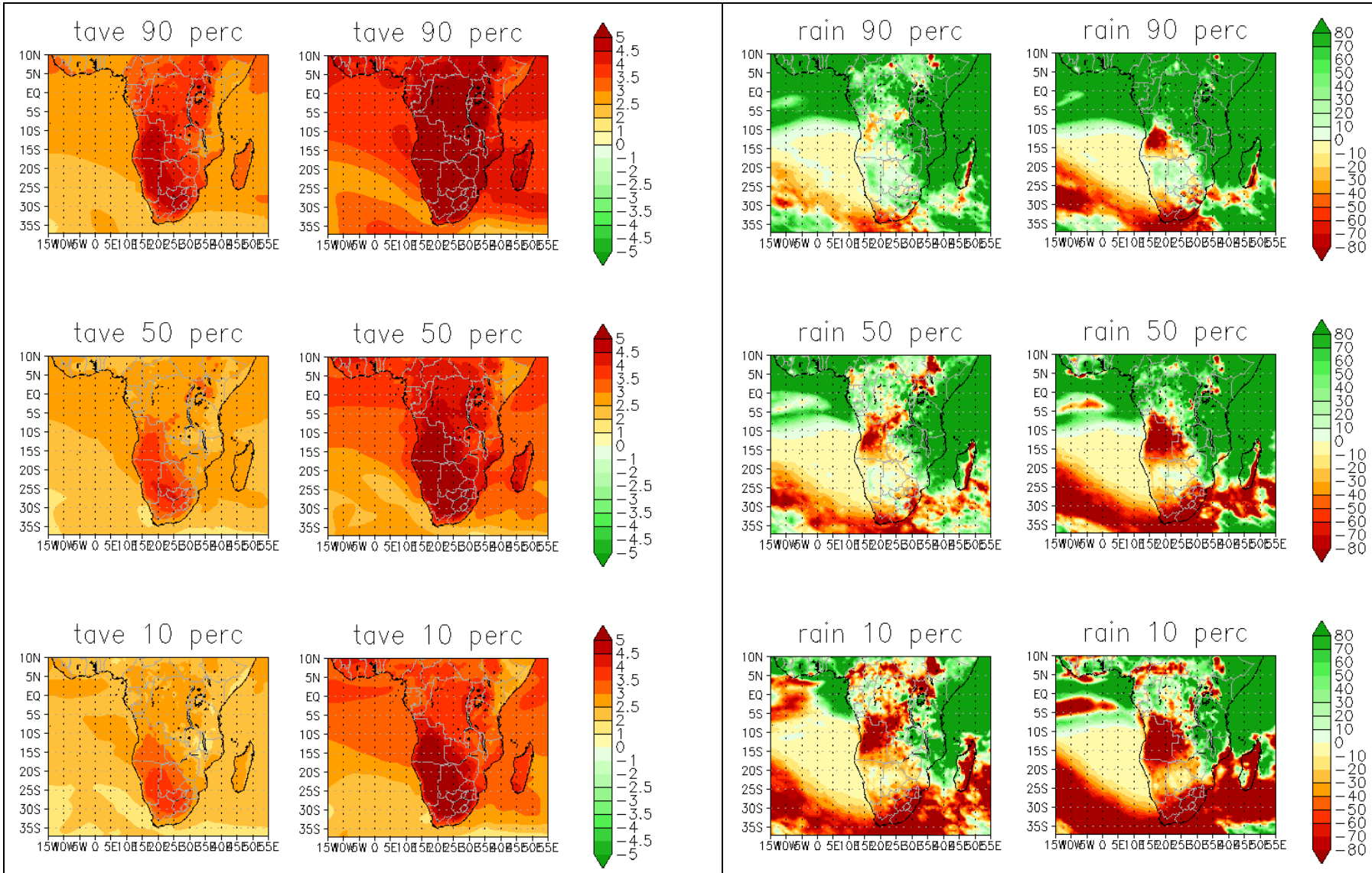
[1] IPCC. 2013. *Impacts, Vulnerability and Adaptation: Africa*. IPCC Fifth Assessment Report, draft for Final Government Review, Chapter 22.

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



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

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



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

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

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

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

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

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

In recognition of the above issues and their longer-term implications for society and universities, the Southern African Regional Universities Association (SARUA) hosted a Leadership Dialogue in 2011, which resulted in a vision for a collaborative programme on climate change capacity development, with a defined set of outcomes.

1.2 The SARUA Climate Change initiative: History and objectives

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

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

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

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

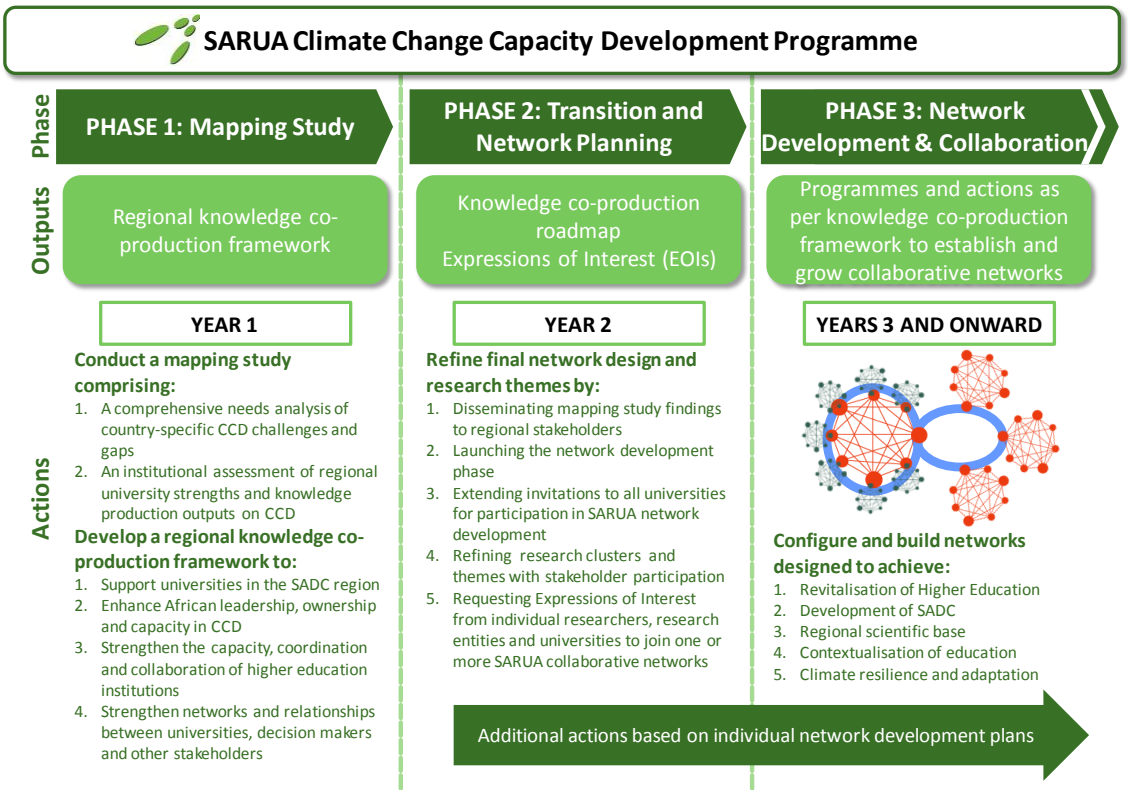


Figure 3: The SARUA Climate Change Capacity Development Programme, showing the mapping study

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

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

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

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

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

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

To address these factors, the mapping study aimed to:

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

While the mapping process has used a country-by-country approach, this is supplemented by a regional perspective generated through analysis across countries, to provide a platform for regional collaboration and knowledge co-production. This document contains the country analysis from Seychelles.

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

1.4 Key concepts

Climate Compatible Development

Climate compatible development (CCD) is low carbon, climate resilient development. The concept has been developed in recognition of the urgent need for adaptation, given current climate variability and the severity of projected climate impacts that will affect the region; and the need to reduce emissions as rapidly as possible to avoid more catastrophic climate change in the future. Thus while CCD can be framed in different ways, given nationally and locally specific development trajectories, it does require that current and future climate risks are mainstreamed into development, and that both adaptation and mitigation are integral goals of development, as indicated by Figure 3. Thus CCD not only recognises the importance of both adaptation and mitigation in new development pathways, but, as further explained in Mitchell and Maxwell (2010), "Climate compatible development goes one step further by asking policy makers to consider 'triple win' strategies that result in low emissions, build resilience and promote development simultaneously". In the southern African context, poverty reduction, as an integral component and goal of regional and national development strategies, would be a desired co-benefit. Uncertainties in major drivers of change, including climate, socio-economic and political risks, necessitate that CCD be viewed as an iterative process, in which vulnerability identification and risk reduction responses are revised on the basis of continuing learning. Climate compatible development emphasises climate strategies that embrace development goals and development strategies that integrate the threats and opportunities of a changing climate.[5] Thus climate compatible development opens up new opportunities for interdisciplinary and transdisciplinary research, teaching and engagement with communities, policy makers and practitioners.

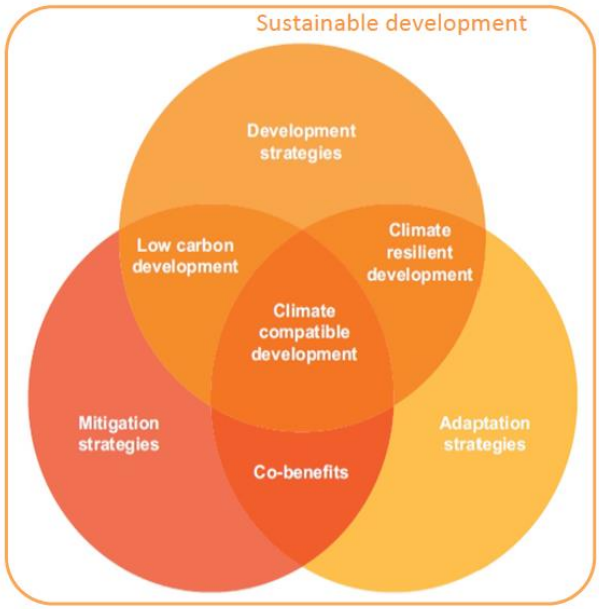


Figure 4: Conceptual framework for Climate Compatible Development (adapted from Mitchell and Maxwell, 2010)

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

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

Climate-resilient pathways

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

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

The IPCC highlights the need for a focus on both adaptation and mitigation, as indicated by the following sentence: "Climate-resilient pathways are development trajectories that combine adaptation and mitigation to realise the goal of sustainable development. They can be seen as iterative, continually evolving processes for managing change within complex systems."[7]

Sustainable Development

The most widely accepted definition of sustainable development, as formulated in the Bruntland Commission's 'Our Common Future' report in 1987, is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". This definition has been highly influential in shaping international environmental and development policy, since the Rio Earth Summit in 1992, where Agenda 21 was put forward as a global development plan for aligning goals of economic development with social and environmental sustainability. Early discussions on sustainable development tended to focus on the triple bottom line concepts of environment, economy and society separately. More recent discussions on sustainable development foreground the need for 'strong sustainability', in which society, economy and environment are seen as interacting in an interrelated, nested system. The concept of sustainable development as used widely today emphasises that everything in the world is connected through space, time and quality of life, and thus necessitates a systems approach to understanding and solving interlinked social, environmental and economic problems.

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

[7] Ibid.

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

2 METHODOLOGY, DATA SOURCES AND ANALYSIS LOGIC

2.1 Research Design

This country-based study has been informed by an interactive and dialogical research design that included document analysis of key national and regional documents focusing on climate change in Seychelles 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 Seychelles, within an overall interpretive, participatory and consultative and social realist methodology[8]:

2.1.1 Document analysis

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

- Initial National Communication (INC) to the United Nations Framework Convention on Climate Change (UNFCCC), 2000;
- National Capacity Self-Assessment (NCSA) for implementation of the Rio Conventions, 2005;
- Seychelles National Climate Change Strategy, 2009;
- Second National Communication (SNC) to the United Nations Framework Convention on Climate Change (UNFCCC), 2011;
- National Report: Republic of Seychelles – preparations for the Rio+20 United Nations Conference on Sustainable Development, 2012; and
- Global Islands' Vulnerability Research, Adaptation, Policy and Development (GIVRAPD) Project, Climate Modelling Report Summary, January 2013, Seychelles.

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

2.1.2 Stakeholder and university staff consultations (national workshop)

As part of the SARUA mapping study Initiative *Climate Change Counts*, country consultations were held in Seychelles on 4 and 5 September 2013 in Victoria, Mahé.[9] The consultations were structured as a 1.5 day programme, with a combined group of participants that included university, government, private sector and NGO stakeholders. See Appendix A for the list of participants. A summary of the content of the different sessions is provided below in Table 1. From detailed workshop proceedings captured by a team of rapporteurs a workshop report was produced and circulated to all invitees to the workshop for verification and expansion. 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: Seychelles workshop programme outline

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

[9] The Seychelles consultations were made possible through the kind contributions and support of the University of Seychelles and the Ministry of Environment and Energy.

