climate change counts

STRENGTHENING UNIVERSITY CONTRIBUTIONS TO CLIMATE COMPATIBLE DEVELOPMENT IN SOUTHERN AFRICA

Mauritius Country Report

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southern african regional universities association

SARUA CLIMATE CHANGE COUNTS MAPPING STUDY

VOLUME 2 COUNTRY REPORT 4 2014

STRENGTHENING UNIVERSITY CONTRIBUTIONS TO CLIMATE COMPATIBLE DEVELOPMENT IN SOUTHERN AFRICA

Mauritius Country Report

Series Editor: Piyushi Kotecha

Authors: Penny Urquhart and Heila Lotz-Sisitka

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Note

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

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

ADB	African Development Bank
BID	Background Information Document
CBO	Community Based Organisation
CCAM	Conformal-Cubic Atmospheric Model
CCD	Climate compatible development
CCPT	Climate Change Preparedness Teams
CDKN	Climate and Development Knowledge Network
CGCMs	Coupled Global Climate Models
CNG	Compressed Natural Gas
CSIR	Council for Scientific and Industrial Research
EEZ	Exclusive Economic Zone
EPCO	Environmental Protection and Conservation Organisation
ESSA	Education for Strong Sustainability and Agency
FFEWS	Famine and Flood Early Warning System
GHG	GreenHouse Gas
GIS	Geographical Information System
GIVRAPD	Global Islands' Vulnerability Research, Adaptation, Policy and Development
HEI	Higher Education Institution
HEMA	Higher Education Management Africa consortium
INC	Initial National Communication to UNFCCC
IOC	Indian Ocean Commission
IPCC	Intergovernmental Panel on Climate Change
LID	Low Impact Development
LNG	Liquefied Natural Gas
LULUCF	Land Use, Land Use Change and Forestry
MCA	Mauritius College of the Air
MGI	Mahatma Gandhi Institute
MID	Maurice Ile Durable
MIE	Mauritius Institute of Education
MIPAM	Mauritius Institute of Public Administration and Management
MRC	Mauritius Research Council
NAMAs	Nationally Appropriate Mitigation Actions
NCCAPF	National Climate Change Adaptation Policy Framework
NCSA	National Capacity Self-Assessment
NEF	National Empowerment Foundation
NGO	Non-Governmental Organisation
NODC	Central database centre
NPCS	National Parks and Conservation Society

R&D	Research and Development
RoM	Republic of Mauritius
SADC	Southern African Development Community
SADC REEP	Southern African Development Community Regional Environmental Education Programme
SARUA	Southern African Regional Universities Association
SASSCAL	Southern African Science Service Centre for Climate Change and Adaptive Land Use
SIDS	Small Island Developing State
SITRAC	State Information Training Centre
SNC	Second National Communication
SST	Sea Surface Temperature
TEC	Tertiary Education Commission
TNA	Technology Needs Assessment
TNC	Third National Communication
UNDP	United Nations Development Programme
UNFCCC	UN Framework Convention on Climate Change
UoM	University of Mauritius
UTM	University of Technology
WIOMSA	Western Indian Ocean Marine Science Association

1 INTRODUCTION

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

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

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

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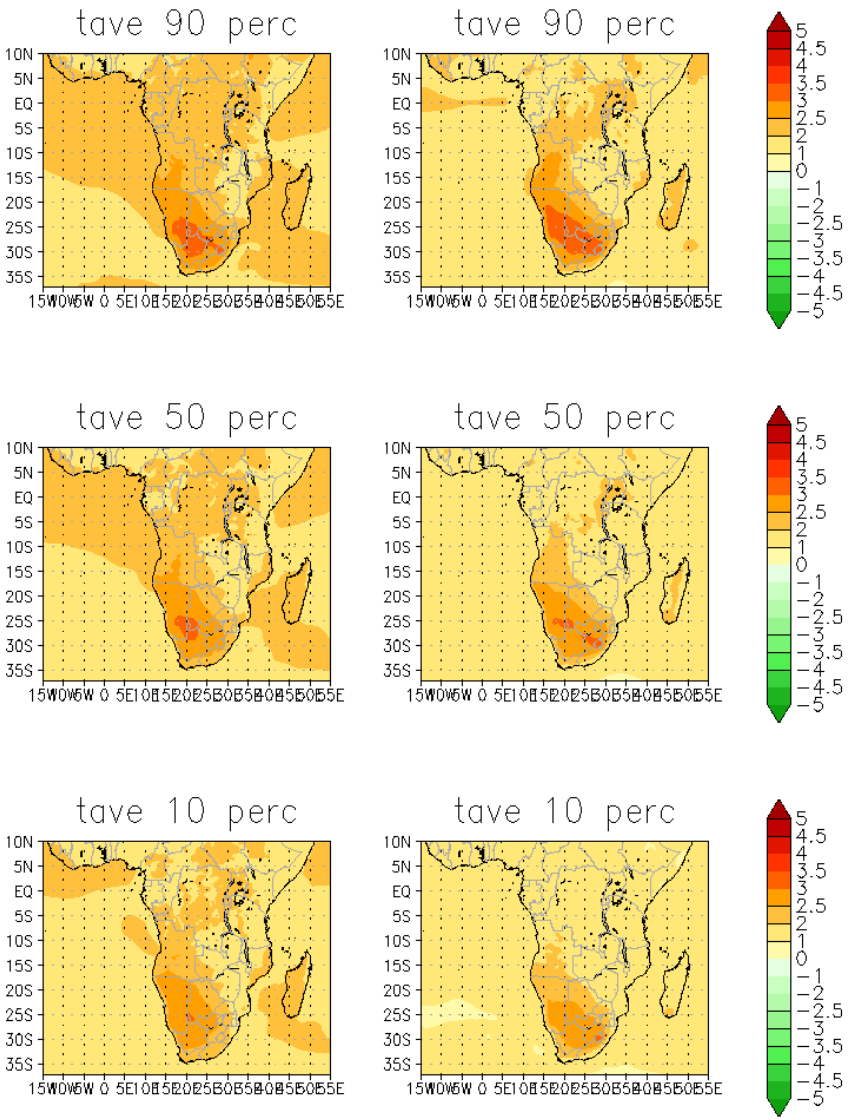
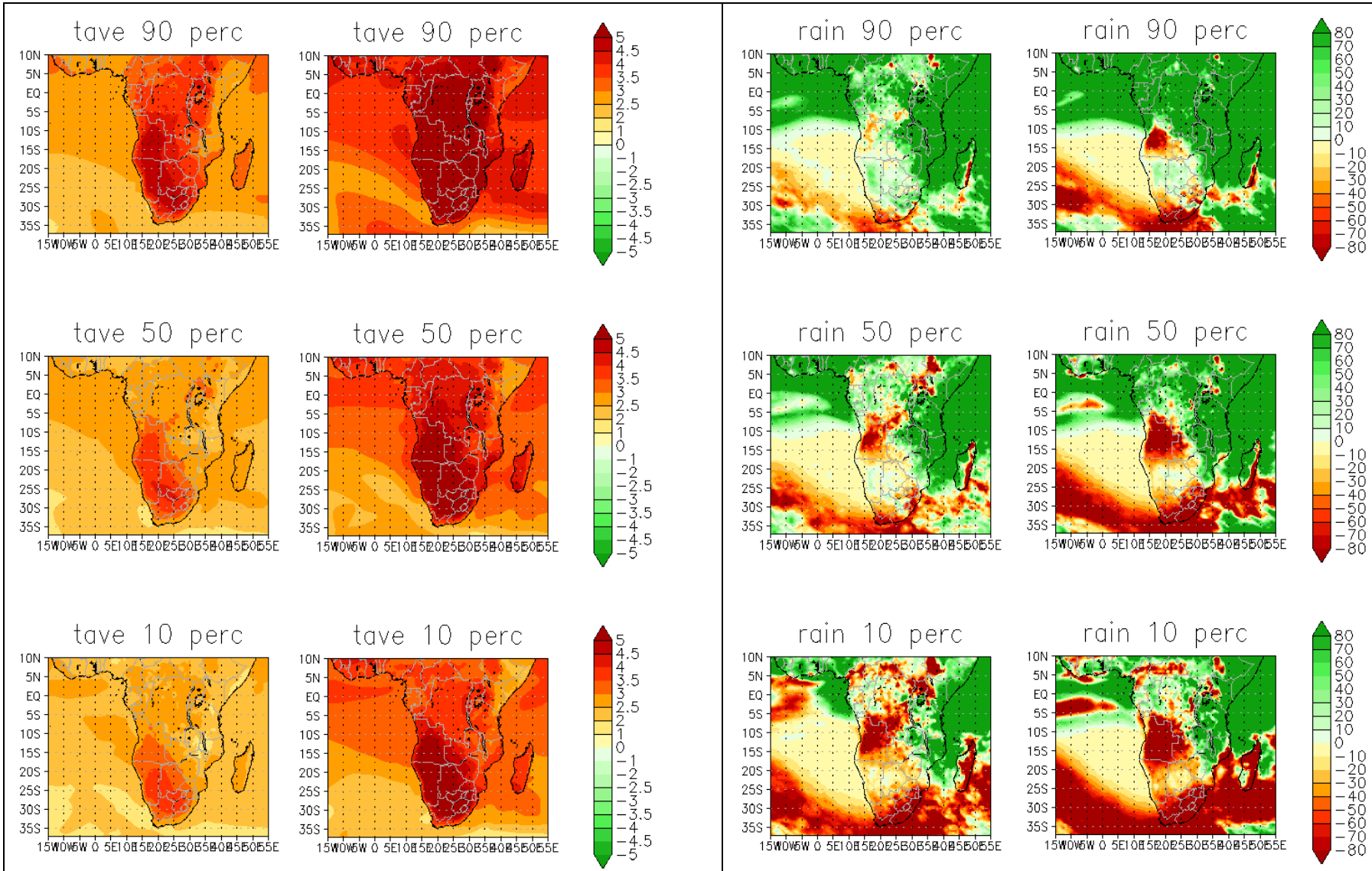
[1] IPCC. 2013. *Impacts, Vulnerability and Adaptation: Africa*. IPCC Fifth Assessment Report, draft for Final Government Review, Chapter 22.