2.1.3 Questionnaires

Two different questionnaires were prepared to obtain more in-depth data on climate change and CCD knowledge co-production practice and possibilities, and to enable people who were unable to attend the country workshops to participate in the mapping study (See Appendices C and D). One was designed for university professionals and the other for national and regional stakeholders who are involved in climate change and CCD. For Seychelles, a total of 15 questionnaires were answered, which included 13 stakeholders and 2 university professionals. Questions covered the following:

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 Namibia, and b) by time and resource constraints that did not allow for **in-depth field visitation, individual interviewing or observation** before, during and after the consultation process. Moreover, the information generated at the country workshop relates to the number of participants, their expertise and the number of different sectors and institutions present. Further, while every effort was made to obtain questionnaire responses from as wide a range of stakeholders as possible, and follow-ups were

made post-workshop to enhance this, the range of questionnaire responses obtained does provide certain limitations to the data set. However, the **best available information was carefully consolidated, reviewed and verified** in the construction of this Country Report. Overall, the mapping study was further constrained by a budget cut imposed mid-way through the study.

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

This Country Report therefore presents as a useful 'initial document' and it is hoped that Seychelles, and in particular, the University of Seychelles (US), the Ministry of Environment and Tourism and other national stakeholders can take this analysis forward in ongoing mapping and planning activities related to CCD research and knowledge co-production.

2.3 Expanding the mapping study

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

2.4 Analysis logic

The analysis logic informing this Country Report is threefold. It firstly maps out a 'needs analysis' which identifies country based knowledge, research and capacity gaps for key CCD priorities as articulated in documents, workshop and questionnaire responses. Secondly, it provides an 'institutional analysis' providing insight into existing institutional capacity for CCD knowledge co-production. Thirdly, it provides a perspective not only on existing knowledge co-production practice for CCD in Seychelles, 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 Seychelles, which may also assist Seychelles **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 Seychelles' socio-economic context, which provides the baseline for addressing the climate change-related needs and priorities in the country (section 3.2), and a summary of the observed and projected climatic changes for the country (section 3.3). This is followed by an overview of the broader priorities for addressing climate change as identified by policy (section 3.4.1), in workshops (section 3.4.2) and via the questionnaires (section 3.4.33). A summative discussion is then provided of the broader climate change-related priorities and needs from these three sources of data in section 3.4.4. The needs analysis then moves on to describe more specific priorities and needs, and their associated knowledge, research and capacity gaps (section 3.5). The following differentiation of knowledge, research and capacity gaps is used:

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

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

3.2 Socio-economic context

The Seychelles consists of an archipelago of over 115 diverse islands, both granitic and coralline, some extending over 1 000 kilometres from Mahé, the largest island.[10] The archipelago has a total land area of 45 500 hectares. In 2010, the population of Seychelles was around 88 113; 90 percent of people and development are located on the coastal plateaux, with 87 percent of the population on Mahé. The tropical maritime climate has two distinct seasons, linked to the predominant monsoon winds: the dry season from May to September (south-east monsoon) and the wet season from November to March (north-west monsoon), in which heavy seas and storm surges can be experienced, related to cyclonic activity to the south. Temperature varies between 25°C and 26°C in July and August, and between 27°C and 28°C in March and April. Mean annual rainfall varies according to topography, with Mahé receiving 2 369 mm over the coastal areas. Seychelles is recognised as an important biodiversity centre, especially its unique forests and bird species. Environmental threats include land use change, biological invasions, forest fires, and commercial over-exploitation of certain species.

[10] Approximately 30 km by 5 km.

Seychelles' economic growth averaged 7.7 percent per annum between 2005 and 2007, largely due to the tourism sector. The economy was badly hit in 2008 by internal and external factors, including the petroleum and food price spike and global economic crisis. While Seychelles enjoys a literacy rate of 97 percent and a high average life expectancy of 72 years, poverty and unemployment have increased since the economic decline, with 13 percent of Seychellois living below a US$3.50 per day poverty line. The economy relies heavily on tourism and fisheries. The country depends almost totally on imported petroleum products for its energy needs, with currently limited use of renewable energy. Seychelles has the second highest GDP per capita in Africa, with a GNI per capita of $11,270 in 2011[11], and is one of Africa's six upper-middle-income countries.

3.2 Observed and projected climatic changes, impacts and vulnerabilities

3.2.1 Observed climatic changes

Observed mean annual temperatures over Seychelles Islands have increased at an average rate of 0.11˚C per decade over the period 1960–2006.[12] The observed daily data available is insufficient to determine long-term trends in temperature extremes such as 'hot' or 'cold' days and nights. The annual rainfall over the main granitic islands is increasing; annual trends on Mahé for the period 1972 to 2006 showed an increase of 13.7 mm per year. This increase is not evenly distributed across the year, but rather is attributable to a few heavy rainfall events; however, observations are insufficient to identify long-term trends in rainfall extremes. Observed changing seasonal patterns bring harsher storms with more intense rainfall, and longer dry spells. Extreme tide levels in the last few years have destabilised the coastline. Significantly increasing wind speed trends have been observed during the September-October-November months; and mean annual sea surface temperatures (SSTs) surrounding Seychelles show a statistically significant increasing trend of 0.16˚C per decade for the period 1960–2006.[13]

3.2.2 Projected climatic changes

Projected annual temperature increases are for between 1.2˚C (for the B1 emissions scenario) and 3.4˚C (for the A2 scenario) by the 2080s.[14] General Circulation Model (GCM) projections indicate increases in the frequency of 'hot' days and nights, with their occurrence reaching 51 to 99 percent by 2080s. Cold days and/or nights will drop to few to none towards 2080. The increase in dry spells that resulted in drought conditions in 1999 and the 1998 mass coral bleaching foreshadow likely events under future climate change. GCM rainfall projections for Seychelles span both overall increases and decreases, but tend towards increases in most models. Constructed climate scenarios

[11] http://data.worldbank.org/country/seychelles, accessed 2 July 2013.

[12] http://givrapd.org/wp-content/uploads/2013/01/GIVRAPD-Seychelles-Climate-Model-Summary.pdf, accessed 3 July 2013.

[13] http://givrapd.org/wp-content/uploads/2013/01/GIVRAPD-Seychelles-Climate-Model-Summary.pdf, accessed 3 July 2013.

[14] This section is drawn largely from GIVRAPD (2013) http://givrapd.org/wp-content/uploads/2013/01/GIVRAPD-Seychelles-Climate-Model-Summary.pdf, accessed 3 July 2013, as well as the Seychelles SNC (2011).

for the islands of Mahé and Aldabra point to a 'more likely than not' wetter rainy season and drier dry season.[15] GCM projections of rainfall extremes are mixed across the range of models, ranging across both decreases and increases in all measures of extreme rainfall. The models project increases in SSTs throughout the year, ranging from +1.1˚C to +3.2˚C by the 2080s, across three emissions scenarios. Sea level rise for the period 2070–2100 is expected to be in the range of 0.5 to 0.6 metres, depending on the global emissions trajectory.

3.2.3 Impacts and vulnerabilities

Climate change and the related projected sea-level rise threaten the very fabric of Seychelles' socio-economic development (SNC 2011): particular vulnerabilities lie in water resources, fisheries, agriculture, industry, human settlements, health and coastal zones. Seychelles will face serious water shortages in the near future (INC 2000), linked to a lack of adequate resources to invest in appropriate reservoirs, growing demand, and changes in rainfall. Enhanced erosion and coastal flooding risks are expected as a result of higher sea levels, increased intensity of tropical storms and greater storm surge, affecting developments and populations concentrated on the coastal plateaux. Increasingly common coastal flooding, especially during spring tides and heavy rainfall, is compounded by the lack of appropriate drainage and high density developments. Landslides will accompany floods in the Mahé group, with its steep mountain slopes. Coastal erosion would have significant impacts on coastal infrastructure, especially tourism and the road network. Health risks include the high risk of climate sensitive diseases (chikungunya, leptospirosis and dengue) during the wetter north-west monsoons, heat waves (uncommon) and respiratory ailments arising during extreme drought conditions.

Rising sea surface temperature and changes in ocean chemistry will negatively impact on the natural protective barrier of the coral reef systems, which are a major tourist attraction, and essential to fisheries and biodiversity conservation. Repeated coral-bleaching episodes could result in possible coral extinctions within the Seychelles region by 2040. Further impacts on biodiversity include threats to rare turtles and tortoises, such as the giant Aldabra tortoises and Hawksbill sea turtles; mountain frogs; and endemic birds such as the Black Parrot. The economy will be impacted by worsened water shortages resulting from dryer south east monsoons.[16] Extended droughts may increase the likelihood of forest fires, with negative impacts on biodiversity and ecosystem functioning, as well as on the economy.

3.3 Identified needs: Short to medium term national priorities for CCD in Seychelles

Section 3.4 focuses on the broad priorities and needs for addressing climate change and moving towards CCD in Seychelles. Section 3.4.1 highlights key priorities and needs articulated in policy and

[15] This situation is already evident in the 1972–2006 interval.

[16] The heavy rainfall experienced during the 1997–1998 El Nino and the 1998–2000 La Nina events profoundly affected the economy, with fisheries accounting for 45 percent of the total losses in monetary terms, followed by agriculture (28 percent) and tourism (12 percent).

strategy, after which some of the broader priorities articulated by workshop participants are discussed in section 3.4.2. This is followed by a presentation of the broader needs for CCD as specified in the questionnaire responses (section 3.4.3). A summative perspective on the broader identified needs for adaptation, mitigation and, ultimately, for CCD, is provided in section 6.1.

3.3.1 Identified adaptation and mitigation priorities articulated in policy and strategy

The Second National Communication process focused primarily on the need for strengthening technical and institutional capacities to mainstream climate change into national policies and development guidelines of Seychelles, and highlighted four **priority sectors for adaptation**: Fisheries, Agriculture, Water and the Coastal Zone Sector. Specific adaptation measures prioritised in the SNC include:

- **Seychelles Agriculture and Fisheries Insurance Fund (SAFIF):** an insurance mechanism to address loss and damage due to the adverse effects of climate change, through holistic combination of agricultural extension services, risk mitigation and management, and insurance
- **Fisheries**: establishment of the Seychelles Ocean Temperature Monitoring Network (SOTN) to improve knowledge of climate-driven changes in marine ecosystems and their implications for management; and determination of the socio-economic impacts of climate variability on Seychelles Industrial Tuna Fishery, to identify management and policy strategies
- **Health**: strengthen public health infrastructure and resources, including public health training programmes, research to develop and implement more effective surveillance and emergency response systems, health education programmes, along with prevention and disease control programmes; procure adequate financial resources
- **Water resources**: water demand management; rainwater harvesting; improved forecasting of dry periods; education and awareness raising
- **Coastal zone**: enhanced drainage and flood management, mainstreaming adaptation options into Integrated Coastal Management and Sustainable Development Plans

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

- Lack of financial resources to implement adaptation measures for climate change;
- Inadequate institutional, system and individual capacity in issues related to climate change;
- Inadequate public awareness on climate change and its potential impact on ecosystems and the economy; and
- Inadequate training and technology transfer on adaptation and mitigation technologies.

Priorities for mitigation: The national total of CO_2 emissions in 2000 was 273.146 Gg (273 146 tonnes), of which 95 percent came from the energy sector and 5 percent were from the forestry sector. While Seychelles remains a net sink for greenhouse gases, there has been a 46 percent increase in CO_2 emission from the energy sector since 1995. Mitigation priorities in Seychelles include continued increase in the use of cleaner production technologies, adoption or implementation of energy conservation measures and the use of energy efficient equipment and appliances. The SNC states that “the country should seriously consider the options for increasing the use of renewable energy technologies, especially solar energy, for both solar water heating and

photovoltaic systems." Proper management and utilisation of forest resources could further reduce national GHG emissions. The SNC notes the need for an assessment to determine the amount of biomass that could be sustainably harvested to substitute imported oil.

3.3.2 Identified needs associated with CCD articulated in workshop interactions

From the general discussions in the Seychelles workshop a variety of specific needs were raised which touched on some of the more concerning priorities with regard to climate change adaptation and mitigation. These can be categorised into six key areas: sea-level rise, water resources, health, coastal zones, rising sea surface temperature and droughts. Within each priority area expressed in the workshop, key targeted impacts, which would have associated knowledge and research needs, were raised:

- **Sea level rise**: salt water intrusion; impact on coastal communities and agriculture; loss of livelihoods;
- **Water resources**: increased water demand; change in rainfall pattern; lack of storage capacity:
- **Health**: climate sensitive diseases such as leptospirosis, dengue, chikunguya; heat waves; respiratory ailments arising from extreme droughts;
- **Coastal zones**: enhanced erosion and coastal flooding; coastal infrastructures such as road network are affected;
- **Rising sea surface temperature**: effects on coral reefs, fisheries, tourism; compounded by ocean acidification; and
- **Droughts**: increase in forest fires; loss of biodiversity.

Further discussions added more nuance to the prioritised needs for Seychelles, which ranged from institutional, educational and financial needs/concerns.

From an institutional level, a representative from the Seychelles Chamber of Industry highlighted the need for an auditing system in the Seychelles to observe what is being done, and what the current trends are, yet no consensus on who would action such a system was found. Another institutional concern raised by a representative from the UNDP GEF-SCP was the need to be able to track donor funding into the Seychelles, as this is not as transparent as it should be.

Other broad needs include improved collaborative partnerships and curriculum development, particularly higher education, as well as improved funding and resourcing of teachers working with CCD themes.

Regarding mitigation, a need raised was addressing transport issues, with suggestions for more fiscal incentives from the Ministry of Finance to encourage the use of electric cars and hybrid cars.

3.3.3 Identified needs for CCD articulated in questionnaire data

Questionnaire data showed that there is a relationship between institutional interest / mandate and/or disciplinary interest / mandate and the definition of priority needs (see Table 2).