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



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

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



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

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

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

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

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

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

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

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

Box 1: Mauritius's vulnerability to climate change

The Republic of Mauritius is particularly vulnerable to the adverse effects of climate change as it is a Small Island Developing State (SIDS). Vulnerability is especially high in the coastal zones, where the combination of accelerating sea level rise and increasing frequency and intensity of tropical cyclones includes risks of considerable economic loss, humanitarian stress and environmental degradation. The National Climate Change Adaptation Policy Framework (NCCAPF) notes that half of the beaches on Mauritius could disappear by 2050, with disastrous impacts on coastal ecosystems and the economy. The agricultural sector is highly vulnerable to climate variability and change. Climate change impacts on fisheries will include migratory shifts in tuna aggregations, thereby disrupting the local seafood hub activities and other fish-based industries (SNC 2010). Analysis shows that higher temperature, precipitation, humidity and recurrent floods facilitate the spread of vector-borne and infectious diseases, such as chikungunya and dengue, while hot spells and more frequent heat waves in summer could increase the occurrence of respiratory complications, cardiovascular diseases, food poisoning, diarrhoeal and skin diseases. A more detailed account of Mauritius' vulnerability to climate change is covered in section 3.3.3.

1.2 The SARUA Climate Change initiative: History and objectives

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

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

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

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 Namibian Country Report forms part of the mapping study. The SARUA climate change initiative is diagrammatically illustrated in Figure 3.

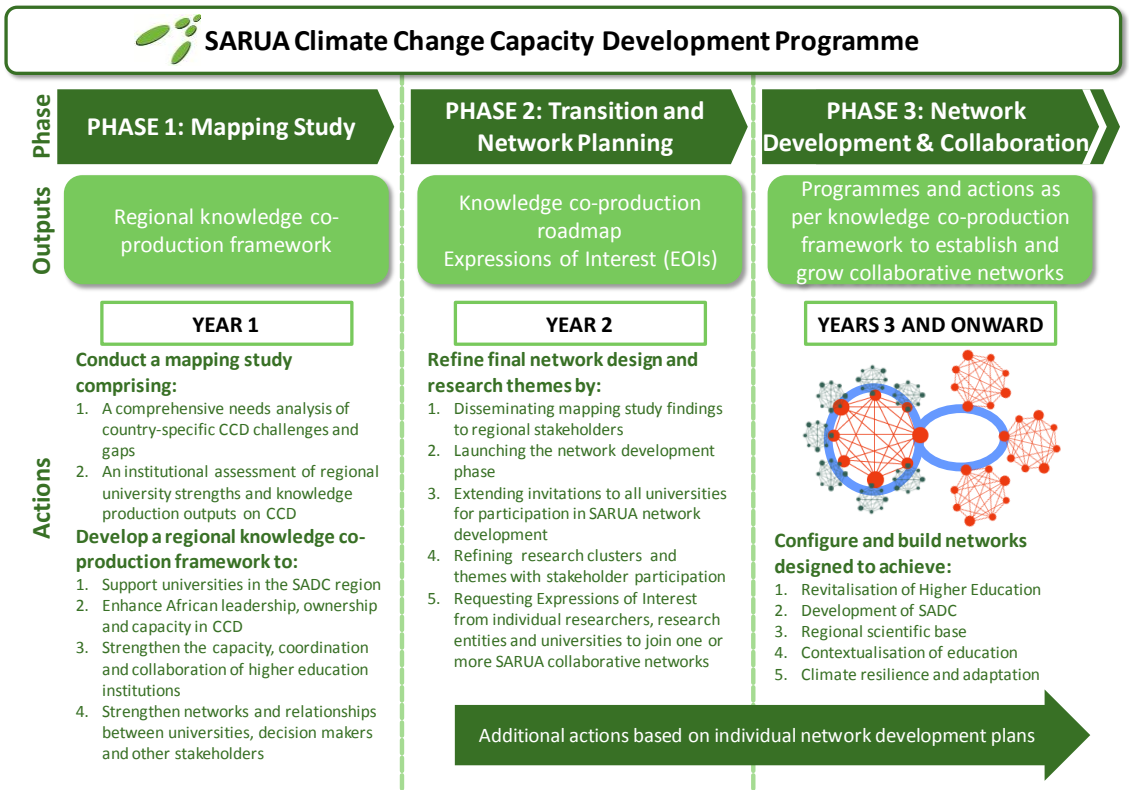


Figure 3: The SARUA Climate Change Initiative

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

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

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

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

To address these factors, the mapping study aimed to:

- Explore diverse understandings of CCD on a country-by-country basis;
- Scope CCD knowledge and capacity needs on a country-by-country basis (a 'needs analysis'); 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 Mauritius.

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

1.4 Key concepts

Climate Compatible Development

Climate compatible development (CCD) is low carbon, climate resilient development. The concept has been developed in recognition of the urgent need for adaptation, given current climate variability and the severity of projected climate impacts that will affect the region; and the need to reduce emissions as rapidly as possible to avoid more catastrophic climate change in the future. Thus while CCD can be framed in different ways, given nationally and locally specific development trajectories, it does require that current and future climate risks are mainstreamed into development, and that both adaptation and mitigation are integral goals of development, as indicated by Figure 4. Thus CCD not only recognises the importance of both adaptation and mitigation in new development pathways, but, as further explained in Mitchell and Maxwell (2010), "Climate compatible development goes one step further by asking policy makers to consider 'triple

win' strategies that result in low emissions, build resilience and promote development simultaneously". In the southern African context, poverty reduction, as an integral component and goal of regional and national development strategies, would be a desired co-benefit. Uncertainties in major drivers of change, including climate, socio-economic and political risks, necessitate that CCD be viewed as an iterative process, in which vulnerability identification and risk reduction responses are revised on the basis of continuing learning. Climate compatible development emphasises climate strategies that embrace development goals and development strategies that integrate the threats and opportunities of a changing climate.[5] Thus climate compatible development opens up new opportunities for interdisciplinary and transdisciplinary research, teaching and engagement with communities, policy makers and practitioners.

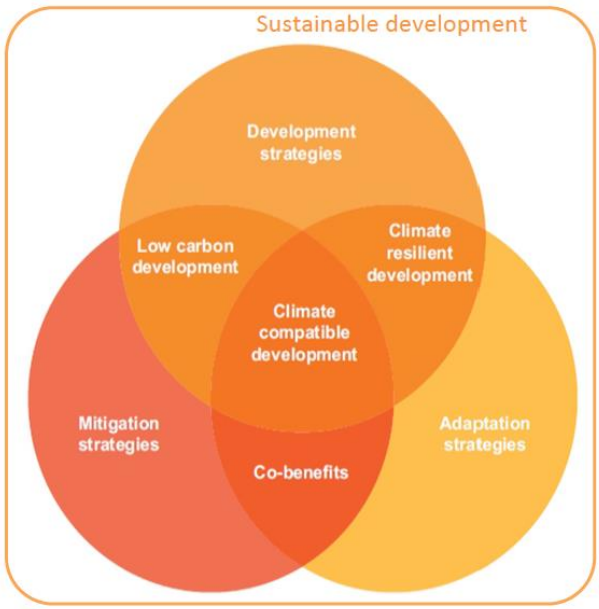


Figure 4: Conceptual framework for Climate Compatible Development (adapted from Mitchell and Maxwell, 2010)

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*

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

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

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

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

Sustainable Development

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

In 2002 South Africa hosted the World Summit on Sustainable Development, and the Johannesburg Plan of Implementation re-affirmed commitment to Agenda 21, and the Millennium Development Goals. These are currently under review and will be expanded through Sustainable Development Goals. In 2012 the Rio+20 Conference was held in Rio de Janeiro, and the outcomes of this global summit on sustainable development are captured in a document entitled 'The Future We 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.

[7] IPCC. 2013. Fifth Assessment Report.

2 METHODOLOGY, DATA SOURCES AND ANALYSIS LOGIC

2.1 Research Design

This country-based study has been informed by an interactive and dialogical research design that included document analysis of key national and regional documents focusing on climate change in Mauritius 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 Mauritius, 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. The following documents were analysed through rapid desk review, to develop the Mauritius Country Report:

- Initial National Communication (INC) to the United Nations Framework Convention on Climate Change (UNFCCC), 1999;
- National Capacity Self-Assessment (NCSA) for implementation of the Rio Conventions, 2005;
- UNDP Climate Change Country Profile for Mauritius, 2010;
- Second National Communication (SNC) to the United Nations Framework Convention on Climate Change (UNFCCC), 2010;
- Mauritius National Climate Change Adaptation Policy Framework, 2013; and
- Global Islands' Vulnerability Research, Adaptation, Policy and Development (GIVRAPD) Project, Review of Current and Planned Adaptation Action, 2013.

[8] A social realist methodology takes account of knowledge that has previously been established via scientific methods before enagaging 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 on 11 and 12 September 2013 at the Université des Mascareignes, Mauritius.[9] The workshop was run with a combined group that included university, government, private sector and NGO participants. See Appendix A for the list of participants. A summary of the content of the different sessions is provided below in Table 1. A workshop report was produced from detailed workshop proceedings captured by a team of rapporteurs, and circulated to all who participated in the workshop for verification and accuracy. Data produced in the workshops was also verified and added to during plenary sessions. The workshop report forms a substantive basis of the data used for this Country Report, combined with document analysis and questionnaire data.