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

Need identified	Institutional interest / mandate and/or disciplinary interest / mandate
Promote energy and water use efficiency (related to physical planning). Promote effective use of land according to represent nature LUP. Avoid industrialisation through [illegible] oil industry.	UNDP-GEF
More research, sensitisation at all levels and better legal framework. The economic benefits of the whole process need to be well thought out and explained so that all partners come on board.	SCCI
Research. Formulation of new policies to guide CCD. Involvement of all relevant partners responsible for development. Continuity of work in CCD.	Public Health Department, Min. of Health
Research gaps for baseline studies and funding	Mangroves for the Future (MFF)
Research in order to have adequate data that can be used to support policy formulation and implementation and for decision making	Risk Management Section / Seychelles Tourism Board
Synthesis of knowledge. Getting together of researchers to collaborate work	GEF Small Grants Programme
Top-down decisions don't match infrastructure e.g. have Energy Act but PUC has not decided on feed-in tariff for renewable energy	Sustainability for Seychelles
Traditional values (fishermen etc). Changing society's view/ ways in the high carbon development	UNDP-GEF
Responsive curriculum at school level. Informed policy makers for promoting and advocating CCD. Reducing the burden of climate related diseases through effective management. Adaptation of new planning for building and homes	Public Health Services
1. Improved policies when it comes to EIA and reinforcing it accordingly 2. Funding and development of more learning support materials to educate society on climate threats and opportunities 3. More capacity building workshops for different professionals to develop knowledge and skills about strategies or methods to improve on their daily practices 4. Capacity building workshop for policy makers and other senior officials to be exposed to new ways of thinking 5. Stronger networking between SADC countries 6. More research by local and international professionals	Ministry of Education
Convincing business and industries. Educating general public, children and Seychelles in general about CCD. Financial assistance is also important, technological capacity, human capacity, convincing decisions and policy makers, institutional capacity etc.	University of Seychelles, Management

Table 2 above shows that many of the needs identified in the individual questionnaires by governmental representatives, NGOs and donor organisations focus on the need for research and knowledge production. Policy development, collaborative research and action, and education were also raised by several participants. No definite trend emerged with regard to the participants' department or mandate governing their climate change or CCD prioritised need. Instead an overwhelming convergence towards improved research, collaboration, policy development and

implementation and education seemed to cut across all mandates and areas of institutional interest. This being said the interdisciplinary and multi-sectoral nature of climate change can be seen by the nuanced differences between those needs emergent from the Ministry of Education and those from the Public Health Services, where health and curriculum needs overlapped. *How to harness such perspectives within the varied mandates and institutional areas, and the associated expertise that informs such perspectives is the ultimate challenge of a knowledge co-production framework and process.*

3.4 Specific knowledge and capacity needs: CCD research, knowledge and individual and institutional capacity gaps

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

3.4.1 Needs analysis: Specific research needs and knowledge gaps

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

- Planning, education and health; and
- Coastal zone and forestry (including tourism and fisheries).

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

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

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
Responsive curriculum that fully incorporates CCD	▪ Identifying the country's needs and relevant policies for CCD ▪ Identifying the proper balance in content to respond to both national and global issues in a way that is appropriate for Seychelles	▪ Research into effective curriculum development methodologies for integration of CCD and related issues ▪ Systematic evaluation of curriculum	▪ Lack of human capacity to develop and/or implement the curriculum (not enough trained and skilled people)	▪ Lack of a repository system ▪ Not enough stakeholder consultations in developing the curriculum
Informed policy making to promote CCD implementation	▪ Identifying existing policies ▪ Understanding CCD	▪ More action-based research ▪ Evidence of policies that work ▪ Relevant research in CCD/policies/methodologies for developing iterative and evidence based policies ▪ Lack of social impact assessment when developing policies	▪ Capacity building for more researchers/policy makers on application of the policy into practice ▪ More informed policy makers	▪ Lack of proper implementation, monitoring and enforcement of policies ▪ Sensitisation of policy makers about relevant evidence-based decision making ▪ Policy making using bottom-up approach
Reducing the burden of climate-related disease through effective waste water management	▪ Public awareness about climate-related diseases ▪ Proper documentation of households connected to the sewerage system ▪ Lack of information on best localised sewerage system works	▪ Localised research and survey of the existing/proposed centralised system ▪ Lack of social impact assessment when developing waste water management plans	▪ Engineering expertise	▪ Lack of funding to implement the identified waste water management solution ▪ Lack of public awareness ▪ Resistance to change from certain home owners – vested interests / seeking compensation for pipes crossing their land ▪ Lack of prioritisation of areas most affected by flooding

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
Need to centralise baseline data relating to CCD and enhance access to information to all stakeholders	▪ Unavailability of data for informed policy and decision making ▪ Ownership of data ▪ No existing legislation on accessing data	▪ Lack of long term scientific studies on the impact of climate change in certain areas and on biodiversity	▪ Lack of human resources and capacity building training exercises ▪ Lack of technological expertise in certain fields	▪ Inadequate infrastructure e.g. laboratories ▪ Funding for long-term research ▪ No strategic and prioritised national research framework on climate change /CCD
Climate change-related impacts on soil erosion and how this will exacerbate problems related to unplanned development of land in coastal zones	▪ No data on soil sodicity and salinity ▪ Inadequate presentation/ publishing of research in this area ▪ Lack of understanding of the impacts	▪ Few baseline studies of soil in general in surrounding areas ▪ Effect of climate change on soil fertility	▪ Lack of awareness of farmers, land use planners and the agriculture experts on the impacts associated with the development of these areas ▪ Not enough trained soil experts	▪ Not enough incentives/ support and added value for local experts in these areas
Impact of climate change on marine fauna and flora	▪ Lack of understanding of the impacts of climate change on marine fauna and flora ▪ Relationship between these species and climate change ▪ Lack of indicators on specific marine fauna and flora	▪ Long-term trends on the impact of climate change on the indicator species	▪ No trained botanists and researchers in different fields	▪ Effective long-term monitoring and evaluation system

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

The mapping study identified a number of programmes and projects involving government and donor agencies that are specifically focused on addressing climate change challenges, and which include research needs (implicit or explicit) that would need to be addressed through knowledge co-production involving multi-stakeholders at different levels, as shown in Table 4 below. Some suggestions are provided for research and knowledge gaps that may be at least partially addressed by these programmes. It is not clear to what extent university researchers are involved in these programmes, although it is likely that this is the case, given the small set of researchers working on climate change in Seychelles.

Table 4: Climate change programmes in Seychelles, with potential associated research needs

Project/programme	Partner organisations for knowledge co-production	Related research needs, linked to specific knowledge needs (as indicated in policy (P), and supplemented by workshop (W) and questionnaire data (Q))
Seychelles Climate Change Support Programme 2010–2013 ▪ Budget support for climate change and sustainable development policy and implementation; create institutional and legal framework to promote renewable energy and energy efficiency ▪ Aim is to mainstream climate change into national development policies and key sector strategies and action plans	LEAD AGENT: Government of Seychelles, EU, Global Climate Change Alliance	▪ Improved policies when it comes to EIA and reinforcing it accordingly (Q) ▪ Lack of social impact assessment when developing policies (W)
Ecosystem based adaptation (EbA) to climate change in Seychelles 2012–? ▪ Water resources; will address water scarcity and coastal flooding through ecosystem based measures of restoring or maintaining key ecosystem services in the coastal and hinterland areas ▪ EbA to be mainstreamed into development planning and financing. Strong knowledge management focus on EbA, to include awareness raising targeting decision makers and coastal communities	LEAD AGENT: Ministry of Home Affairs, Environment, Transport and Energy UNDP/GEF Adaptation Fund	▪ Research needed into the economic/financial benefits of climate compatible developments and new business opportunities (Q) ▪ Lack of micro-insurance, risk reduction financing mechanism and private sector financing for adaptation (Q) ▪ Assessment needed of different energy and water use (related to physical planning) (Q) ▪ Localised research and survey of the existing/proposed centralised system (W) ▪ Lack of social impact assessment when developing waste water management plans (W)

Project/programme	Partner organisations for knowledge co-production	Related research needs, linked to specific knowledge needs (as indicated in policy (P), and supplemented by workshop (W) and questionnaire data (Q))
Many Strong Voices (MSV) Ecosystem based adaptation project 2013–? ▪ Empower communities to make informed choices on climate change ▪ Integration of scientific and traditional knowledge (will formalise a methodology that combines evidence-based, scientific data with community knowledge and experiences) ▪ Case studies from Seychelles and Belize	LEAD AGENT: Many Strong Voices, UNEP, CICERO, communities, government	▪ Public awareness about climate related diseases (W) ▪ Lack of capacity to promote and apply energy efficiency, renewable energy resources, efficient use of water resources, etc. (Q) ▪ Research into sustainable agricultural practices (P) ▪ Lack of educational specialisation opportunities (Q) ▪ Research into effective curriculum development methodologies for integration of CCD and related issues (Q and W)

Note: This table is based on best available information gathered during the mapping study, but may not be complete.

It is clear that the Ecosystem-based adaptation project, funded by the Adaptation Fund, will have strong elements of both knowledge management and policy influence, as EbA will be mainstreamed into development planning and financing. The knowledge management component will further include awareness raising targeting decision makers and coastal communities. The MSV project's aim of formalising a methodology that combines evidence-based, scientific data with community knowledge and experiences will be of great interest for any future activities to enhance knowledge co-production in Seychelles.

A further potential knowledge co-production partnership alluded to in the questionnaire data could be between the University of Seychelles and the UNDP. The Seychelles government is aiming to build capacity to implement the National Climate Change Strategy (NCCS) through establishing the Climate and Environmental Services Division in the Department of Environment. In order for this strategy to be implemented effectively, a willingness to engage in knowledge co-production and collaboration will be needed, as well as adopting a multidisciplinary and/or transdisciplinary approach to CCD. Further supporting this point, the Environment Management Plan 2000–2010 of the Seychelles identifies both climate change and capacity building as **cross-sectoral** issues, and highlights a number of areas where climate change capacity building is linked to the wider strategy that would incorporate a variety of different cross-cutting areas, therefore requiring the contribution of different forms of expertise.

Table 5: Additional detailed research and knowledge needs alluded to or identified in the SNC (2011), and workshop and questionnaire data

As in Table 4, additions from workshop and questionnaire data are indicated in italics, (P) refers mainly to the SNC (2011)

VULNERABILITY, IMPACTS AND ADAPTATION

Fisheries

- Links between temperature rise, coral damage and bleaching
- Generally, what is meant by 'blue economy' and how to apply it: is it even compatible with development planning in Seychelles? (Q)
- Lack of understanding of the impacts of climate change on marine fauna and flora (W)
- Relationship between these species and climate change (W)
- Lack of indicators on specific marine fauna and flora (W)

Agriculture and Water Resources

- Assessment of different energy and water use (related to physical planning) (Q)
- Localised research and survey of the existing/proposed centralised system (W)
- Lack of social impact assessment when developing waste water management plans (W)
- Research into sustainable agricultural practices (P)

Health

- Research on climate related diseases and the role of effective management (Q)
- Public awareness about climate related diseases (W)
- Proper documentation of households connected to the sewerage system (W)
- Lack of information on best localised sewerage system works (W)
- Lack of understanding of effects of climate change on human health (P)
- Research to develop and implement more effective disease surveillance and emergency response systems (P)

Coastal Zone Management

- Promote affective use of land according to represent nature LUP (Q)
- Lack of baselines and related maps (soil, reefs, mangroves etc.) (Q)
- No data on soil sodicity and salinity (W)
- Inadequate presentation/ publishing of research in this area (W)
- Lack of understanding of the impacts (W)
- Baseline information, including that on the physical, human and built environments, to better support monitoring and assessment studies at local, island, national and regional scales (P)

Disaster Risk Management

- Understanding of extreme events, from the frequency and severity of tropical cyclones and ENSO events to trends in heavy precipitation, including current patterns of frequency and severity and improved projections of how those patterns might change (P)

MITIGATION

- Lack of capacity to promote and apply energy efficiency, renewable energy resources, efficient use of water resources, etc. (Q)
- Specific GHG inventory capacity needs in the energy, transportation, agriculture, and waste management sectors (P)
- Sustainable energy and low carbon development

CROSS-CUTTING ISSUES

Capacity Building, Training and Institutional Strengthening

- Research in order to have adequate data that can be used to support policy formulation and implementation and for decision making (Q)
- Top down decisions don't match infrastructure e.g. Have energy act but PUC has not decided on feed-in tariff for renewable energy (Q)
- Stronger networking between SADC countries (Q)
- Identifying the proper balance in content to respond to both national and global issues in a way that is appropriate for Seychelles (W)

Research and Information Needs, including how to use climate change information

- [see Table 3 above]

Education, Public Awareness, Participation and Access to Information

- Lack of educational specialisation opportunities (Q)
- Research into effective curriculum development methodologies for integration of CCD and related issue (Q and W)

Financial Resource Mobilisation and Management

- Funding and development of more learning support materials to educate society on climate threats and opportunities (Q)
- The economic/financial benefits of climate compatible developments and new business opportunities. (Q)
- Lack of micro-insurance, risk reduction financing mechanism and private sector financing for adaptation (Q)
- Systematic evaluation of curriculum (W)

Legislative Development

- Development of a better legal framework (Q)
- Formulation of new policies to guide CCD (Q)
- Improved policies when it comes to EIA and reinforcing it accordingly (Q)
- Lack of social impact assessment when developing policies (W)

Table 5 above offers some indication of where the major needs are, which is of relevance for further policy review and development, and for the implementation of the National Climate Change Strategy. All these needs are highly reliant on research and knowledge (co) production processes, and it would be important that the diversity of these knowledge needs should be well articulated in such policy at a suitable level of detail.

What is of interest in this analysis (as presented in Table 5), is that the potential national research and knowledge needs (identified in Table 3) are more nuanced when considered in thematic context. This is an important point to note for knowledge co-production processes, so as not to lose the specificity of the research problems and/or contexts.

It is noteworthy to consider that workshop and questionnaire responses show additional research and knowledge gaps to those outlined in current policy documentation, such as the SNC (2011). Priorities lie in policy and curriculum development, water resource management, coastal zone management and fisheries. The need for improved methodological approaches to adaptation and specifically policy development are raised continuously throughout the needs

analysis. Considering this, a further part of addressing this question of methodological or process related to CCD policy implementation is the need for a strong analysis of individual and institutional capacity gaps, as now addressed in the following two sections.

3.4.2 Needs analysis: Individual capacity gaps

Individual Capacity needs raised in the workshop and questionnaire focused on *curriculum development support*, as well as more *capacity building workshops and training programmes* for different professionals to develop knowledge and skills about strategies or methods to improve on their daily practices. What emerged both in the workshops and the questionnaires was a need for *capacity support for policy makers and other senior officials* specifically. Within specific areas/disciplines, the policy documents and workshop participants pointed towards improved *meteorological, water resource assessment, agriculture and resource planning, GHG inventories, fundraising, oceanography, hydrology, coastal engineering, and coastal management capacities*. Specific capacity needs for improved *education, awareness and training* on climate change issues across all sectors was highlighted across all three datasets.

3.4.3 Needs analysis: Institutional capacity gaps

Institutional capacity needs were extensively covered in the workshops and questionnaires. In addition to this the policy documents reviewed contributed extensive lists for specific institutional capacity needs. Overall, *policy improvement and implementation*, alongside *funding*, and *network development* (specifically within the SADC region) were rated as the most commonly cited institutional needs. The workshop discussions focused also on *monitoring* (specifically sea-level rise, temperature and GHG emissions), institutional capacity to promote *information sharing and networking*, *improved incentives and taxation mechanisms*, appropriate *technology development*, *curriculum development* and *renewable energy expansion*. The workshops identified the *inadequate integration of climate change across the board*, including the gender-differentiated and HIV/AIDS aspects, into *policies, plans and strategies at all levels*, including *economic development planning*.

If one considers the issues reported on in section 3 *in relation to each other,* one can begin to map out CCD capacity development pathway/s for Seychelles, as outlined in section 6.

4 INSTITUTIONAL ANALYSIS

4.1 Introducing the institutional analysis

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

The institutional 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 Seychelles, and identifies some of key stakeholders that could form part of a Seychelles's CCD knowledge co-production framework.

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

4.2 Policy and institutional arrangements

4.2.1 Policy and institutional arrangements governing Higher Education in Seychelles[17]

In the years following independence in Seychelles, education discourse evolved in the context of a broad political vision of the social, economic and educational transformation considered necessary for the creation of a post-colonial society which would, among other things, redress discrimination and inherited inequalities (Education Act 1982). This was aimed at building national unity and promoting cultural identity. In the process, higher education did not get the necessary emphasis. It was not until the late 1990s that higher education in Seychelles began to receive greater attention. Public higher education in Seychelles is still therefore in its infancy, defining and positioning itself in the national and regional socio-economic and political development discourse (Ministry of Education and Youth 2004). Seychelles witnessed the establishment of its first public university in 2009. Being the first university in a country with a population of less than 90 000, the university brings with it aspirations and expectations from all sectors of society.

[17] This short summary is derived from a SARUA Country Profile' compiled by Lifutso Ts'ephe in 2011. "Chapter 11: Seychelles," *A profile of Higher Education in Southern Africa. Volume 2.* (www.sarua.org)

The University of Seychelles (UniSey) has its main campus at Anse Royale, and the School of Education is located at Mont Fleuri (Seychelles Nation Online, 3 August 2012). Formally inaugurated in late 2010, and with a 2012 intake of about 300 students in twelve degree programmes, UniSey is hoping to turn the island tourist destination into a knowledge centre for the region (Fine 2011). As a new university, UniSey offers degree programmes through the University of London International Programme. Students who enrol with UniSey receive course materials from the University of London International Programme Colleges and, on completion of their study programmes, graduating students are awarded a degree from the University of London as well as the University of Seychelles. The vice-chancellor of the University of London is a member of the UniSey Board. UniSey has formalised partnerships with other international universities, including Université Paris-1 Panthéon-Sorbonne in France, University of Edith Cowan in Australia, TERI University in India and China Ocean University (Fine 2011). The government of Seychelles offers scholarships for students studying at UniSey, and the university itself has a scholarship scheme that is funded by donations from individuals and the private sector.[18]

4.2.2 Policy context for climate change

Seychelles adopted a National Climate Change Strategy (NCCS) in 2009, a National Energy Policy in 2010, and the Seychelles Energy Bill was enacted in December 2012. Central to the NCCS is the mainstreaming of climate change into sustainable development as a national cross-sectoral programme addressing matters of policy, institutions, capacity building and civil society involvement. The 2011 SNC highlighted the need to prepare a National Climate Change Strategy and Action Plan (NCCSAP) to address climate change and its adverse impacts. The national Seychelles Sustainable Development Strategy 2011–2020 (SSDS) was adopted in December 2011, with climate change as a major chapter. Plans for 2012/2013 were to complete mainstreaming climate change into all key sectors of the SSDS 2011-20, and to revise the Town and Country Planning Act and Environment Protection Act to accord with the NCCS. Further relevant policy and legislation includes the following: (i) a new Environment Protection Bill, currently being finalised; (ii) the National Disaster Management Policy; and (iii) the Seychelles Sustainable Tourism Master Plan 2012-2020, the main objective of which is to promote responsible tourism. A Seychelles Sustainable Tourism Label (SSTL) has also been launched, but it is unclear whether this includes specific climate change aspects.

4.2.3 Institutional arrangements for Climate Change

The Ministry of Environment and Energy has primary responsibility for environmental policy, legislation and climate change issues. Within the Ministry, the Climate Affairs, Adaptation and Information (CAAI) Division includes the Seychelles National Meteorological Services (SNMS), which provides weather and climate services for the development and coordination of climate change adaptation and mitigation activities as per the National Climate Change Strategy

[18] http://www.unisey.ac.sc/university

(NCCS), and to guide the Environment Department on Climate Change negotiations, environment policies, law and international treaties.[19] The NCCS is being implemented with steering and monitoring from the National Climate Change Committee (NCCC). The main functions of the NCCC are to:

- Provide an overall co-ordination of the development and implementation of the National Climate Programme and Climate Change Research;
- Develop a plan of action that identifies high priority multidisciplinary tasks to be promoted within the National Climate programme;
- Act as an interface between the National Climate Programme and the government; and
- Maintain national and relevant international climate change information (inventory) at the National Climate Change Information Centre located at the Meteorological Services.

Stakeholder engagement: The SNC process resulted in an elevation of climate change issues on the national agenda through strengthened cooperation and increased involvement of all relevant stakeholders in the process. The SNC process further included a national education and awareness programme on climate change in the water sector, which was felt to have truly succeeded in mobilising both teachers and students throughout the country. Several multi-stakeholder workshops were held to develop the Rio+20 national report, in which climate change was mainstreamed.

4.3 Research and development frameworks

A National Research and Development Council Act was developed in 1980, but this is apparently not in force. The Council would have had the role, inter alia, of collecting and collating information on research and development of relevance to Seychelles, and of evaluating and disseminating research findings. The need for an overarching and strategic research framework to guide and co-ordinate research on climate change and CCD was identified by this mapping study as a key action to enhance research on and response to Seychelles' climate change priorities.

4.4 Some current CCD initiatives and programmes

While there are a number of CCD initiatives and programmes active in Seychelles, driven by government, NGOs, donors, and the private sector, limitations and the required focus of this institutional analysis meant that only a few of these have been identified. Table 6 sets out some of these initiatives. This list is not comprehensive, but rather illustrative of how some of the priorities and needs identified above are already being addressed. More comprehensive national analysis would be able to expand the insights into existing active programmes.

[19] http://www.meteo.gov.sc/, accessed 18 November 2013.

Table 6: Some CCD initiatives and programmes in Seychelles

Programme / Initiative	Driving agency / department	Focus and timeframe	Status / additional comments
Seychelles Climate Change Support Programme	Implementer: Government of Seychelles, EU, Global Climate Change Alliance	2010 to 2013: Budget support for climate change and sustainable development policy and implementation; create institutional and legal framework to promote renewable energy and energy efficiency	Aim is to mainstream climate change into national development policies and key sector strategies and action plans
Ecosystem based adaptation (EbA) to climate change in Seychelles	Ministry of Home Affairs, Environment, Transport and Energy UNDP/GEF Adaptation Fund	2012 to unknown date Water resources; will address water scarcity and coastal flooding through ecosystem based measures of restoring or maintaining key ecosystem services in the coastal and hinterland areas	EbA to be mainstreamed into development planning and financing. Strong knowledge management focus on EbA, to include awareness raising targeting decision makers and coastal communities
MSV Ecosystem based adaptation project	Many Strong Voices, UNEP, CICERO, communities, government	2013 to 2015: Empower communities to make informed choices on climate change	Integration of scientific and traditional knowledge. Case studies from Seychelles and Belize
Five Frameworks Act	UNDP and GEF Programme coordination unit	Timeframe unknown: Policy development	Sets of legal frameworks for environment protection and minimising climate change impacts
La Digue and Praslin demo projects	UNDP and GEF Programme coordination unit	Timeframe unknown: Awareness activities, community development Renewable energy through solar panels and water harvesting	Data analysis, gaps identification, indicators for climate change MNE Focussing on climate change
Actions on policy reviews, enforcement/ monitoring and implementation	Ministry of Environment and Energy	Timeframe unknown: evaluation of projects, EIAs, protection measures, policy enforcement and coastal zone management works.	Working with United Nations Framework for Climate change

Programme / Initiative	Driving agency / department	Focus and timeframe	Status / additional comments
Education and awareness programmes for tourism/general public	Sustainability for Seychelles	Promotes sustainable living through projects: CC workshops, waste management, rainwater harvesting and energy efficiency	Outreach, policy development. Project implementation in community development. Project implementation in collaboration with the tourism establishments.
Promote Seychelles sustainable tourism label programme in tourism establishments	Seychelles Tourism Board	Promote risk and disaster management programmes within the tourism sector. Outreach programmes for education and awareness on sustainable tourism practices	Most components of the programme are linked with CC adaptation.
Capacity building for school environment leaders on climate change	Ministry of Education, Environment Education Unit	Focus on climate change and how it can be integrated across different subjects. Focus on impacts of climate change	They would like to include specific CCD components in workshops/ training organised
Mangroves for the Future: Coastal environmental protection and sustainable	Mangroves for the Future	Projects relating to coastal environment s/ environmental protection, sustainable development/ community engagement with strong focus on resilience.	Environmental focus/ concept of CCD are embedded in formulation of projects
Plant conservation education	Plant Conservation Action	Raise awareness on plant conservation through outreach education	Linked climate change to plant conservation livelihood
Research and outreach Regulatory activity	Seychelles National Parks Authority	Biodiversity conservation projects (restoration of degraded ecosystems)	

Note: The list is not comprehensive.

It is evident from the above table that Seychelles has made a strong and positive linkage between sustainable tourism and climate change adaptation. This is underpinned by both government, in the form of the Seychelles Tourism Board, and by NGOs. Similarly, both government structures, such as the Ministry of Education environmental education unit, and NGOs such as Sustainability for the Seychelles, Plant Conservation Action and Mangroves for the Future, have dedicated programmes on environmental education, in many of which climate change is embedded. It is clear that NGOs and donor-supported programmes are playing a key role in supporting climate change-related activities in Seychelles.

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

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

As mentioned above, the National Seychelles Sustainable Development Strategy 2011–2020 (SSDS), adopted in December 2011, is the umbrella national policy for climate change, in terms of which the 2009 National Climate Change Strategy (NCCS) should be read. Mainstreaming climate change – impacts, adaptation and mitigation – into all sectors of the key economy is a key thrust of the NCCS.

From the workshop and questionnaire data it can be seen that the concept of CCD has different meanings and lends itself to a diversity of contextual interpretations. It is also multidisciplinary, and multi-faceted and has diverse research and capacity building implications. This was further explored in the workshop which brought in regional perspectives, stressing that there is need for alternative development options that are continually responsive to changing climate change and emerging global and regional development paradigms related to climate which take into account what is happening in the region in and around Seychelles. Linked to this was the need to see CCD as not a static concept, but rather as an emergent and evolving research area that needs to include indigenous forms of mitigation and adaptation.

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

- Development approaches that minimise advance impacts of CC while maintaining economic growth and social development.
- Development/innovation that responds to the climate changes taking place for the benefit of the human race. It forms an integral part of sustainable development.
- Development that minimises the harm caused by climate impacts while maximising the many human development opportunities.
- I understand CCD to be similar to the concepts of climate smart development and resilience, which are a central focus of MFF projects.
- Development that limits carbon emissions in the atmosphere and is resilient to climatic conditions and the effect of climate change.

- Development that mainstreams climate change risks during planning and project phases Climate proofing/ resilience. Helping communities to adapt to CC either through outreach/awareness or providing affordable technology.
- Development (including infrastructure, education, economic etc) that will/are being done alongside considerations of climate change.
- Development that minimises harm and side effect caused by climate change or impact, while maximising the human development opportunities by a low emission and more resilient future.
- Development which will help with the mitigation and adaptation of climate change impacts.