Table 1: Workshop programme outline

TIME	DAY 1: 11 SEPTEMBER 2013	DAY 2: 12 SEPTEMBER 2013
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	Mauritius 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) ▪ Mauritius priorities and needs, knowledge and institutional gaps and capacity ▪ Plenary report-backs from group work	Opportunities for collaboration ▪ Policy implications for government, universities and donors
SESSION 4	What is the role of the university sector? ▪ Identifying other knowledge partners	Way forward and closure
SESSION 5	Framing Climate Compatible Development	

[9] The Mauritius consultations were made possible through the kind contribution of the Université des Mascareignes.

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 Appendix C and D). One was designed for university professionals, and the other for national and regional stakeholders involved in climate change and CCD. For Mauritius, a total of 26 questionnaires were answered, which included nine stakeholders and 17 university professionals. Questions covered the following areas:

2.1.3.1 University staff questionnaire

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

2.1.3.2 Stakeholder questionnaire

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

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

2.2 Limitations of the mapping study

This mapping study was constrained by a lack of baseline data on knowledge and research gaps for climate compatible development and university-based responses in Mauritius, and by time and resource constraints that did not allow for **in-depth field visitation, individual interviewing or observation** before, during and after the consultation process. Moreover, the information generated at the country workshop relates to the number of participants, their expertise and the number of different sectors and institutions present. Further, while every effort was made to obtain questionnaire responses from as wide a range of stakeholders as possible, and follow-ups were

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

While much information could be obtained on climate change- and CCD-related knowledge gaps, research needs and capacity gaps, there is obviously more to be learned about these. Similarly, as much information as possible was obtained on 'who is doing what' and on existing research, knowledge co-construction practice and possibilities, but there is clearly also more to learn about these. This mapping study Country Report therefore presents as a useful 'initial document' and it is hoped that Mauritius, and in particular, the Mauritius Research Council, University of Technology of Mauritius (UTM), Université des Mascareignes and University of Mauritius, together with the Ministry of Environment and Sustainable Development, Ministry of Agriculture, Ministry of Tertiary Education, Science, Research and Technology, the Mauritius Institute of Education, Mauritius Oceanography Institute, the Central Electricity Board, the Meteorological Services 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 different universities in Mauritius, and in a way that would allow for aggregate data within and across Faculties and Departments. The scope of such a detailed analysis lay beyond the capacity of the current mapping study. Data from questionnaires is therefore indicative rather than conclusive. Similarly, the questionnaire for stakeholders can be administered with additional national and local stakeholders (Appendix D) involved in environment and development initiatives in Mauritius to understand the full scope of climate change and CCD responsiveness in Mauritius, and to further develop the knowledge co-production capacity for CCD in Mauritius. 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 Mauritius, 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 Mauritius. Ministries and institutions who could take this study forward could include the Ministry of Environment and Sustainable Development, Ministry of Agriculture, Ministry of Education and Human Resources, Ministry of Tertiary Education, Science, Research and Technology, the Mauritius Institute of Education, the Central Electricity Board, Mauritius Research Council, Meteorological Services, 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 Mauritius, 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 Mauritius, which may also assist Mauritius **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 Mauritius's socio-economic context, which provides the baseline for addressing the climate change-related needs and priorities in the country (section 3.2), and a summary of the observed and projected climatic changes for the country (section 3.3). This is followed by an overview of the broader priorities for addressing climate change as identified by policy (section 3.4.1), in workshops (section 3.4.2) and via the questionnaires (section 3.4.3). The needs analysis then moves on to describe more specific priorities and needs, and their associated knowledge, research and capacity gaps (section 3.5). A summative discussion of the needs analysis is provided in section 6.1.

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

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

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

3.2 Socio-economic context

The Republic of Mauritius (RoM) lies in the Indian Ocean between latitudes 19°50' south and 20°30' south, approximately 2 000 km off the east coast of Africa. The country has a population of approximately 1.3 million people, with 42 percent in urban areas. The surface area of the main volcanic island of Mauritius is 1 865 km², comprised of an irregular Central Plateau surrounded by mountain ranges and plains. The RoM includes the smaller islands of Rodrigues, St. Brandon, Agalega, Tromelin and the Chagos Archipelago (with Diego Garcia), surrounded by coral reefs and with a current marine Exclusive Economic Zone (EEZ) of 2 million km². The mild tropical maritime climate has two seasons: the warm and wet summer, and the cooler and drier winter. Temperature variation is slight, averaging between 22°C in July-August-September and 26-27°C in January-February-March. Rainfall ranges from 4 000mm on the Central Plateau to 800mm along the coast, peaking between January and March. The Outer Islands have a higher degree of rainfall variability. The world's third largest coral reef protects the main island. Marine biodiversity is now under threat from sea level rise, coral bleaching and damage to ecosystems. About 25 percent of Mauritius's land area is still under forest cover.

In the move from a low-income, agriculturally based economy to an upper middle-income diversified economy, Mauritius's past high dependency on sugar production has declined, with financial and industrial services, tourism and information technology coming to the fore; tourism, fisheries and financial services have grown significantly in recent years. Sugar cane production still occupies

90 percent of cultivated land, with the remaining land worked by small growers for food crops, tea, tobacco, palm, fruit and flowers. More than 80 percent of Mauritius's energy comes from imported fossil fuels. The Human Development Index is high, at 0.728, and per capita GDP (PPP) is $14,523. The adult literacy rate is 88 percent, and life expectancy at birth averages 73 years. Total access to electricity is 99.4 percent dropping to 58 percent for the rural population. Unemployment stands at 7.7 percent of the total labour force.[10]

3.3 Observed and projected climatic changes, impacts and vulnerabilities

3.3.1 Observed climatic changes

The following climatic changes have been observed in Mauritius:

- Average temperature has risen by 0.74°C compared to the 1961–1990 mean;
- Annual rainfall has shown a decreasing trend of around 8 percent over Mauritius since the 1950s;
- Rainfall patterns show a delay in the onset of summer rains, resulting in a lengthening of the dry season;
- Rainfall variability shows an increase;
- The annual number of hot days and warm nights has increased; and
- The frequency of extreme weather events, heavy rains and storms has increased.

The increase in sea level appears to be accelerating: between 1998 and 2007, local mean sea level rose by 2.1mm per year, whilst over the last five years it has been rising by around 3.8 mm/year.[11]

3.3.2 Projected climatic changes

According to analysis carried out for UNDP in 2010, the mean annual temperature is projected to increase by 1.0 to 2.0°C by the 2060s, and 1.1 to 3.4°C by the 2090s.[12] All projections indicate substantial increases in the frequency of days and nights that are considered 'hot' in current climate, and substantial decreases in the frequency of days and nights that are considered 'cold' in current climate. While there is lack of agreement between climate models on the direction of precipitation changes, the seasonal picture is more coherent, with projections for July-August-September rainfall tending towards decreases. According to the Mauritius Meteorological Services, heavy precipitation events, risks of flash floods and number of intense tropical cyclones will increase. Rainfall observations are insufficient to identify trends in daily rainfall extremes. Events of high energy waves (tidal surge) will increase, with associated impacts on the shores of Mauritius.

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[10] Source for socio-economic indicators: World Bank, 2012.
[11] Source for observed climatic changes: http://environment.gov.mu/English/Climate_Change/Pages/Climate-Change.aspx, accessed 22nd August 2013.
[12] Most information in this section comes from the 2010 UNDP Climate change country profile – see McSweeney, C., M. New, G.Lizcano and X. Lu. 2010. "The UNDP Climate Change Country Profiles Improving the Accessibility of Observed and Projected Climate Information for Studies of Climate Change in Developing Countries," *Bulletin of the American Meteorological Society* 91, 157-166; and http://www.geog.ox.ac.uk/research/climate/projects/undp-cp/index.html?country=Mauritius&d1=Reports

3.3.3 Impacts and vulnerabilities

As a Small Island Developing State, the Republic of Mauritius is particularly vulnerable to the adverse effects of climate change, due to a combination of its size, location, proneness to natural disasters, reliance on imports and relatively small human resources base. Vulnerability is especially high in the coastal zones, where the combination of accelerating sea level rise and increasing frequency and intensity of tropical cyclones includes risks of considerable economic loss, humanitarian stress and environmental degradation. Examples of the severity of recent climate variability include Mauritius experiencing its worst drought in 1999 and 2011, and flash floods in 2008 and 2013 resulting in loss of lives. The National Climate Change Adaptation Policy Framework (NCCAPF) notes that half of the beaches on Mauritius could disappear by 2050, with disastrous impacts on coastal ecosystems and the economy.

Linked to the decreasing trend in annual rainfall, utilisable water resources will decrease by up to 13 percent by 2050. Increased flash floods and reduced recharge of aquifers are projected. The agricultural sector is highly vulnerable to climate variability and change. A range of scenarios yielded projected reductions in cane yield of between 34 and 48 percent, and in sugar yield of between 47 and 65 percent, should rainfall decrease by 10 to 20 percent and temperature increase by 2°C. Based on past experience, economic impacts from extreme events could be highly significant: for example, a fall of 43.9 percent in the economic contribution from sugar cane occurred in 1999 when a severe drought was experienced, and a fall of 25 percent in 2002 from an intense tropical cyclone. Heat stress will have a negative impact on productivity in the poultry and livestock sector.

Climate change impacts on fisheries will include migratory shifts in tuna aggregations, thereby disrupting the local seafood hub activities and other fish-based industries (SNC 2010). This could lead to conflict over the stock at national and international levels. Furthermore, changes in distribution of fish stocks, as well as fluctuations in abundance of conventionally fished and “new” species, may disrupt existing allocation arrangements. Fisheries catches have declined due to various factors, including climate change impacts on the coral cover and the marine ecosystem. Live corals would be reduced by 80 to 100 percent in the event of 3.28°C rise in temperature, which could happen by the year 2100, or earlier. Significant losses in the fisheries sector have already been noted as a result of fish mortalities around Mauritius due to abnormal sea surface temperature (SST) over the last decade. Any further rise in SST will highly jeopardise the livelihoods of many people and endanger food security.

Analysis shows that higher temperature, precipitation, humidity and recurrent floods facilitate the spread of vector-borne and infectious diseases, such as chikungunya and dengue, while hot spells and more frequent heat waves in summer could increase the occurrence of respiratory complications, cardiovascular diseases, food poisoning, diarrheal and skin diseases.

> *“We have had 0.74 degrees temperature increase relative to the 1960–1991 average. Experts should note what the significance of this is to lay people. Mauritius as a small island developing state has to address daunting challenges related to climate change, including very high impacts on economics and security.”*
>
> Government stakeholder, Mauritius

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

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

3.4.1 Identified adaptation and mitigation priorities articulated in policy and strategy

According to Mauritius's Second National Communication to the UNFCCC (2010), the greatest impact of climate change in the coming years will be in the form of increasing exposure to natural disasters. To address this, the earlier emphasis on risk reduction and preparedness is now expanding to include a broader focus on longer-term adaptation.

3.4.1.1 Adaptation

The focus sectors of the National Climate Change Adaptation Policy Framework (NCCAPF) are water, agriculture, fisheries and tourism; with gender and health considered as cross-cutting priorities. According to the 2010 Second National Communication (SNC), the key sectors already impacted upon are: infrastructures that support community livelihoods, water resources, coastal areas, coral reefs, fisheries and other marine-based resources, agriculture, tourism, human health and biodiversity.

The strategic objectives of the NCCAPF further highlight the adaptation priorities for RoM. They are to foster the development of strategies, plans and processes to:

- Avoid, minimise or adapt to the negative impacts of climate change on key sectors and assets of Mauritius, namely agriculture, water, fisheries and ecosystems;
- Avoid or reduce damage to human settlements and infrastructure, and also possible loss of lives caused by climate change;
- Build capacity to understand, analyse and pre-empt in a timely manner in the wake of future climate change impacts within the RoM; and to
- Integrate and mainstream climate change adaptation into core development policies, strategies and plans of the RoM.

The NCCAPF sets out sectoral strategies and action plans for each priority sector as follows:

- ***Water demand and supply*****:** Fully develop the potential of integrated water management; aggressively increase water use efficiency; practice and promote integrated flood management; enhance and sustain ecosystems; expand water storage and conjunctive management of ground and surface water resources; enhance monitoring, data analysis and management; and plan for and adapt to sea level rise.
- ***Agriculture and terrestrial ecosystems*****:** Water supply and conservation support; proactive management of agricultural invaders, pests and diseases; sustainable land use planning

practices; practices to integrate ecosystem services for enhanced agro-biodiversity; building institutional support; research, technology, development and communication.

- ***Fisheries and marine ecosystems*:** Sustainable utilisation of fisheries resources; protect critical habitat and plan for future hazards; sustainable aquaculture development; and data collection and information sharing (includes convening inter-disciplinary researchers to exchange information on observations and results).
- ***Tourism and coastal management*:** Guidance for coastal development; and engage tourism sector in adaptation and sustainable development.

Barriers to adaptation

The NCCAPF notes that climate change impacts, vulnerability, adaptive capacity and barriers to adaptation are location-specific and will change over time, but that the supportive processes for adaptation are similar. These include bottom-up as well as top-down adaptation processes from community-level adaptation design and implementation, to access to information across all levels, to the enabling national-level processes to finance and build capacity. Multi-stakeholder processes are proposed for integration purposes. The enabling framework has been designed to address key barriers such as lack of financing options, lack of institutional framework, and low levels of adaptation technology transfer, as set out in Table A1 of the NCCAPF. The NCCAPF further sets out tools for integrated climate change policy making, which include structures, scenarios and policies.

3.4.1.2 Mitigation

During the period 2000 to 2006, net greenhouse gas (GHG) emissions rose by 16.8 percent in the energy sector, which contributes the most to national emissions, with an annual average increase of 2.7 percent. The land use, land use change and forestry (LULUCF) sector represented a net removal of CO_2 from the atmosphere during the period 2000–2006. This net removal was much lower in the year 2000, due to the conversion of some 300 hectares of forest land for a dam. Mitigation measures noted in the SNC include renewable energy; reducing traffic congestion which is one of the main causes of high level of CO_2 emissions in the transport sector; managing landfills to reduce emissions, possibly through direct conversion to electricity or through methane produced during composting or gasification; programmes in the agricultural sector to reduce burning of residues and promote their conversion to composts, to be used in lieu of inorganic fertilisers; and enhancing sink capacity through better management of existing forests while reducing timber exploitation.

The main mitigation measures implemented since 2000 include:

- Shift to energy-efficient appliances and buildings;
- Promotion of solar water heaters through financial incentives;
- Installation of four wind turbines in Rodrigues;
- Flaring of landfill gas;
- Partial replacement of sodium vapour lamps for street lighting with energy saving lamps;
- Setting-up of endemic gardens in schools to enhance sink capacity and promote awareness;
- Planting of mangroves as sinks to CO_2 and initiation of an afforestation and tree planting campaign;
- Phasing out of HFCs and PFCs;
- Replacement of household incandescent bulbs with energy saving lamps; and
- Increasing the energy conversion efficiency of bagasse.

3.4.2 Identified needs associated with CCD articulated in workshop interactions

Participants provided a range of responses during the workshop session dedicated to identifying climate change- and CCD-related needs, which indicated a strong level of engagement with the issue. Overall concerns cited included the need for collection and dissemination of **more data** on climate change, particularly for baselines; demand for **experts** in specific fields to undertake targeted projects; the need for additional training of new graduates to address the **lack of personnel** in many areas relevant to CCD; and enhanced clarity and commitment to **funding** climate change projects. Some participants noted the need to start by identifying the **real cause of the problem**. More specific needs were articulated by workshop participants under three themes – **Energy and Industry, Education and Planning** and **Marine and Coastal management** – and are discussed in section 3.5.1.

3.4.3 Identified needs for CCD articulated in questionnaire data

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

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

Need identified	Institutional interest / mandate and/or disciplinary interest / mandate
Scientific literacy of the public in general, and education of decision makers. Availability of specialist knowledge, funding. Promotion of industry-led initiatives for CCD.	Civil Engineering
Awareness at all levels. People are indifferent to MID policies/measures. Aggressive campaigns to sensitise citizens about the risks they are facing with climatic change. Improved facilities like disposal of wastes and recycling of paper and electronic wastes should be more accessible.	Software Engineering
The high emission of carbon dioxide emission into the atmosphere. Educate society, create awareness and campaigns or climate change.	Software Engineering
The tourism industry, which is dependent on the climate and environment. The food and agriculture industry - potable water distribution/farming/ irrigation etc.	Civil Environmental Engineering
Transport (combat traffic jams as this directly related to emission of CO_2). Conception of sustainable buildings to consume less energy.	Civil Engineering
To have the most economically active stakeholders take actions towards CCD, such as corporate players. Consumers, individuals to redirect their thoughts towards the likely impacts if they do not have direct stakes.	Business Education
Maximum usage of green technology.	Software Engineering/Applied Computing
Political will/firm government/ consultant	Mechanical and Production Engineering
Access to green technologies. New policies.	Chemistry

Need identified	Institutional interest / mandate and/or disciplinary interest / mandate
To bring consistency between projects within the sector and climate component as well as between projects between sectors. Moreover, decision makers from different sectors must synchronise their strategies towards climate related issues.	Economics and Statistics
Legislation. There will be need for more appropriate legislation if we want to change the approach to development.	Civil Engineering
Scientific literacy of the public in general, and decision makers in particular, has to be raised. Availability of specialist knowledge, funding. Promotion of industry-led initiatives for CCD.	Civil Engineering
Political commitment. Government should lead by example. Business and private sector should be sensitised. Awareness. Financing. Overall change to mind-set.	Consultancy
"Education!"	Environmental Protection and Conservation
We have to convince policy-makers/politicians (who only think of their political office) of the real threat of CC to sustainable development and mainstream climate change into development process.	Human development
For CCD to be achieved, we should pay special attention to socio-economic factors, mostly social factors.	Agro-Industry, National Parks and Conservation Services

Table 2 shows that stakeholders and university staff observe a wide range of priority needs that require attention for CCD in Mauritius. Thus, while there are different perspectives on broad priorities to address in Mauritius, these did not map out clearly at all along disciplinary or institutional mandates, but tended to focus on cross-cutting issues, or even issues beyond the apparent disciplinary or institutional orientation of the questionnaire respondent. This is positive for addressing the interdisciplinary and multi-sectoral nature of climate change, and for harnessing skills in Mauritius to address CCD through knowledge co-production. However, it is important to identify and recognise these different perspectives in knowledge co-production processes and approaches, as personal experience and context can shed light on the specific priority areas that need to be addressed.