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 while the concept of CCD is relatively new to some of the stakeholders, others have a sophisticated understanding of this, which may comprise concepts of resilience and of maximising opportunities in the process. Context also has an influence on how CCD is understood, and influences meaning making and understanding of the concept. This has important implications for knowledge co-production processes, and will require careful engagement in development of mutual understanding in such processes.

4.5.2 Current research related to Climate Compatible Development

4.5.2.1 General view

According to the SNC, while there have been a number of workshops and conferences aimed at raising awareness on the issue of climate change, programmes aimed at building capacity for climate resilience and adaptation are virtually non-existent. In addition to this, the SNC reports that a curriculum review has revealed that while there is support for environmental education initiatives, climate change as a topic in itself still needs to be incorporated into the curriculum at different levels. Despite this there is obviously willingness to participate in climate change research, on the part of organisations such as Sustainability for Seychelles, Mangroves for the Future, the Seychelles Ocean Temperature Network and other international partnerships such as the Sea Level Rise Foundation and the Island Conservation Society. Current research related to climate change focuses mainly on coastal marine development, climate change and tourism, fisheries and water security, including elements of waste management. Higher Education Institutions potentially involved in climate change research are limited to the University of Seychelles: however, given that this is a new institution, with the focus of the Department of Environmental Science being mainly on curriculum development, the research possibilities have not yet been implemented. Research appears to be mainly carried out in local NGOs and regional/international organisations such as the UNDP, which has collaborated with the University of Seychelles to develop curriculum.

While not present at the workshops, background research into the Second Communication to the UNCFF (SNC 2011) revealed a number of prolific climate change researchers in Seychelles:

Dr Denis Chang Seng[20], who helped draft the SNC, and Professor Rolph Payet, currently Minister of Environment and Energy, and Pro-Chancellor of UniSey.

Dr Denis Chang Seng is currently a research associate at the Institute for Environment and Human Security at the United Nations University, and previously carried the position of acting Director at the National Meteorological Services, Policy, Planning and Services of the Ministry of Environment and Natural Resources in the Seychelles. Dr Chang Seng's publications address mainly the water sector in the Seychelles, exploring various associated climate change related development and adaptation issues, and adaptive disaster risk reduction.

- Chang Seng, S.D. et al. 2010: Seasonal Response of Lettuce to Weather Stresses and Implications of Climate Change on Crops in the Seychelles, UNDP, Seychelles.
- The following publications by Dr Chang Seng were written in 2009 to inform Seychelles Second National Communication (SNC) under the United Nations Framework Convention on Climate Change (UNFCCC):
  - Climate Change Adaptation in the Water Sector in the Seychelles:
  - Education and Awareness in the Climate Water Sector
  - A Case Study on Rain Water Harvesting Potential in Victoria, Mahe, Seychelles as an Adaptation Strategy to Climate Change
  - Hydro-Climate Statistical Prediction of Seychelles Dry Season
  - A Modeling Assessment of Climate, Socio-Economic and Technological Change Impact on the Water Resource

His broader international research is also very useful for considering climate change compatible development more generally:

- Chang Seng, S.D. 2012. "A Conceptual Framework for Early Warning System Governance: Towards Effective and Sustainable Resilience," *IDRIM Journal* (forthcoming).

  Chang Seng, S.D. and J. Birkmann. 2011. "Migration and Global Environmental Change : SR4b: Early Warning in the Context of Environmental Shocks: Demographic Change, Dynamic Exposure to Hazards, and the Role of EWS in Migration Flows and Human Displacement". Foresight Project, Government Office for Science, UK. www.bis.gov.uk/foresight/our-work/projects/published-projects/global-migration/reports-publications; www.bis.gov.uk/assets/bispartners/foresight/docs/migration/science-reviews/11-1123-sr4b-early-warning-systems-for-environmental-shocks-demographic.pdf

- Birkmann, J., S.D. Chang Seng and D. Suarez. 2011. "Adaptive Disaster Risk Reduction in the Light of Climate Change". Ed DKKV, Germany. www.dkkv.org/de/publications/ressource.asp?ID=302
- Prepared Chapter 7 (DKKV 2010): Emerging Challenges for Early Warning Systems in Context of Climate Change and Urbanization. www.unisdr.org/publications/v.php?id=15689

[20] Dr Denis Chang Seng: Tel + 49-228-815-0242 and e-mail: changseng@ehs.unu.edu

Professor Rolph Payet was a lead author on the 2007 IPCC Fourth Assessment Report. His research interest has focused on islands, climate change and biodiversity, coastal zone management, and tourism development, within a sustainable development umbrella. Some of his more recent publications include the following:

- **Payet R.A.** 2007. "Impact of Climate Change on tourism demand in Seychelles and socio-economic implications." In *Climate Change and Adaptation,* edited by N. Leary, J. Adejuwon, V. Barros, I. Burton, J. Kulkarni and R. Lasco. London: Earthscan.
- Leary, N., J. Adejuwon, J. W. Bailey, V. Barros, M. Caffera, S. Chinvanno, C. Conde, A. De Comarmond, A. de Sherbinin, T. Downing, H. Eakin, A. Nyong, M. Opondo, B. Osman, **R. Payet**, F. Pulhin, J. Pulhin, J. Ratnasiri, E. Sanjak, G. von Maltitz, M. Wehbe, Y. Yin and G. Ziervogel. 2006. *For Whom the Bell Tolls: Vulnerabilities in a Changing Climate*. AIACC Working Paper No. 21. Washington, DC: START, 2006.
- **Payet, R.A**. and W. Agricole. 2006. *Climate Change in the Seychelles – Implications for Water and Coral Reefs*. AMBIO, 35 (4):182.
- **Payet, R.A.** 2006. "Sustainability in the context of coastal and marine tourism in Seychelles". PhD thesis, Department of Biology and Environmental Science, University of Kalmar, Sweden.
- **Payet, R.A.,** J. Bijoux, J. Adam. 2006. "Status and Recovery of Carbonate and Granitic Reefs in the Seychelles inner islands and implications for Management," CORDIO 2005 Status Report, Kalmar, Sweden.
- **Payet, R.A.** 2006. "Decision Processes for Large Marine Ecosystems Management and Policy," *Ocean and Coastal Management* 49: 110-132.
- **Payet R.A.** 2005. "Climate policy implications of the recent ENSO events in a small island context". In *Climate and Africa*, edited by Pak Sum Low, 229-237. Cambridge University Press.
- **Payet R.A.** 2005. "Research, assessment and management on the Mascarene Plateaux: A Large Marine Ecosystem Perspective," *Phil. Trans. R. Soc A* 363: 295-307.
- Sheppard C., D. Dixon, M. Gourlay, A. Sheppard and **R.A**. **Payet.** 2005. "Coral mortality increases wave energy reaching shores protected by reef flats: Examples from the Seychelles," *Journal of Estuarine, Coastal and Shelf Science* 64: 223-234.
- **Payet, R.A**., N. Soogun, E. Ranaivoson, R.J. Payet and F.A. Abdallah. 2004. "Indian Ocean Islands - GIWA Regional Assessment 45b". Global International Waters Assessment (GIWA). University of Kalmar, Kalmar, Sweden.
- **Payet, R.A.** 2004. "Coral Reefs in Small island States: Status, Monitoring Capacity and Management Priorities," *International Journal of Island Affairs*, Special Issue: Island Biodiversity-sustaining life in vulnerable ecosystems (February 2004): 57-65.
- **Payet, R.A.** and D. Obura. 2004. "The Negative Impacts of Human Activities in the Eastern African Region: An International Waters Perspective," *AMBIO* 33 (1): 24-33.
- Cesar H., P. van Beukering, **R.A. Payet** and E. Grandcourt. 2004. "Evaluation of the socio-economic impacts of marine ecosystem degradation in the Seychelles". Cesar Environmental Economics Consulting, Netherlands. Unpublished Report.
- Obura, D., O. Linden, **R.A. Payet,** M. Richmond, C. Sheppard, D. Souter and D. Wilhelmson. 2004. "Coral reefs of Cosmoledo Atoll in the Aldabra group of Southern Seychelles: status and prospects in a changing world". In Proceedings of the 10th International Coral Reef Symposium. 27 June – 2 July, 2004. Okinawa, Japan.

- **Payet. R.A.** 2003. Integrated Coastal Zone Management in Seychelles, In: *Successes and failures of Integrated Coastal Zone Management in Eastern Africa and Island States, 1996-2001* (Volume 2), edited by C. Voabil and S. Engdahl, 121-148. Mozambique: SEACAM Publication.

In addition to the work of Dr Chang Seng and Professor Payet, other valuable research was uncovered in background research focusing on monitoring GHG, climate change and health and monitoring ocean temperature in relation to fisheries in the Seychelles:

- GoS. 2009: Technologies and Measures for the Mitigation of GHG in Seychelles, National Climate Change Committee.
- Henriette-Payet E. And S. Julienne. 2009. Impact of Climate Change on the Health Sector. Enabling activities for the preparation of the Seychelles second national communication to the United Nations Framework Convention on Climate Change. National Climate Change Committee. Seychelles.
- Robinson, J., C. Gerry and J. Bijoux. 2009. Fisheries and Marine Environment Sector (Establishment of the Seychelles Ocean Temperature monitoring Network-SOTN). Enabling activities for the preparation of the Seychelles second national communication to the United Nations Framework Convention on Climate Change. National Climate Change Committee.

A rapid review of published research available on Google Scholar (first ten articles listed with 'climate change Seychelles' in the search) provides a further assessment to uncover research conducted on climate change in Seychelles, and what role Seychelles plays in the regional and international climate change and CCD community. Five articles were observed relating to Seychelles.

Table 7: First ten articles listed with 'Climate Change' and 'Seychelles' in the search and the origin of the first author

Article	Origin of first Author
Pearce-Kelly, P. 2011. "The potential effects of climate change on the status of Seychelles frogs (Anura: Sooglossidae)," *Journal of Threatened Taxa* 3(11): 2153-2166.	Seychelles
Payet, P.A. 2009. "Climate Change and the tourism dependent economy of the Seychelles" (Chapter 8). In *Climate change and adaptation* (Volume 2), edited by Neil Leary. Earthscan.	Seychelles
Gössling, S., and K.P. Schumacher. 2010. "Implementing carbon neutral destination policies: issues from the Seychelles," *Journal of Sustainable Tourism* 18(3): 377-391.	Sweden
Cinner, J. E., T.R. McClanahan, N. A. J. Graham, T.M. Daw, J. Maina, S.M. Stead, A. Samukota, K. Brown and Ö. Bodin. 2012. "Vulnerability of coastal communities to key impacts of climate change on coral reef fisheries," *Global Environmental Change* 22: 12-20.	Australia
Bombi, P., M. D'Amen. J. Gerlach and L. Luiselli. 2009. "Will climate change affect terrapin (*Pelusios subniger paritalis* and *P. castanoides intergularis*) conservation in Seychelles?" *Phelsuma* 17A: 1-12.	Italy/Seychelles

While only five articles were found through this Google Scholar search, it is encouraging to see that there are a range of different research publications available regarding climate change in Seychelles, and that two out of the five publications with the title including "climate change" and "Seychelles" published within the last two years were published by researchers from the Seychelles. The articles/chapters focus on biodiversity, policy development, coastal and marine conservation and tourism. Overall it seems that climate change related research in Seychelles is predominantly carried out on tourism, water security and the impact of climate change on marine ecosystems and coastal communities. This reflects the heavy reliance of Seychelles' economy and livelihoods on tourism and fisheries, as well as the growing water scarcity in the country. While the latter is related to the lack of water storage infrastructure, combined with population growth and residential and other forms of development, policy documents highlight the likelihood of negative effects on water availability from a number of climate change-induced effects. While limited search results were obtained in this particular search, this must be seen within the context of the additional research papers and reports mentioned above.

4.5.2.2 University-based research

Unsurprisingly, considering that UniSey was only inaugurated in 2010, the Seychelles questionnaire and workshop data showed little to no diversity of climate change related research within university faculties and departments. Only one participant answered the questionnaire and the workshop data provided only one example of climate change research.

Table 8: Diversity of university faculty and department involvement in CC research

Faculty / School / Centre	Department	Programmes / Institutes
University of Seychelles, Science Faculty	Environmental Science	Research for geography and environment (students dissertation)
University of Seychelles	Previous Vice Chancellor[21]	Climate Change and tourism, economics, conservation, management and policy

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

Workshop and questionnaire data showed that the majority of climate change-related research undertaken in the Seychelles emerges from NGO conducted research, government commissioned research for policy documents and the national communications process, and other international sources. The University of Seychelles respondents stated that their climate change-related work mainly focuses on teaching (practical and theory), while there is

[21] Professor Rolph Antoine Payet is founding member/trustee of the Global Island Partnership, the Sea Level Rise Foundation, the Seychelles University Foundation, the Seychelles Centre for Marine Research and Technology, the Island Conservation Society and the Silhouette Foundation. Dr Payet has also been instrumental in increasing the visibility and impact of numerous regional and international organisations such as the International Coral Reef Initiative (co-chair from 2003–2005), the Global Forum on Oceans, Coasts and Islands, and the Interim Coordinator of the Nairobi Convention UNEP Regional Seas Programme.

postgraduate research related to climate change in Geography and Environmental Science. The University's centre for environmental education is in collaboration with the Wildlife Clubs of Seychelles (WCS). NGOs currently play a greater role in research than the University itself, while there is collaboration on the part of international programmes and NGOs with UniSey in curriculum development, for example in developing climate change-related course modules.