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

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

3.5.1 Needs analysis: Specific research needs and knowledge gaps

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 Mauritius workshop were the following:

- Energy and Industry;
- Education and Planning; and
- Marine and Coastal management

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

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

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
Increase public awareness on the concept of climate change	▪ No clear delineation between the concepts of climate change and Climate Compatible Development ▪ Primary climate information ▪ Communication strategy to get message across	▪ Impact of climate change on different sectors ▪ Communication strategies best suited for different strata of the population	▪ Communication specialists in CCD	▪ No proper repository ▪ Institutional prioritisation for sectoral investment ▪ Mechanisms to promote information sharing and networking
Mainstreaming CC in curriculum at all levels from pre-primary to tertiary levels	▪ No baseline information, including that on the physical, human and built environments ▪ Lack of concrete mechanism to support mainstreaming of climate change and CCD	▪ Models of curriculum development suitable for CCD	▪ Curriculum development specialists ▪ CCD experts	▪ No curriculum framework incorporating CCD ▪ Evaluation of existing curricula on ESD and CC ▪ Human resources development to increase the local knowledge base
Capacity building of all stakeholders at all levels	▪ Inaccessibility to new knowledge ▪ Constantly keep up to date with latest trends and developments	▪ Methodologies, approaches, models and initiatives concerning climate change development ▪ Techniques and technologies in place to deal with climate change ▪ Lack of multidisciplinary and interdisciplinary research ▪ Gap in terms of transfer of research findings for policy makers	▪ Lack of training, expertise skills and know-how ▪ Lack of interest to conduct research in CC	▪ Lack of knowledge management system ▪ Lack of networking; lack of linkages between industries and research institutions ▪ Lack of funding ▪ Research uptake management

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
Community engagement	▪ Evidence of how climate change will affect livelihoods patterns ▪ Communication strategy at grassroots level	▪ Development of benchmarks	▪ Insufficient staff numbers, shortage of qualified and experienced staff in the executing institutions	▪ Increase and continual involvement of financial institutions ▪ Monitoring and evaluation ▪ Redirect CSR fund to CC programme
Transport sector energy consumption	▪ Experiments limited to motor cars only, need to be extended to other vehicles including marine engines(alternative fuels) ▪ Database in current implementation of alternative fuels in other countries (Brazil /ethanol; India CNG) ▪ Availability of proper data for research analysis	▪ Detailed research on the uses of energy in the past few years ▪ Environmental impact of the transport sector/per passenger emission ▪ Road development impact on energy consumption ▪ Survey on the park of vehicle (average consumption, 'age' of vehicle) ▪ Change in habit of people travelling by car instead of public transport	▪ Transport specialist ▪ Raise knowledge of existing transport maintenance technicians ▪ Bioethanol experts ▪ LNG/CNG experts	▪ New relevant transport policies ▪ CO_2 tax emission policies ▪ Building more institutional capacity within the Mauritius Land transport authority leading to energy efficient transport systems
Renewable energy	▪ Availability of proper data for deep analysis ▪ Past reports in the field of resource assessment ▪ Marine studies related to energy ▪ Information on the availability of state-of-art technologies	▪ Proper resource assessment (wind map, solar map, geothermal) ▪ Environmental assessment ▪ Economic/ social evaluation of the introduction of these technologies ▪ Study smart grid concept and its applicability ▪ Storage technologies to be investigated	▪ Experts, engineers, technicians in renewable energy ▪ Monitoring and evaluation expertise ▪ Local capacity building of the industry for manufacturing	▪ Build capacity in electricity utility for integration of renewable energy ▪ Institution (universities) to be able to provide logistics to perform local resource assessment ▪ Regional/ local research centres on technology innovation to enable collaboration between universities

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
Energy efficiency	▪ Sensitisation ▪ Availability of proper data for deep analysis ▪ Data on current state of equipment and appliances in use ▪ Benchmarking of energy use in different sectors/ equipment ▪ Dissemination of energy statistics	▪ Survey on energy efficiency practices elsewhere ▪ Research on methodology and means to help educators enhance the application of energy efficiency practices for learners	▪ Engineers, technicians, architect specialised in specific fields ▪ Energy auditors ▪ Energy stewards (behavioural changes)	▪ Redefine our curriculum/ programmes at primary, secondary and tertiary levels of education focussing on energy efficiency ▪ Proper legislations to enable enforcement of energy efficiency measures
Building design	▪ Lack of information on locally available building materials ▪ Lack of technical information on existing building construction ▪ Benchmarking of our building standards and energy use ▪ Dissemination of available research on materials	▪ Survey on local available building materials ▪ Survey on existing building construction, construction details and energy usage ▪ Green building concept in the Mauritian context ▪ Review of research carried out	▪ Experts in the field of building and construction	▪ Interaction between regional institutions and universities
Effect of climate change on the marine ecosystem	▪ Need for more standardised baseline data on: living resources for marine ecosystem, water quality, oceanographic data ▪ Lack of understanding of the interaction between the physical environment and the ecosystem ▪ Lack of knowledge on the carrying capacity/economic evaluation of the coastal zone ▪ Inadequate knowledge on land-based activities and sources of pollution on the marine environment ▪ Better knowledge of extreme weather events ▪ Indigenous knowledge and cultural values	▪ Development of robust baseline data ▪ Standardisation and harmonisation of data between research institutions ▪ Incomplete inventory of living resources and their economic value ▪ Environmental economics ▪ Ecosystem services and values	▪ Train scientists, equipment ▪ Insufficient specialised skills, e.g. modelling skills, statistical analysis, GIS, taxonomists ▪ Environmental economists ▪ Stewardship and ownership ▪ Change of mind-set	▪ Horizontal integration amongst institutions ▪ Multidisciplinary approach ▪ Sharing of data ▪ Regional approach ▪ Enhanced collaboration between Ministries, research institutions and NGOs ▪ Enforcement capacity ▪ Lack of resources (financial, technical and technological) ▪ Logistics ▪ Strengthening of the central data base centre (NODC)

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
Effect of climate change on coastal zone	▪ Inadequate baseline information on rate and exact causes of erosion ▪ Inadequate understanding of sea level rise and lagoonal dynamics ▪ Mapping of impacts of extreme events ▪ The physical and socio-economic impacts of climate change on the coastal zone ▪ Impact of wave surges on coastal infrastructure and economic activities ▪ Impact of climate change on built environment, communities and tourism	▪ Lack of long term series data ▪ Collection of baseline data ▪ Collection of data on sea level rise and lagoonal dynamics ▪ Risk profiles of extreme events ▪ Lack of seawater current pattern data of lagoon ▪ Data needed on 0.5 m contours intervals ▪ Modelling of impacts	▪ Train scientists, equipment ▪ Insufficient specialised skills, e.g. modelling skills, statistical analysis, GIS, taxonomists ▪ Environmental economists ▪ Stewardship and ownership ▪ Change of mind-set	▪ Proper mainstreaming of climate change issues into development by decision makers ▪ Horizontal integration amongst institutions ▪ Multidisciplinary approach ▪ Sharing of data ▪ Regional approach ▪ Enhanced collaboration between ministries, research institutions and NGOs ▪ Enforcement capacity ▪ Lack of resources (financial, technical and technological) ▪ Logistics ▪ Strengthening of the central data base centre (NODC)
Effect of climate change on fisheries	▪ No dedicated studies on impacts of climate change on fisheries (artisanal or open sea) and commercial marine organisms	▪ Long term monitoring of catches, species composition, migration routes, spawning patterns ▪ Effects of elevated temperature on fish composition and diversity ▪ Changes in the reef ecosystem on the coral	▪ Train scientists, equipment ▪ Insufficient specialised skills, e.g. modelling skills, statistical analysis, GIS, taxonomists ▪ Environmental economists ▪ Stewardship and ownership ▪ Change of mind-set	▪ Proper mainstreaming of climate change issues on development by decision makers ▪ Horizontal integration amongst institutions ▪ Multidisciplinary approach ▪ Sharing of data ▪ Regional approach ▪ Enhanced collaboration between ministries, research institutions and NGOs ▪ Enforcement capacity ▪ Lack of resources (financial, technical and technological) ▪ Logistics ▪ Strengthening of the central data base centre (NODC)

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

The prioritised **knowledge gaps** emerging from the workshop participants, as set out for the three thematic areas in Table 3, focused on adaptation, mitigation and some larger cross-cutting themes. Knowledge on climate change effects on patterns of citizens' livelihoods was prioritised. Mitigation-related knowledge gaps prioritised included the need to explore alternative fuels and energy use in different sectors and exploring new technology development, as well as an understanding of the current state of equipment and appliances in use, and establishing benchmarks of current building standards and energy use. Marine and coastal knowledge gaps raised concern over knowledge of marine ecosystems and natural resources, water quality, and understanding the carrying capacity/economic evaluation of the coastal zone. Participants felt here was inadequate knowledge on land-based activities and sources of pollution on the marine environment. Extreme weather events also required further investigation, specifically mapping of impacts on the built environment, communities and tourism. In addition to this, exploring indigenous knowledge and cultural values associated to adaptation are needed.

Participants called for overarching knowledge transfer and communication strategies, stressing the current inaccessibility of new climate change knowledge, which could be remedied by improving general baseline data, particularly long-term data, and the knowledge repositories available to store these. Benchmarking was also called for, for example in the area of building standards and energy use, as well as curriculum development.

Some of the key knowledge gaps identified in the policy documents echoed those raised in the workshop, focusing on regional sea level rise projection; long-term data on climate change and human health; applied weather and climate data for use in different sector; baseline information regarding climate change effects on physical, human and built environments, and monitoring and assessment studies at local, island, national and regional scales.

Prioritised **research gaps** raised concern about the need for environmental research in general, exploring the impact of climate change on different sectors and how research can contribute to improving communication strategies to share findings. Research into curriculum development and the need for multidisciplinary and interdisciplinary research was highlighted. A key gap identified was lack of research uptake into policy. A number of interesting gaps were highlighted in the area of integration of CCD into curriculum development, including models of curriculum development suitable for CCD.

Research gaps to enhance mitigation-related response include energy use assessments; transport sector/per passenger emission research; road development; accessibility of car versus public transport assessments; and energy resource surveys (wind map, solar map and geothermal) were called for, as were surveys into building construction, energy usage and presence of 'green' development.

Participants further identified research into collaborative management of nature resources, and developing detailed inventories of current living resources and their economic value as priorities. The economic value of ecosystem services and their vulnerability to climate change was seen as a key research priority, alongside examining sea level rise, lagoon dynamics, and creating risk profiles

of areas vulnerable to extreme events. All of these specific research gaps echo the research priorities highlighted in the policy, showing consensus regarding the priority research areas for Mauritius.

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.

Table 4: Some climate change programmes in Mauritius, with potential associated research needs

Research needs, linked to specific knowledge needs – as indicated in policy (P), supplemented by workshop (W) and questionnaire data (Q)	Partner organisations for knowledge co-production
▪ Renewable sources of energy ▪ Wind resource assessment, photovoltaic, online daily traffic fluidity monitoring rain water harvesting and green roof, low impact development (LID) (P) ▪ Energy use assessments; transport sector/per passenger emission research; road development; accessibility of car versus public transport assessments; and energy resource surveys (wind map, solar map and geothermal) were called for, as were surveys into building construction, energy usage and presence of 'green' development (W)	LEAD AGENT: Université des Mascareignes Faculty of Sustainable Development and Engineering
▪ TNA (Technology Needs Assessment) (P) ▪ Need to explore alternative fuels and energy use in different sectors and exploring new technology development (W) ▪ Integrate and mainstream climate change adaptation into the institutional framework and into core development policies, strategies and plans (P)	LEAD AGENT: Ministry of Environment and Sustainable Development POTENTIAL PARTNER: Université des Mascareignes Faculty of Sustainable Development and Engineering
▪ Monitoring CC in the Republic of Mauritius ▪ Collection of data and developing trends for various calamities (P) ▪ Development of CC indices: as per WMO recommendations (P) ▪ Establishing baselines (P, W)	LEAD AGENT: METEO services
▪ Cross-cutting Climate Change Research (P) ▪ Acclimat (Acclimatisation aux changements climatiques) (P) ▪ Vulnerability assessments in each of the IOC countries (P) ▪ The main output is production of strategy adaptation to CC which has been adopted by IOC council in January (P)	LEAD AGENT: Indian Ocean Commission (IOC) PARTNERS:

Table 5 provides a more detailed overview of the research and knowledge needs associated with CCD in Mauritius, drawing on all three data sources.

Table 5: More detailed research and knowledge needs from Mauritian policy documents, workshop and questionnaire data

Aspect	Sector	Needs
Aspect A: ADAPTATION	Food Security and Agriculture	▪ Research on agrobiodiversity (P) ▪ Medicinal plants and traditional knowledge neglected (P) ▪ Change in yield and quality of other crops in different microclimate (P) ▪ Link between land degradation and climate change (P) ▪ Multi-linkages in the interaction between change in forests, lands, biodiversity and climate change (P)
	Water	▪ Joint studies/research on the impacts of climate change on the hydrological cycle and on the fresh water availability including groundwater in coastal aquifers (P) ▪ Likely impacts of CC at local level/regional level of our territory
	Marine Biodiversity and Fisheries	▪ Limited marine biodiversity knowledge hinders environmental surveys (W) ▪ Lack of environmental impacts baseline information, upon which to base studies of climate impacts (W) ▪ Surveys of marine biodiversity, continuously updated (W) ▪ Processes for collaborative management of marine biodiversity (W) ▪ Baseline data on living resources for marine ecosystem, water quality, oceanographic data (W) ▪ Lack of understanding of the interaction between the physical environment and the ecosystem (W) ▪ Lack of knowledge on the carrying capacity/economic evaluation of the coastal zone (W) ▪ Inadequate knowledge on land-based activities and sources of pollution on the marine environment (W) ▪ Indigenous knowledge and cultural values (W) ▪ Development of robust baseline data; standardisation and harmonisation of data between research institutions; incomplete inventory of living resources and their economic value; environmental economics; ecosystem services and values (W) ▪ No dedicated studies on impacts of climate change on fisheries (artisanal or open sea) and commercial marine organisms (W) ▪ Long term monitoring of catches, species composition, migration routes, spawning patterns (W) ▪ Effects of elevated temperature on fish composition and diversity (W) ▪ Changes in the reef ecosystem on the coral (W) ▪ Research studies of the migration of tuna in the Indian Ocean in the event of a change in the sea surface temperature and sea level rise (P)

Aspect	Sector	Needs
	Infrastructure and Tourism	▪ Further study and research on the reciprocal impacts between tourism and climate change (P) ▪ Inaccessibility to new knowledge (W) ▪ Constantly keep up-to-date with latest trends and developments (W) ▪ Lack of information on locally available building materials (W) ▪ Lack of technical information on existing building construction (W) ▪ Benchmarking of our building standards and energy use (W) ▪ Survey on local available building materials; survey on existing building construction, construction details and energy usage (W) ▪ Green building concept in the Mauritian context (W) ▪ Impact of climate change on built environment, communities and tourism (W)
	Coastal Protection	▪ Climate change and sea level rise projections, with a focus on regional level (P) ▪ Baseline information, including on the physical, human and built environments (P, Q) ▪ Monitoring and assessment studies at local, island, national and regional scales (P) ▪ Identification of vulnerable areas (P) ▪ Development of relevant climate change indicators and make projections of future climate (including forecasting climate hazards and climate extremes) and sea level rise (P) ▪ Development and mapping of vulnerable areas of coastal zone (vulnerability atlas) on the basis of CC scenarios (P) ▪ Research on the relationship of global warming and tropical cyclone intensity in the South West Indian Ocean (P) ▪ Inadequate baseline information on rate and exact causes of erosion (W) ▪ Inadequate understanding of sea level rise and lagoonal dynamics (W) ▪ Mapping of impacts of extreme events (W) ▪ Physical and socio-economic impacts of climate change on the coastal zone (W) ▪ Impact of wave surges on coastal infrastructure and economic activities (W) ▪ Lack of long term series data; collection of baseline data (W) ▪ Collection of data on sea level rise and lagoonal dynamics (W) ▪ Risk profiles of extreme events (W) ▪ Lack of seawater current pattern data of lagoon; data needed on 0.5 m contours intervals; modelling of impacts (W)
	Health	▪ Good quality data from long term monitoring to establish linkages between climate change and human health (P, Q) ▪ Research to improve understanding of the response to global warming, climate change and climate variability and establish links to human health (P) ▪ The main sectors that are vulnerable to the impacts of CC must be identified and the most appropriate measures taken to mitigate those impacts (Q)

Aspect	Sector	Needs
Aspect B: MITIGATION	Sustainable Energy and Low Carbon Development	▪ Assess the effectiveness and appropriateness of the alternate transport technologies and also other options such as decentralisation (P) ▪ Research and development on impacts of climate change on different sectors (P) ▪ Breeding of sugar cane for producing new varieties with higher fibre content to generate more bagasse and/or for ethanol production (P) ▪ Biomass and bio-diesel production (P) ▪ Experiments limited to motor cars only, need to be extended on other vehicles including marine engines(alternative fuels) (W) ▪ Database in current implementation of alternative fuels in other countries (Brazil /ethanol; India CNG) (W) ▪ Availability of proper data for research analysis; detailed research on the uses of energy in the past few years (W) ▪ Environmental impact of the transport sector/per passenger emission (W) ▪ Road development impact on energy consumption. (W) ▪ Survey on the park of vehicle (average consumption, 'age' of vehicle); change in habit of people travelling by car instead of public transport (W) ▪ Proper resource assessment (wind map, solar map, geothermal) (W) ▪ Survey on energy efficiency practices elsewhere; research on methodology and means to help educators enhance the application of energy efficiency practices for learners (W)
Aspect C: CROSS-CUTTING ISSUES	Capacity Building, Training and Institutional Strengthening	▪ Applied research to bridge knowledge gaps in general (P, Q) ▪ No baseline information, including that on the physical, human and built environments (W, Q) ▪ Lack of concrete mechanism to support mainstreaming of climate change and CCD (W, Q) ▪ Models of curriculum development suitable for CCD (W)
	Research and information needs, including how to use climate change information	[see Table 3 above]
	Public Awareness, Participation and Access to Information	▪ No clear delineation between the concepts of climate change and Climate Compatible Development (W) ▪ Primary climate information communication strategy to get message across Impact of climate change on different sectors (W) ▪ Communication strategies best suited for different strata of the population (W, Q) ▪ Evidence of how climate change will affect patterns of their livelihoods (W) ▪ Communication strategy at grassroots level; development of benchmarks (W)

Aspect	Sector	Needs
	Financial Resource Mobilisation and Management	▪ In depth research and studies from a technical, economic and financial point of view of promising low-emission technologies focusing on renewable energy (solar, hydro, wind, and marine-based energies) (P)
	Technology Development and Transfer	▪ Methodologies, approaches, models and initiatives concerning climate change development (W) ▪ Techniques and technologies in place to deal with climate change (W) ▪ Economic/ social evaluation of the introduction of these technologies (W) ▪ Study smart grid concept and its applicability; storage technologies to be investigated (W) ▪ Data on current state of equipment and appliances in use; benchmarking of energy use in different sectors/ equipment dissemination of energy statistics (W, Q)
	Legislative Development	▪ Applied weather and climate data for use in different sectors (P) ▪ Lack of multidisciplinary and interdisciplinary research; gap in terms of transfer of research findings for policy makers (W)

The table above offers some indication of where the major needs are, which is of relevance for the implementation of a future National Climate Change Strategy and Action Plan for Mauritius. 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 4), 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.

The priorities for CCD relating to sea-level rise, coastal protection, fisheries, tourism, curriculum development, participant and knowledge transfer (identified in workshop data, see section 3.3 above), should not only move towards CCD in technical ways, but also deal with the social processes necessary to **implement policies and strategies related to CCD.** There is growing consensus, congruent with the definition of CCD, that adapting to climate change requires iterative and participatory learning processes, for which understanding social learning and triggers for behavioural change are important steps. A further component of addressing process issues related to CCD policy implementation is analysing individual and institutional capacity gaps, as addressed in the following two sections.

3.5.2 Needs analysis: Individual capacity gaps

Assessment of Mauritian policy and strategy documents reveals several priority individual capacity gaps, both sectoral and cross-cutting, in the response to climate change and for CCD implementation. Policy also points to a general lack of education, awareness and training on climate change issues across all sectors.