Associated with these research initiatives are a number of active researchers, who were mentioned in workshop and questionnaire data. These active researchers are mainly not in the university sector, but are from NGO, government and private sectors. These researchers are listed in a table in Appendix B.

4.5.2.3 Centres of Expertise[22]

Potential centres of expertise in climate compatible research in Seychelles were identified as:

- Department of Environmental Science, University of Seychelles;
- Sustainability for Seychelles;
- UNDP - GEF Programme coordination unit;
- Mangroves for the Future; and
- Ministry of Environment and Energy.

With regard to **research networks** mentioned in the workshops and questionnaire data, two stood out. A major network operational in Seychelles is the NGO **Sustainability for Seychelles**, which works with various organisations and individuals in the Seychelles in the areas of environmental education, climate change adaptation and mitigation. Secondly, **ENGOs (Environmental Non-Government Organisations)** work in connection with the Ministry of Environment and Energy. The network, liaises with various organisations for pooling data on research and innovation practices in the tourism sector associated with climate change and CCD.

4.5.3 Curriculum innovations and teaching for CCD

The University of Seychelles currently offers two relevant degrees: one in Geography and the other in Environmental Science, oriented towards responding to environmental challenges, and which include climate change. An undergraduate BSc course in Environmental Science (with specialisation in climate change and others) has been developed at University of Seychelles[23], while the UNDP/GEF programme has supported the University of Seychelles to

[22] Centres of Expertise refers to already established research centres or institutes most often operating at university level, or between a number of universities with networked partnership links (these may be national or international). A research network refers to interest-based research groupings that convene regularly to discuss or debate research or concerns relevant to CCD.

[23] More information on this can be obtained from the course developers, Ms Sherley Marie, Dean (Sherley.marie@unisey.ac.sc) and Ms Kelly Hoareau (Kelly.bucas@unisey.ac.sc).

develop course modules in climate change. In addition to this, although not a tertiary level course, the Sustainability for Seychelles network has developed education and awareness programmes for tourism establishments for good sustainable practices in their daily operations.

The mapping study consultations were felt to be happening at a fortuitous time, as UniSey was currently developing the third year specialisation in climate change in its BSc Environmental Science, and the discussions would provide an opportunity to see where the specific needs were, which could be incorporated into this specialisation. Given the evolving nature of the UniSey curriculum, it is not possible at this stage to further examine the scope and focus of the integration of CCD. At an appropriate stage, the University-based questionnaire (esp. Section C) in Appendix C could be used by *both faculties and all departments* within the university, to both explore and possibly motivate for further mainstreaming of climate change and CCD in departments other than the environmental science one. The questionnaire could be introduced to all staff in the university, preferably at Departmental level to obtain a clearer view of how CCD is / is not being integrated into teaching, and where the 'gaps' are for new development of CCD content into either existing programmes or into the design of new programmes. Such a process would advisably be led by the Academic Registrar of the university to ensure consistent and comprehensive data.

Teaching methods adopted by the University of Seychelles go beyond lectures and traditional practice and incorporates social, experiential forms of learning through community surveys, community action research and field visits and visits/activities with CCD. Inter- and transdisciplinary approaches to curriculum innovation are discussed in section 5. There was emphasis in the workshop on innovative approaches that develop a sense of excitement in the subject, rather than "doom and gloom", and on making sure that climate change and CCD are integrated across the board, even if this means that some people would cover the subject several times, in different degrees and courses. This would be essential, given the rapidity with which the subject is evolving, and the need for iterative approaches and processes given the inherent complexity and uncertainty – for example, with respect to climate projections and modeling.

> *"I am 55 years old, I am in the troisième age. I trained as a food inspector, I went to university relatively late to do a Masters degree. The reality is that you cannot study anything in an isolated context anymore. You cannot study anything by avoiding CCD. So it is very important, you cannot treat a subject in isolation. If you are to survive, because we are evolving so fast, you need to connect."*
>
> Senior business and industry manager, Seychelles

The Ministry of Education is currently working on a new curriculum on climate change for primary education. Two relevant institutions are the Environmental Education section in the Ministry of Environment and Energy, and the Environmental Education Unit within the Ministry of Education. The disaster reduction division (DRDM) has its own environmental education unit. All schools have environment representatives, for whom the EE unit organises training; lately climate change issues have been included in this training. Thus it appears there is significant attention given to enhancing the integration of climate change into the school

curriculum, in which it already does appear, as well as several institutions that are able to collaborate on this matter.

4.5.4 Community and policy outreach

The limited questionnaire data reveals no information regarding the contribution of university staff to policy and community outreach. However, further investigation has revealed that in the past, Professor Payet as well as Dr Cheng Seng have contributed thoroughly and deeply to relevant policy processes in Seychelles. UniSey's teaching methods that incorporate social, experiential forms of learning through community surveys and community action research do constitute community outreach and engagement activities. It is not clear to what extent research on the part of any of the university staff involves this element. One of the workshop participants was a lecturer on early childhood development, and is also a Wildlife Club leader, and she has been engaged in awareness raising on climate change and related issues in the university. While there are some promising activities on the part of the university towards stronger community and policy engagement, this seems to be an area in which further efforts could be made to develop a more strategic approach, firstly by identifying in a more coherent fashion what has already been carried out, and then identifying the opportunities for further development of these two important outreach areas for the university.

4.5.5 Student involvement

Other than the Environmental Science students at the University of Seychelles, little information was provided on student involvement in climate change and CCD in Seychelles, apart from mentioning that student dissertations do sometimes encompass this area. The workshop discussions noted the collaboration between government environmental education units and the Wildlife Clubs of Seychelles, found in each school, which may provide further opportunities for students to be more actively involved.

4.5.6 University collaboration and networking

There was a great deal of discussion in the workshop on the need for more collaborative partnerships to address climate change and CCD, building on those already in existence. Concrete suggestions are provided in section 4.6.1. Positive existing examples include the strong partnership between UniSey and the private sector, enabled by a Memorandum of Understanding and including sponsorship by the private sector of some students; and the collaborative partnerships between government, NGOs and UniSey for CCD curriculum development, noted above.

The sole questionnaire respondent from the University of Seychelles mentioned that they were currently engaged in collaboration with other universities and organisations; however further details were not provided. They did highlight engagement with other universities on providing internships, and involvement in a variety of networking processes with NGOs and government. Specific networks for climate change and CCD identified in the questionnaires include:

- SADC REEP: SADC Regional Environmental Education Programme;
- EEASA: Environmental Education Association of Southern Africa;
- Indian Ocean Commission;
- Various local NGOs including the Wildlife Clubs Seychelles (WCS), Sustainability for Seychelles (S4S) and Nature Seychelles;
- Red Cross/Red Crescent (RC/RC) Climate Centre;
- Seychelles Ocean Temperature Monitoring Network;
- Global Island Partnership;
- Sea Level Rise Foundation;
- Seychelles University Foundation;
- Seychelles Centre for Marine Research and Technology; and
- Island Conservation Society.

The institutional analysis thus indicates a high level of *potential* for knowledge co-production partnerships, building on the existing knowledge partners for CCD knowledge co-production in Seychelles. Table 9 shows these 'mapped' out, with ascribed roles provided in Table 10 (as per workshop discussions).

Table 9: CCD Knowledge co-production partners (potential, with some already actualised)

Research organisations	Civil society organisations	Private Sector	Government	Regional organisations	International organisations
▪ University of Seychelles ▪ Department of Environmental Science ▪ Environmental Education Department	▪ Sustainability Seychelles ▪ Nature Seychelles ▪ Plant Conservation Action ▪ Mangroves for the Future	▪ Various Tourism operators in Seychelles	▪ Seychelles National Parks Authority ▪ Ministry of Environment and Energy ▪ Seychelles Tourism Board ▪ Ministry of Education, Environment Education Unit ▪ Public Health Department, Public Health Services,	▪ SADC REEP	▪ UNDP-GEF Programme coordination unit

During the workshop, different roles were ascribed to different partners involved in the knowledge co-production process, as set out in Table 10.

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

Universities	Private sector/Other	Donors	Governments
▪ Train students and promote research in various fields with regards to climate change ▪ Create platform for networking in CCD ▪ Produce graduates and professionals in CCD ▪ Enhance partnership between universities and local actors ▪ Lead research in CCD issues and collaborative research with other climate change related institutions e.g. meteorology, environment, health, agriculture ▪ Building capacity: forestry related activities/ meteorology/ coastal zone management. ▪ Include local benefits of CCD in curriculum ▪ Develop new programmes ▪ Help to develop and promote community projects ▪ Host national and international CCD events ▪ Undertake continuous research in CCD ▪ University sector should be the main actor to initiate research works, knowledge sharing	TRADITIONAL HEALERS: ▪ Support HEIs' research/teaching/ learning on the role of indigenous knowledge/cultural practices in CCD	CONSERVATION SOCIETIES: ▪ Provide baseline info on flora NGOS: ▪ Exchange of climate change information ▪ Data collection and reporting by scientific and governmental collection ▪ Provide baseline information on fauna and biodiversity in general	MINISTRY OF EDUCATION: ▪ Developing a curriculum framework incorporating CCD MINISTRY OF ENVIRONMENT: ▪ Partner with HEIs to raise moral and value- based environmental protection

Table 10 has collated the roles identified by workshop participants, which would need to be further discussed and developed within the country. The table also shows that while there is a range of potential partners in CCD knowledge co-production, Seychelles stakeholders ascribe many potential roles to the university. It will take some time, and consistent effort, as well as support from the other stakeholders, for the university to build on its promising start and take up all of these roles. Development of a strategic national research framework on climate change and CCD in Seychelles, as noted elsewhere in this report, could provide an important initial step, as could addressing the key enablers for knowledge co-production identified in the workshop, and set out in Table 11.

Table 11: Key enablers to ensure co-production and use of knowledge

Universities & the HEI sector	Private sector	Donors	Governments
▪ Allow different persons to participate on strategic / decision making committees ▪ Hold meetings with stakeholders on how we can collaborate effectively ▪ Clear agreement on authorship ▪ Review the work load policy at the University ▪ Develop policy to enable transdisciplinary research at University of Seychelles ▪ Balance between staff engagement and research ▪ Other activities should feature in university policies ▪ Remuneration should be based on staff engagement in quality research ▪ Set up a research centre ▪ Invest in capacity building in research ▪ Change from being consumers only to authors	▪ Stronger collaborative communication ▪ Communicate opportunities to UniSey ▪ Collaborate with the University for research/ tenability studies of projects within their respective sector. ▪ Offer funding opportunities: funding for scholarships for empowerment, fund community projects to implement CCD ▪ Better engagement for CSR in financing research work ▪ Lobby to reform fiscal policy commercialisation and giving value ▪ Making business and financial sense of the knowledge produced	▪ Communicate funding opportunities to UniSey ▪ Communicate/providing capacity for effective writing of proposals ▪ Forum for exchange between research/skills base and organisations ▪ Better system of auditing and monitoring ▪ Finance research relevant to National needs ▪ Facilitate financing of CCD research ▪ Implementing development funding ▪ Do more marketing and advertising for the local community and finding opportunity for projects ▪ Identify donor criteria for funding research ▪ Encourage duding/emerging researchers (fair allocation of research grant) ▪ Targeted funding to put policy changes in practice e.g. in the community ▪ Recognise sole researchers who want to advocate knowledge (in grant application) ▪ Promote areas of potential funding and educate organisation on the types of projects where funding may be granted	▪ Provide incentives for private sector to invest more in environmentally friendly technology ▪ Have strategic planners who will communicate their plans ▪ Communicate areas of need for research with University of Seychelles ▪ Specific feedback on what the government needs to be able to implement e.g. SSOS (Blue Economy) ▪ Should be engaged in research and evidence based on decision-making ▪ National Human Resource Development Council (NHRDC) should allocate environment courses at university to students so that they can get a wide range of expertise ▪ Make provision for research in budget ▪ Use more research findings for informed decision making ▪ Use the University for more research on policy formulation ▪ Respect academic freedom of university staff

Table 11 shows a range of different enabling factors/steps to promote collaborative research on climate change in Seychelles, for each of the main stakeholder groups. For example, the private sector is seen a potentially an important enabler through the modalities of collaboration, communication, funding, and working with the university on commercialisation of CCD technology – an important step in giving value to what is being done. These enabling factors could be further discussed, contextualised and developed through an in-country process, which could be led by UniSey.

4.5.7 University policy and campus management

Due to the limited information received from the questionnaire process, we are unable to report on any university policies or campus management systems responding to climate change and CCD.

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

4.6.1 Building collaborative partnerships

Discussions in the workshop on 'who is doing what and how' led to some high quality reflections on the status quo, and what could be done differently. These show that Seychelles stakeholders and researchers have good understanding of what needs to be strengthened and what could be done differently when it comes to CCD in research, teaching, outreach and networking in their contexts.

At a university level, it was reported that more climate change related components could be developed for curriculum development. The need for improved partnership networks within and across the faculties was stated, as well as similar networks with the private sector and other stakeholders. Finally, it was suggested that integration of climate change components in the national Science and Technology Fair would be a further step to improve and widen CCD capabilities in Seychelles. All the above could be assisted through the university creating a stimulating platform for climate change, even an e-platform.

A variety of other specific ways forward were suggested by other participants from NGOs, Government and the private sector:

- Sensitise the business community on opportunities relating to CCD;
- Stronger links to implementation/ responsibilities/ funding opportunities;
- More awareness of CCD;
- Set up/ reviews guidelines on CCD for developers and planners; and
- Seychelles National Parks Authority identified the possibility of establishing collaboration between the meteorological office and SNPA, focussing on training and research (meteorological data analysis and interpretation).