The workshops highlighted the need for more marine scientists, environmental managers, environmental engineers, technicians, environmental economists, green architects and energy auditors. Participants felt that expertise in the following areas was also crucial for Mauritius:

- Building and construction;
- Monitoring and evaluation;
- Communication in CCD;
- Curriculum development;
- Taxonomy;
- GIS;
- Statistic analysis;
- Climate and impacts modelling;
- Bioethanol development; and
- Energy efficient, low carbon transport systems.

Participants noted insufficient specialised skills in working and operating certain technologies related to climate change research and mitigation, as well as a significant shortage of qualified and experienced staff in the executing institutions. Concerns were raised over a general lack of interest to conduct research on climate change, suggesting a need to shift mindsets and behaviours of people to fully engage with climate change research and CCD.

3.5.3 Needs analysis: Institutional capacity gaps

The policy analysis showed obvious institutional capacity gaps present in the Mauritian response to climate change and CCD. Of primary concern was the need to improve knowledge sharing and access to climate change and CCD-related information, which requires addressing access and dissemination gaps as well as improving data collection and management of data. Technological inadequacies focused on the low use of renewable energy technologies within institutions, and the lack of energy efficiency protocols, policies and management. General research concerns focused on inadequate tools, equipment and logistical facilities to sustain or implement field work. The noticeable lack of a national research plan to undertake climate change and CCD related research was highlighted, and the need for an integrated approach to such research. The lack of grant programmes with national and international technical and financial support for this kind of research was of concern. Specific areas that were highlighted as needing institutional support were climate change mitigation research, natural resource management and the effect of climate change of tourism. The need for a national network of protected areas and buffer zones to allow natural ecosystem adaptation was called for as was the need for the fisheries sector to improve monitoring procedures. Required institutional capacity in the tourism sector related to diversifying the existing tourism market, as well as creating climate change informed tourism and establishing environment management systems, audits and verification in hotels. Generally, the policy documents called for local networking of climate change researchers and the development of institutional synergies within this field.

Workshop participants called for a variety of improved institutional capacities and arrangements. These included improving arrangements for transboundary marine environmental plans; developing institutional structures for improved feedback loops on environmental outcomes; developing a repository for climate change data, research and knowledge; and institutional prioritisation to develop a curriculum framework incorporating CCD. Participants also felt that an evaluation of existing curricula on ESD and CC would be useful to inform such institutional curriculum frameworks. Participants said that new relevant policies should be developed, such as transport policies that tax carbon emissions and green building and construction policies. A call for institutions to not only accommodate but promote multidisciplinary research was cited in the workshop, as was the need for sharing data regionally and internationally across sectors. In general, workshop participants called for an overall mainstreaming of climate change and CCD across sectors.

> *"While climate change is the favourite term of politicians and scientists, the layperson is indifferent to climate change. The reason is due to the fact that the layperson is unaware of the gravity of the situation."*
>
> Mauritius government stakeholder

A synthesis perspective of the individual and institutional capacity gaps identified is provided in section 6.1.

4 INSTITUTIONAL ANALYSIS

4.1 Introducing the institutional analysis

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

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

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

4.2 Policy and institutional arrangements

4.2.1 Policy and institutional arrangements governing Higher Education in Mauritius[13]

Tertiary education started in 1924 with the College of Agriculture, and has since developed into a diversified system composed of public, private, regional and international institutions catering for a wide range of courses, programmes, diplomas and degrees (Mohamedbhai 2006). As in most African countries, it was not until after independence that the higher education system really became a national priority. Tertiary education in Mauritius encompasses a wide range of institutions with diverse characteristics. Some institutions provide all levels of tertiary education in a range of disciplines, while others focus their activities on only one or two areas at certain levels. A number of the institutions providing tertiary education are international institutions that offer education via distance methods (Mohamedbhai 2006). Within the public sector, five key institutions are evident: the University of Mauritius (UoM), the University of Technology (UTM), the Mauritius Institute of Education (MIE), the Mahatma Gandhi Institute (MGI) and the Mauritius College of the Air (MCA). There are other higher education providers which are not under the umbrella of the Tertiary Education Commission. These include the Swami Dayanand Institute of Management, the Institut

[13] This short summary is derived from a SARUA Country Profile compiled Nteboheng Mahlaha in 2011. "Chapter 8: Mauritius," in *A profile of Higher Education in Southern Africa, Volume 2* (www.sarua.org).

Superieur de Technologie, the Industrial and Vocational Training Board, the Mauritius Institute of Health, the School of Nursing and the Council of Legal Education. There is also an Industrial and Vocational Training Board that provides mainly vocational courses. The University of Mauritius was established in 1965 and initially consisted of three schools: agriculture, administration and industrial technology. However, in recent years the UoM has expanded: it now comprises five faculties and is the largest provider of higher education in Mauritius, with a strong research focus. Two state institutions, the Mauritius Institute of Public Administration and Management (MIPAM) and the State Information Training Centre (SITRAC Ltd), were merged to form the Mauritius University of Technology (UTM), which opened its doors to students in September 2001. This university's vision is 'to become a university of national, regional and international renown, providing multi-level quality tertiary education and training including continuing professional education geared towards sustained capacity-building for increasingly technology-driven and enterprise-based developments' (University of Technology, Mauritius 2012).

Estudos Gerais Universitarios was the first higher education institution established in Mauritius (in 1962). In spite of the impressive socio-economic developments experienced by most sectors in Mauritius, education in general seems to have lagged behind. In a recent World Economic Forum report (2012), it was observed that 'educational enrolment rates remain somewhat low, especially at the university level; education spending is low; and the educational system gets mediocre marks for quality'. This supports recent calls on government and other stakeholders for education (and higher education in particular) to receive new impetus (African Development Bank 2009). The ADB further indicates in its report that, while there is a need to improve access to higher education and its skills base, the sector will have to forge closer ties with the world of business and industry in order for the country to make the transition to a knowledge hub for the region. Higher education in Mauritius is governed by the Tertiary Education Commission (TEC), which was created in 1988 as an independent body under the Ministry of Education. The commission's main responsibilities at that time were to develop and co-ordinate post-secondary education in Mauritius and to allocate government funds to the institutions under its jurisdiction. There were no private tertiary institutions at that time and no provision was made for private higher education institutions (Ministry of Education and Scientific Research 2004). The TEC has since evolved and the accreditation of both public and private tertiary institutions in Mauritius now falls within its mandate (Mohamedbhai 2006).The TEC has been enshrined in a five-year strategic plan with the main vision to 'make Mauritius the intelligent Island of the region in the Global Village', and a clear mission to 'position Mauritius in the region as a world class knowledge hub and the gateway for post-secondary education' (TEC 2007: 5). The main responsibilities of the TEC are to:

- Register and accredit private universities and other post-secondary institutions;
- Recognise and determine the equivalence of academic qualifications in post-secondary institutions inside and outside Mauritius; and
- Promote and maintain high-quality standards in post-secondary education institutions through quality assurance and accreditation mechanisms.

These responsibilities are linked to specific goals, including to:

- Provide the environment necessary to create a regional knowledge hub and a centre for higher learning and excellence in Mauritius;

- Increase access to post-secondary education through the establishment of open and distance learning;
- Align post-secondary education with international standards and quality;
- Promote regional and international collaboration and co-operation through student diversity and relationships with institutions abroad; and
- Advocate, nurture and promote principles of good governance, transparency and accountability in the post-secondary education system.

In 2001 the Mauritius Qualifications Authority was established. Its function is to evaluate and recognise qualifications awarded by training institutions running technical schools and vocational courses.

4.2.2 Policy context for climate change

Mauritius launched its National Climate Change Adaptation Policy Framework (NCCAPF) in 2013. The NCCAFP consists of a National Climate Change Adaptation Policy, a Climate Change Adaptation Strategy and Action Plan, a Climate Change Adaptation Investment Programme, and project concepts. The NCCAPF aims to integrate and mainstream climate change into core development policies, strategies and plans of Mauritius, and stresses the need for integrated policy making for adaptation. Principles of the NCCAPF include the need to undertake adequate planning to develop resilience, enhance and maintain environmental quality, promote the development of a strong and diversified economy and create an enabling environment through the adoption of appropriate technologies and practices. The NCCAPF acknowledges that actions towards climate change resilience are aimed at supporting sustainable development to ensure an equitable future, in which society is engaged at all levels, which places this overarching policy within the framework of climate compatible development. A Climate Change Bill is under development, to establish the legal framework and mechanism for making Mauritius climate change-resilient and adopting a low-carbon economy, in line with the overarching Government objectives of developing a green economy.

Of significance for both adaptation and mitigation, the Long Term Energy Strategy 2009 – 2025 aims to meet 35 percent of the energy demand through renewable energy sources by the year 2025. Climate change policies, strategies and action plans to address adaptation and mitigation of risks in the agriculture, tourism and fisheries sectors in the RoM, including in the water sector for Rodrigues, were developed under the Africa Adaptation Programme. The Third National Communication (TNC) to the UNFCCC is currently under development. The Ministry of Environment and Sustainable Development, in collaboration with key stakeholders, is further currently initiating a process to develop a Low Carbon Development Strategy, as well as Nationally Appropriate Mitigation Actions (NAMAs). These will be based on assessments to be carried out in the sectors concerned, taking into account long term energy security for equitable development in Mauritius.

The Maurice Ile Durable programme is a further highly relevant policy and implementation initiative, which constitutes a social undertaking driven through the office of the Prime Minister to shape the future of the country, with the umbrella of sustainable development. There are currently 207 MID-related projects. The aim of MID is to focus on the five Es: Environment, Energy, Education, Equity and Employment. Efforts are being made with regard to schools, energy efficient lamps, waste reduction, composting of solid waste – household composting promotion, and the creation of MID

clubs in schools to boost MID aims. The MID programme also includes a focus on Green economy, Ocean economy and Green Employment Policy.