In addition to this, government representatives all felt that improved collaboration with the University of Seychelles was needed to improve their capacities to respond to climate change and incorporate CCD. Overall, this shows that responding to the current situation in Seychelles

with a view to 'doing things better, requires an integrated approach, and will require especially the participation of university and government leadership, but also leadership of other stakeholders (e.g. business).

> *"We hope that the university can become the place that people go to, to find out who is doing what, and how to further research on this."*
>
> University professional, Seychelles

4.6.2 Strengthen and expand understandings of CCD

As shown in section 4 above, while CCD may be a relatively new concept to some stakeholders and university researchers, for others it was a very familiar and integrated part of their operations, research and teaching. In general, the mapping study has identified the need to create an integrated knowledge of CCD across society, and to test climate responses that work through action-oriented research.

Linked to the need to strengthen and expand of understandings of CCD, workshop participants stressed the importance of integrating this into a Seychelles' education system, including public education and grass roots community programmes. With Seychelles' particular vulnerability to sea-level rise and natural disasters in the Western Indian Ocean, the Ministry of Environment and Energy has recognised the significance of these hazards and is focused to further explore CCD in the country.

Given that the NCCS was designed as a working document, to be periodically reviewed and revised/enhanced, an element of a future review of this could include the development of a common understanding of the core issues of Climate Compatible Development. This broad societal understanding could then be expanded to develop a knowledge co-production process to address national priorities.

> *"The whole issue is: what are the business opportunities? We know it is there, it is already coming, it will come more and more. Perhaps I have the privilege in having knowledge across a wide range of sectors. As private sector of Seychelles, it is important that we are confident in the future –- there will be a transformation of the economy, and there will be more opportunities. When we talk about environmental conservation, we need to do a lot more, including research. We are already paying to support this in our taxes."*
>
> Senior business and industry stakeholder, Seychelles

4.6.3 Capacity building for CCD and staffing

There was a strong call for capacity building, particularly for undertaking research but also for integrating CCD into curriculum and teaching. Workshop participants suggested developing a network of researchers and practitioners on Human Resources development for CCD, building on the existing collaboration between NGOs, government and UniSey on climate change-related curriculum development. This could be expanded to include the private sector as well,

which would have the added advantage of ensuring that courses developed meet the needs of business and industry, thus also helping to ensure employment for graduates.

Given the multidisciplinary nature of climate change, and the desirability of inter- and transdisciplinarity for addressing complex climate change problems in a solution-oriented manner, such capacity building should take both a specialist (to develop specialist research capacity) and a multidisciplinary approach, that allows for knowledge exchange and the development of collaboration. Capacity building interventions should be developed in line with the relevant key objective (and related activities) of the National Climate Change Policy on building capacity and social empowerment at all levels to adequately respond to climate change. Additionally, it is recommended that emphasis be placed on innovative teaching methods to make the subject compelling, as described in the quote below.

> *"CCD is the business of the future, so it's not a bad thing to prepare our future professionals, like it or not, this is coming. It will happen when the world business community decides it should come online. We are still busy making money out of the other technology, but it's going to come. So if we prepare our professionals today, I don't see harm. But it is the approach we take, you have to make it exciting. So the environment can become exciting, because there is a lot of money to make out of it."*
>
> Senior manager, business and industry, Seychelles

4.6.4 Curriculum development and curriculum innovation

As shown in the discussion above, climate change is currently integrated into undergraduate courses in the Environmental Science discipline. Additionally, all BEd students have two environment and sustainability education modules, with a chapter on climate change; a pass is required in both these two modules. In recognition that every discipline can contribute towards issues of addressing climate change, mainstreaming climate change and CCD into all the other courses should be pursued.

Workshop participants highlighted the need for training on climate change and CCD at all levels. The kind of training could depend on financial resources, but should encompass modules, graduate training and short courses. In Seychelles, because of the context of limited human resources, it is common for university-trained people to switch areas after training; thus it is advisable to develop and implement a diversity of training and educational interventions.

4.6.5 Research

Recommendations for building research capability for CCD in UniSey and between other stakeholders included the need for the university to focus on research activities to apply CCD models in Seychelles, as well as engaging in consultancies. A particular area identified was engaging in partnerships with the private sector for technology innovation and development, which could be commercialised to the benefit of the university area. An overarching recommendation raised with consensus across the stakeholder groups was the need to

establish a strategic national framework for research on climate change and CCD in Seychelles, to prevent the current more ad hoc approach, and to capitalise on and develop existing strengths.

A potential entry point for this lies in the requirement of the National Climate Change Strategy (NCCS) for a national research council to be established, to ensure that research is coordinated at the national level. The research council would ensure there is appropriate coordination of research and monitoring, knowledge transfer as a result of the research, and also ensure that appropriate knowledge platforms are maintained and accessible. The NCCS goes on to require that the Climate Unit within the National Meteorological Services be strengthened and appropriately staffed to ensure long-term sustained research. Reinforcing partnerships with other institutions in the region, for example Meteo-Reunion, and internationally, e.g. the Hadley Centre and the University of Hawaii's Sea Level, is called for. Additionally, the NCCS identifies the need to strengthen the capacity of the University of Seychelles and other institutions to develop research programmes and deliver capacity building programmes aimed at implementing activities identified in the NCCS.

What is clear from this picture of Seychelles's overall research concerns is the need for an expanded, more integrated, and collaborative approach to research on climate change and CCD in Seychelles, under the umbrella of a strategic national research framework. The NCCS identifies that the major constraints to this are the availability of resources and skilled staff, but also provides the entry point to providing support for many of the research-related recommendations of the mapping study, through the proposed national research council. It is recommended that the discussion on putting in place this research council be continued as a matter of priority in Seychelles, to enhance the necessary capacity development of researchers, and also to begin the process of capitalising on the research opportunities discussed in the workshop, and highlighted in the quote below.

> *"This is my first meeting with environment people, and I can see you are a different bunch. But speaking about the university point of view, one important thing is transfer of skills outside of the university. What we have achieved today which is actually tempting me to come back tomorrow is the issue of research opportunities. I see that there are opportunities and this is where I would see if I could mainstream into mathematics modelling the environmental context."*
>
> Senior university manager and academic, Seychelles

4.7 The role of university leaders

The role that university leaders play in supporting CCD research and development mostly focused on training and capacity development of expert practitioners needed in climate change adaptation and mitigation. They were also seen to be valuable as the principal actors involved in initiating research and placing necessary mechanisms for a national platform where professional knowledge and information can be shared amongst all organisations and institutions. Interestingly, respondents did not mention university leaders' role in fundraising and/or policy development. A further possibility to demonstrate leadership is in establishing on-campus demonstration projects, such as monitoring and reducing the university's

greenhouse gas footprint, and disseminating this information for both transparency and awareness raising purposes. Hosting the SARUA consultations was seen as an important step to begin developing the university's authority and visibility, as the following quote notes:

> *"The university has not hosted a conference on climate change before, this is our first one. We want to create a platform for this. If we want to become visible, we need to develop authority. And one area where we think we can develop authority is in climate change."*
>
> UniSey professional

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]

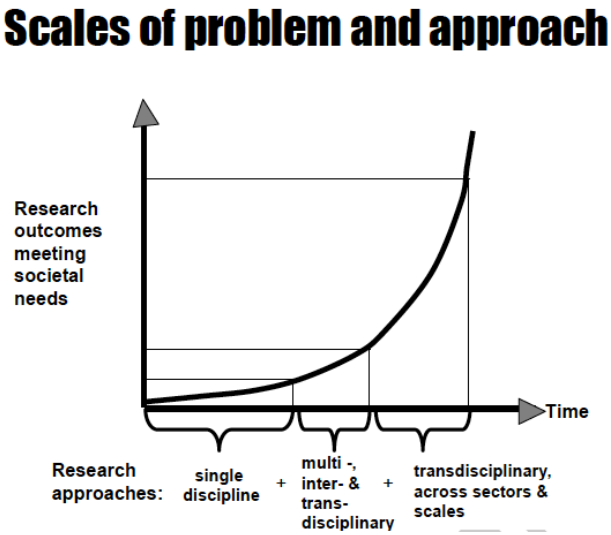


Figure 5: Research approaches

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

Transdisciplinarity

This entails using strategies from inter-disciplinary 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 much 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

The Seychelles workshop highlighted limited to no current examples of transdisciplinary research on climate change in the country. However, there are some research projects which are designed jointly with the private sector; as well as the employment of various forms of multidisciplinary research in the development of the Seychelles' environment report. Regarding the latter, a set of indicators were established for environmental monitoring; these do not have much focus on economic and business aspects, but do include indicators for monitoring development impacts. While this was not a perfect example of transdisciplinary research, the development of the state of environment report could be examined for the way in which it dealt with cross cutting / multidisciplinary aspects. A further possible example to explore was the process to measure the tourism carrying capacity of La Digue. No further details on these processes were provided by participants.

In the workshop discussions it was stressed that this form of research is very time-consuming and does not receive enough recognition. However, benefits included making more effective

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

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

use of funds allocated for research, and ensuring more effective and sustainable outcomes. It was also noted that this could provide a way to overcome the disconnect between policy makers and universities, which related to policy makers not making use of research enough, because they do not understand it.

> *"Everyone has a role in society. Decision makers have to be accountable for the decisions they take. The more you get people to participate, the higher chances that the programme will succeed."*
>
> Senior business and industry stakeholder, Seychelles

Other than the above, it seems that multi-, inter- and trans-disciplinary approaches to research require further development and encouragement in Seychelles.

6 SUMMARY AND CONCLUSION

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

Climate change threatens Seychelles economy and survival. This was a clear message from all data sources of the mapping study. Like all Small Island Developing States (SIDS), Seychelles is particularly vulnerable to climate change, and will be affected by global sea level rise and associated increased storm surges and coastal inundation, leading to increased coastal erosion that will affect coastal agriculture. The projected climate impacts on coral reefs and fisheries, through warming of the ocean and ocean acidification are threats that would undermine food security and livelihoods in Seychelles.

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

Overall the workshops and questionnaires unearthed the critical need for improved education, public awareness, participation and access to information. Currently it was felt that top-down decision making may not result in appropriate and climate-proofed infrastructure. Research and governance systems in Seychelles require improved knowledge co-production, and collaborative responses that are embedded in stronger networks regionally and internationally, including across the SADC countries.

6.1.1 Broad adaptation and mitigation needs

There is broad agreement amongst the three data sources (policy, workshop, questionnaires) on the *broad priority focus areas for responding to climate change,* namely, Fisheries, Agriculture, Water, the Coastal Zone Sector, and Health. Within these broad priorities, the impacts of sea level rise and of rising sea surface temperatures were frequently cited as priority impacts to understand and respond to. Disaster risk management was identified as a key cross-cutting priority. A number of participants in the mapping study noted that one of the highest priorities is to tackle properly energy efficiency and renewable energy such as solar, which would have developmental benefits and would reduce Seychelles' GHG emissions from fossil fuel.

6.1.2 Specific knowledge and research gaps

When comparing the workshop, questionnaire and policy data, the knowledge and research priorities that would further enable the institutional and human development needs of Seychelles covered a variety of key areas. One clear priority was for enhanced knowledge and research on climate modeling, scenario building and methodological development for

adaptation. Within the linked areas of food security and coastal/marine management, fisheries require further knowledge and research into the links between temperature rise, coral damage, acidification, and how this effects Seychelles' 'blue economy', which also includes tourism. Due to Seychelles' interconnected vulnerability in these areas, it is important for future responses to coastal and marine development to take a transdisciplinary approach, as the interplay between sea-level rise, ocean warming, tropical storms and coastal development will have a myriad of potential interconnected factors affecting CCD in Seychelles. With regard to energy and water security, specific research and knowledge priorities lie in improved assessment of energy and water use and how physical planning and development can accommodate this, specifically with waste water management systems, improved renewable energy use and enhanced water storage and water resources management, which would impact positively on human health. Knowledge and research gaps relating to the effect of climate change of human health in Seychelles include research on the impact and management of climate related diseases, public awareness, mapping and enhanced management of current sewerage networks, disease surveillance and the development of emergency response systems. Coastal zone management and disaster risk management require a variety of specific knowledge production activities, including baseline mapping in order to respond more effectively to extreme events and climate-proof existing infrastructure. Mitigation responses in Seychelles were seen to need improved research and technological innovation in energy, transportation, agriculture, and waste management sectors.

6.1.3 Cross-cutting needs

These were well articulated in Seychelles, and key ones are the need for baseline data, access to information and knowledge transfer, and knowledge management in general; access to and adequacy of methodologies to assess climate impacts and develop localised adaptation strategies; addressing fragmentation of efforts and research, which is not long-term, and the lack of value placed on researchers; policy/research/practice linkages – linked to a discussion on the need for more evidence-based policy making, backed up by long-term scientific studies e.g. on impacts on specific ecosystems / sectors; monitoring and evaluation of the environment and of policy, pointing also to the need to develop and monitor appropriate indicators; and finally the need for innovative and creative approaches.

6.1.4 Notable themes

Emerging from the Seychelles workshop and questionnaire data were the importance of developing and using creativity and innovation in the response to climate change – CCD needs to be made more exciting, in order to build a widespread and concerted response; and the potential role of the private sector, both as a knowledge co-production partner, but also with respect to economic opportunities that climate change confers, such as technology development for renewable energy. Seychelles participants repeatedly highlighted the need to mainstream climate change into EIA and social impact assessment (SIA), and the need for enhanced use of these planning tools when assessing plans, technologies and development proposals, to ensure climate resilience.

6.1.5 Individual capacity gaps

The individual capacity needs to meet these priorities require a focus on expanding capacities for curriculum development and the training and professional development of a variety of Seychelles stakeholders and researchers, with specific reference to policy makers, teachers, government officials, farmers, extension officers, meteorologists, water resource managers, financial executives, oceanographers, hydrologists and engineers. Lack of capacities to promote and apply energy efficiency, renewable energy resources, and efficient use of water resources were also identified.

6.1.6 Institutional capacity gaps

It was agreed that improved institutional capacity is needed to respond to specific research and development needs in improving policy, funding, monitoring, knowledge networks, data management, knowledge transfer, modeling/early warning systems, curriculum and renewable energy development. The workshops identified the *inadequate integration of climate change across the board*, including the gender-differentiated and HIV/AIDS aspects, into *policies, plans and strategies at all levels*, including *economic development planning*. A further requirement is for an auditing/monitoring system to both track donor funding going into climate change and CCD-related projects and research, and to track the effectiveness of the response.

6.2 Synthesis perspective on the institutional assessment

A fundamental issue from an institutional perspective for Seychelles in responding better to climate change is the limited supply of human resources in a small country of dispersed islands, with a total population of 90 000 people. As participants at the workshop noted, it is challenging simply to get the identified knowledgeable people together, as everyone is covering broader areas of work than they would in a larger country. The skills shortage is exacerbated by inadequate transfer of technology and knowledge when international consultants are employed to work in Seychelles. Nevertheless, Seychelles has shown great leadership in mainstreaming environmental sustainability into policies, programmes and activities, and in international negotiations on climate change. Seychelles policy and stakeholders recognise that CCD is part of sustainable development, and that the approach is highly relevant for Seychelles. The limited presentation and publishing of research on climate change and CCD was cited as an area in which significant improvement was needed, in both the workshops and the questionnaires. The mapping study has further shown the need for improved, long-term baseline data to inform policy and decision making, and for a range of knowledge management issues to be addressed, including data management and transfer.

The knowledge management issues identified in this mapping study relate to one of the key functions of the National Climate Change Committee, which is to maintain national and relevant international climate change information (inventory) at the National Climate Change Information Centre, located at the Meteorological Services. This inventory/database is in place, in a preliminary form, but will need to be further developed to underpin enhanced knowledge co-production on CCD. Another critical institutional constraint identified in the workshop was for a strategic and prioritised national research framework on climate change /CCD, which

relates as well to another function of the NCCC, which is to provide overall co-ordination of the development and implementation of the National Climate Programme and Climate Change Research.

This mapping study has identified existing initiatives amongst Seychelles stakeholders, including the HE sector, where activities such as research, teaching, policy engagement and community outreach are addressing climate change-related needs. The institutional assessment has shown that while UniSey currently has limited capacity for responding to climate change and moving towards CCD, given the youthfulness of the institution, it has made a good start in mainstreaming climate change into two undergraduate courses in the Faculty of Science, as well as into the BEd degree. There is furthermore CCD expertise in other stakeholder groups, as summarised in the table in Appendix E. However, these areas of capability for work on CCD will need to be supported though concerted efforts to build the capacity of researchers, develop additional strategic partnerships for collaboration, and formulate a national strategic research framework, with an implementation plan, for enhancing CCD research in Seychelles.

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

Considering the workshops and questionnaires, as well as other data sets *in relation to each other;* one can begin to map out CCD capacity development pathways for Seychelles. One example is offered here (Table 12) for a key CCD priority area in Seychelles, identified in all three data sources, namely informed policy making to promote CCD implementation. This would include both adaptation and mitigation priorities. Table 12 provides a synthesised perspective of key knowledge, research, individual and institutional capacity gaps for Seychelles for this priority area, providing insight into the research, capacity building and institutional development pathways needed for enhancing future contributions to CCD.

Table 12: CCD Knowledge, Research, Capacity Building and Institutional Capacity Gap Analysis for one of the Seychelles CCD Priorities: Informed policy making to promote CCD implementation

CCD PRIORITY	Knowledge and research gaps (Research agenda)	Individual capacity gaps (Education and Training agenda)	Institutional capacity gaps (Institutional Capacity Development agenda)
Informed policy making to promote CCD implementation	▪ Identifying relevant existing policies ▪ Contextualised understanding of CCD ▪ More action-based research with a specific focus on generating evidence to influence policy ▪ Evidence of policies that work ▪ Relevant research in CCD/policies/methodologies for developing iterative and evidence-based policies ▪ Social impact assessment of key policies; and methodologies for assessing the social impact of policies in the policy development process	▪ Capacity building for more researchers / policy makers on application of policy into practice ▪ Enhanced understanding amongst policy makers of the need for CCD	▪ Lack of proper implementation, monitoring and enforcement of policies ▪ Sensitisation of policy makers about relevant evidence-based decision making ▪ Policy making using bottom-up approach

Note: The table does not necessarily include all relevant aspects, but is based upon best available information, generated during the mapping study. It is indicative, rather than definitive, and should ideally be further developed at the national level.

The analysis such as the one modelled above, can be developed for all major CCD priorities, and should ideally form part of national climate change policy development. Such an analysis provides a starting point for knowledge co-production at a national level. Key is also to integrate mitigation, adaptation and development priorities into the more specific and sectoral CCD knowledge co-production pathways, as per the CCD framework.

The University of Seychelles has a vision to turn the country into a knowledge centre for the region, and UNDP has noted that possibilities may exist to further develop the results of the mapping study in Seychelles into a programme, as it is consistent with needs and actions already identified under the SSDS and the NCCS. In general, the mapping study has identified the need to create an integrated knowledge of CCD across society, and to test climate responses that work through action-oriented research. In this regard, critical issues to be addressed for Seychelles to expand its CCD knowledge co-production capacity are:

- Further consolidate the national knowledge co-production analyses based on the needs and institutional analyses in this country mapping study, and as modelled in the example above (Table 12), to guide further action at country level
- Expand the capacity of the research institutions that have been identified as having some capacity and expertise for research, teaching and learning on CCD.
- Develop strategies for strengthening individual research competence, so that individual interest and research capacity can grow into a 'node of expertise' and then into a 'centre of expertise', and potentially a Centre of Excellence.[31]
- Improve co-operation, communication, knowledge management and shared access to CCD data at all levels.
- Develop motivation and incentives for researchers, especially for engaging in multi-, inter and transdisciplinary research approaches. Support capacity development of researchers in these areas.
- Strengthen research partnerships and research infrastructure, including research funding and incentives for students.
- Support ongoing processes of curriculum innovation to mainstream CCD into existing courses and programmes, and engage in development of Masters degree curriculum design, potentially in partnership with other southern African universities.
- Strengthen existing policy and community outreach activities within a knowledge co-production framework, building on promising activities; and develop tools for monitoring and dissemination to make the impact of such work visible within the university system.

[31] 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.

- Develop campus management policies and practices that demonstrate commitment to CCD at the institutional level, and support student organisations that are beginning to tackle CCD-related matters.

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

Climate change and CCD research in Seychelles seems to be currently largely located within the NGO and donor sectors, given that prolific former university researchers such as Professor Payet are currently not available for active research in Seychelles. Within the published research, there is an emphasis on vulnerability, impacts and adaptation, particularly related to changes in sea level, sea surface temperatures and ocean acidification; and related cross-cutting impacts on food security, health and the economy, which is heavily reliant on fisheries and tourism. Other areas which lend themselves to an integrated adaptation-mitigation approach include the interplay between energy, waste management and water security.

Particular areas of strength identified in Seychelles, which could be further developed, include:

- **Climate change vulnerability, impacts and adaptation research**: changes in sea level, sea surface temperatures and ocean acidification, and effects of this on tourism and fisheries;
- **Integrated adaptation-mitigation research**: energy, waste management and water security nexus; and
- **Cross cutting issues research**: Teaching and curriculum innovation for CCD.

> *"Climate variability and change is happening much faster than the science has predicted, therefore we need a response that is ambitious …. Therefore we need the funding and resources for small vulnerable countries. It is clear that we need everyone, and your presence here will go a long way to cementing partnerships. We are all stakeholders in our future climate. The future costs of inaction are expected to exceed by far the cost of timely action."*
>
> Mr Wills Agricole, Permanent Secretary of the Ministry of Environment and Energy, in his closing remarks at the Seychelles workshop

APPENDIX A: WORKSHOP ATTENDANCE LIST

List of participants in Seychelles workshop, 4 September 2013 (Day 1)

Auditorium, School of Education, University of Seychelles

Full name	Department/Faculty/Organisation	Designation	Contact number/s	Email address
Gilberte Gendron	Seychelles National Parks Authority (Research Section)		2726125	g.gendron@snpa.sc
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Monia Course	Public Health Services	Senior Public Health Officer	2722842/4388512	monia.course@health.gov.sc
Andrew Richard	Public Health Services	Public Health Officer	2725251	arichard@health.gov.sc
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Elke Talma	Sustainability in Seychelles	Officer	2590772	Turtlechick01@gmail.com
Dr Justin Valentin	University of Seychelles – Faculty of Humanities	Dean	2524362	Justin.valentin@unisey.ac.sc
Kelly Hoareau	University of Seychelles – Faculty of Science	Head of Programme	2513411	Kelly.bucas@unisey.ac.sc

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P. Murugaiyan	Department of Environment	SPO/CAMS	2722159	p.murugaiyan@env.gov.sc
Elisa Socrate	Seychelles Fishing Authority	Fishery Officer	4670335	esocrate@sfa.sc
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Jason Jacqueline	Seychelles National Parks Authority (SNPA)	Director Forestry	2722320	
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List of participants in Seychelles workshop, 5 September 2013 (Day 2)

Auditorium, School of Education, University of Seychelles

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Lisbet Hansen	Mangroves for the Future	Intern		Lisbet_129@hotmail.com
P. Murugaiyan	Ministry of Environment & Energy(Coastal Adaptation & Management Section)	SPO		
Jemma Simeon	University of Seychelles (PVC Officer)	Research Officer	2597521	jemmasimeon@yahoo.com
Justin Valentin	University of Seychelles (Humanities)	Dean	2524362	Justinvalentin@unisey.ac.sc

Full Name	Department/Faculty/Organisation	Designation	Contact number/s	Email address
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BrendaAndimignon	Ministry of Environment and Energy			
Veronique Bonnelame	GEF			
Lindy	Mangroves for the Future			

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

Table 13: Active researchers contributing to CC/CCD related research activities in Seychelles

Name and qualification	Department / area of experitise	Years of experience: Years of experience in CC research	Contact details
Dr Denis Chang Seng	Seychelles water sector and climate change; adaptive disaster risk reduction		Research associate at the Institute for Environment and Human Security at the United Nations University, previously Acting Director of the Seychelles National Meteorological Services
Professor Rolph Payet	Islands, climate change and biodiversity		Current Minister of Environment and Energy, and Pro-Chancellor of UniSey
Dr. Andrew Grieser Johns	Policy development, regulatory activity, community development, Renewable energy , Land use Planning.	30 years : 10 years	Programme Co-ordination Unit, UNDP-GEF a.grieserjohns@pcusey.sc
Dolor C Cencota (Masters)	Environmental Economics	28 years : 20 years	Seychelles Chamber of Commerce and Industry (SCCI) dolor@iac.sc / scci@seychelles.net
Philomena Hollanda (Masters)	Tourism Management and Risk Management	23 years: 5 years	Risk Management Section / Seychelles Tourism Board philomena.hollanda@seychelles.travel

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

APPENDIX C: UNIVERSITIES QUESTIONNAIRE

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

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

B: GENERAL VIEWS

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

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

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

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

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

C: CAPACITY, KNOWLEDGE AND RESEARCH GAPS

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

University	
Faculty	
Department	
Programme / Centre / Institute	

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

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

Climate Change	
Climate Compatible Development	
Other (please specify)	

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

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

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

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

D: CURRICULUM, TEACHING AND LEARNING

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

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

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

E: POLICY / COMMUNITY ENGAGEMENT AND STUDENT INVOLVEMENT

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

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

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

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

F: UNIVERSITY COLLABORATION

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

F1: Inside the university

F2: Between universities in country

F3: With partners

F4: Regionally

F5: Internationally

G: UNIVERSITY POLICY AND CAMPUS MANAGEMENT

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

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

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

APPENDIX D: STAKEHOLDER QUESTIONNAIRE

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

A: GENERAL INFORMATION

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

B: GENERAL VIEWS

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

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

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

C: CAPACITY, KNOWLEDGE AND RESEARCH GAPS

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

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

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

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

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

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

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

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

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

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

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

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

APPENDIX E: IDENTIFIED SOURCES OF EXPERTISE FOR CCD IN SEYCHELLES

Table 14: Identified sources of expertise for CCD in Seychelles

University/ organisation	Nodes of expertise	Centres of expertise	Centres of excellence	Active CCD related Research Networks
University of Seychelles (UniSey)	UniSey Faculty of Science: ▪ Department of Environmental Science, University of Seychelles (currently this is a potential node of expertise, research is largely in the form of student dissertations)	None identified	None identified	▪ Sustainability for Seychelles – NGO focusing on environmental education and climate change adaptation and mitigation; strong community outreach ▪ ENGOs (environmental non-government organisations) work in connection with the Ministry of Environment and Energy, pooling data on research and innovation practices
	Ministry of Environment and Energy: ▪ Individual researcher (Prof. Rolph Payet) working on islands, biodiversity and climate change; Environmental education unit			Mangroves for the Future: ▪ NGO, climate change and climate smart development integrated into all projects; strong community-based focus

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