4.2.3 Institutional arrangements for climate change

The Climate Change Division in the Ministry of Environment and Sustainable Development became operational on 1 March 2010. Core duties of the Climate Change Division include developing a climate change mitigation and adaptation framework; co-ordinating national, regional and international projects on climate change and sea level rise; co-ordinating the implementation and reporting of an inter-sectoral climate change monitoring programme; identifying and co-ordinating research and development priorities associated with climate change; and a climate change Public Outreach Programme.

A multi-sectoral National Climate Committee was established in June 1991 under the chairmanship of the Prime Minister's Office, with the Director of the Meteorological Services acting as co-chairperson, to monitor progress on the science of climate change and evaluate the possible impacts on key sectors of the economy. The NCCAPF notes the development of a Climate Change Committee under the chairmanship of the Permanent Secretary of the Ministry of Environment and Sustainable Development, to better coordinate and monitor the implementation of the recommended policies, strategies and programmes on climate change adaptation. It is unclear whether this committee is in operation. Government has created a Ministry of Social Integration and Economic Empowerment, in line with the focus of the MID programme on the five Es: Environment, Energy, Education, Equity and Employment.

Stakeholder engagement: The process to develop the Mauritius National Climate Change Bill has included substantial participation of a range of stakeholders. The University of Mauritius held a climate change awareness raising week in 2011, which attracted 800 participants (including public, private, NGOs, academics, civil society, students at primary, secondary and tertiary levels and people at senior management level). Under the Technology Needs Assessment process, mitigation and adaptation technologies were identified for key sectors, with prioritisation through an inclusive multi-stakeholder process using Multi Criteria Analysis.

4.3 Research and development frameworks

The Mauritius Research Council (MRC) acts as a central body to advise Government on Science and Technology issues and to influence the direction of technological innovation by funding research projects in areas of national priority and encouraging strategic partnerships. The MRC has implemented a project to promote research on climate change adaptation, as part of the Africa Adaptation Programme.[14]

[14] A list of research projects can be found at http://environment.gov.mu/English/Climate_Change/Pages/Climate-Change.aspx (accessed 22 August 2013).

4.4 Some current CCD initiatives and programmes

While there are a number of CCD initiatives and programmes active in Mauritius, 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. See Table 6, which sets out some of these initiatives. This list is not comprehensive, but rather illustrative of how some of the priorities and needs identified above are already being addressed. More comprehensive national analysis would be able to expand the insights into existing active programmes.

Table 6: Some CCD initiatives and programmes in Mauritius

Programme / initiative	Driving agency / department	Focus and time frame	Status / additional comments
Africa Adaptation Programme in Mauritius	Ministry of Environment and Sustainable Development; plus key sectors of Agriculture, Disaster Risk Reduction, Education, Finance, Fisheries, Tourism and Water	2010–2013: Integrate and mainstream climate change adaptation into the institutional framework and into core development policies, strategies and plans	Flooding, Landslide and Coastal Inundation National Risk Profiles, Maps, Strategy Framework and Action Plans for Disaster Risk Management developed; dynamical downscaling; Regional Workshop on "Leveraging Public Finance to catalyse Private Sector engagement for Resilient Development" in August 2012
Climate Change Adaptation Programme in the Coastal Zone of Mauritius	Ministry of Environment and Sustainable Development UNDP Adaptation Fund	2012–2015: Coastal Zone Adaption: Increase communal and livelihood climate resilience in coastal areas, through adaptation measures to protect currently vulnerable coastal ecosystem and community features at three priority sites; an early warning system for incoming surges; training to promote compliance with climate-proofed planning, design, and location guidelines; mainstreaming policies	Disseminating and managing knowledge to ensure that the benefits from the project are replicated in other areas at risk
Conservation of Biodiversity	NPCS (National Parks and Conservation Society)	Ongoing **Conservation of biodiversity:** Control of soil erosion, removal of exotic plants, planting of endemic species	
Education, awareness and capacity-building of coastal communities (highly dependent on natural resources) at grass-roots level	Environmental Protection and Conservation Organisation (EPCO) – founded in and registered since 1988	**Education, awareness and capacity-building:** Info gathering and data collection through "Situational Analysis" and "Needs Assessment" conducted via surveys and mapping exercises done BY communities FOR communities, i.e. community participation and empowerment. Community empowerment through hands-on participation, with the aim to develop and implement "Mitigation, Adaptation and Resilience Plans" to address CC impacts prior and post weather events	Enables coastal communities to understand CC and equips them to adapt to CC and become resilient post CC impacts. Enables communities to mitigate causes of CC, to adapt to fast occurring changes and to become resilient after extreme weather events. Empowers communities to set up their own "Climate Change Preparedness Teams" (CCPTs) to pass on CC knowledge gained – create ripple effect

Programme / initiative	Driving agency / department	Focus and time frame	Status / additional comments
Teacher Education in Education for Sustainable Development (ESD)	Mauritius Institute of Education	**Teacher education programmes (mainstreaming ESD)** • ESD committee (consultation among all programme coordinators) • Consultancy and technical assistance for national and international government agencies (AAP, UNDP, UNESCO,ADEA) • Outreach projects on CC	Mainstream of CC in the ESD committee and at institutional level.
Research and training in the field of renewable sources of energy and water resource management	Université des Mascareignes Faculty of Sustainable Development and Engineering	Research and training in the field of renewable sources of energy (wind resource assessment, photovoltaic, online daily traffic fluidity monitoring Rain water harvesting and green roof, low impact development (LID), courses related to Environmental Engineering, Management and Economics	Outreach and arousing awareness in the faculty. For Stakeholders: Policy Development , Project Implementation, Community Development

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

Considering these initiatives, which constitute only a small sub-set of action on climate change by Mauritian organisations, it is clear that NGOs and parastatals are involved in important research and work on biodiversity and on community-based adaptation planning and preparedness. There is a strong focus on coastal management and resilience, including through the completed Africa Adaptation Programme and the ongoing Adaptation Fund project. These include an integrated adaptation – disaster risk reduction approach, as does the work of EPCO, indicating good potential for more collaborative work and research in this regard. The initiatives also indicate some of the work being carried out to start to fill some of the identified knowledge, research and capacity gaps. Section 4.5 focuses more deeply on the areas of research, teaching, policy engagement and community outreach of HEIs in Mauritius, towards understanding the current status of HEI responses to climate change.

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

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

Mauritius has a fairly well developed policy framework on climate change, which encapsulates both adaptation and mitigation responses, and the need to more the economy and livelihoods towards low carbon development. Thus the policy framework is broadly consistent with CCD, although the concept is not specifically used and options for an integrated adaptation-mitigation response are not always considered. The MID programme further highlights important issues of equity and empowerment, critical for a just and sustainable response to climate change. Despite this positive situation, the need for greater public awareness on climate change has been clearly identified. Further exploring the concept of CCD, within programmes like the MID, may provide a useful stimulus to develop a common societal understanding of the core issues to be addressed, and the need for knowledge co-production in this regard in Mauritius.

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

- CCD is a mix of adaptation, mitigation and awareness raising.
- CCD is the need to go towards a low-carbon climate relevant development path. Population must be sensitised for greater awareness of urgent threat due to CC and possible measures. Develop a lifestyle that is compatible with the climate or not changing the climate.
- CCD is sustainable development taking climate risks and opportunities into consideration.
- CCD is any kind of development that will not exacerbate the current situation and the effect of climate change.
- CCD refers to any development that can contribute to an elimination or reduction of the effects of climate change.

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

- Climate compatible development' refers to all forms of sustainable policies/programmes (i.e. affecting social/economy/so as to minimise adverse effects of climate change.
- A low carbon environment, with fresh air to breathe in.

- Climate compatible development implies {among many others} awareness of climate change throughout the population, 'low carbon emission' trend, proactive impact assessment.
- Harmonisation of all human activities with existing climate.
- Thinking about impacts on climate first to make informed decisions about sustainable behaviours and practices as major decision.
- Development which does not promote further climate changes and development which adapt to climate change.
- Mauritius is a small island state and is vulnerable to climate change such as flooding, sea level rise, climate change impact on agriculture, droughts among others. Both adaptation and mitigation are therefore important. In terms of mitigation, the island can benefit from a win-win situation. Development strategies and programmes must automatically include climate change component, considering adaptation needs among others, in various sectors. Some main sectors for climate consideration are: agriculture (planters' adaptation), fisheries, road development, etc.
- Any development should take into account the principles of sustainability.

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 many participants in the mapping study have an extremely good understanding of climate resilient development, this concept, as well as the specific **concept of CCD is relatively new** to some stakeholders. **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

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

As mentioned earlier the Mauritius Research Council (MRC) acts as a central body to advise Government on Science and Technology issues and to influence the direction of technological innovation by funding research projects in areas of national priority and encouraging strategic partnerships. The MRC has implemented a project to promote research on climate change adaptation, as part of the Africa Adaptation Programme. A rapid assessment of specific research is underway in Mauritius and is explored further in this section.

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

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

Article	Origin of first author
Gray, M., and B. Lalljee. 2013. "Climate Change Adaptation in Mauritius: Considering the Role of Institutions," *Western Indian Ocean Journal of Marine Science* 11(1): 99-111.	Mauritius
Sultan, R. 2012. "An econometric study of economic growth, energy and exports in Mauritius: Implications for trade and climate policy," *International Journal of Energy Economics and Policy* 2(4): 225-237.	Mauritius
Ateweberhan, M., and T.R. McClanahan. 2010. "Relationship between historical sea-surface temperature variability and climate change-induced coral mortality in the western Indian Ocean," *Marine Pollution Bulletin* 60(7): 964-970.	Kenya
Sultan, R. 2012. "Dynamic linkages between transport energy and economic growth in Mauritius - implications for energy and climate policy," *Journal of Energy Technologies and Policy* 2(1): 24-36.	Mauritius
Sultan, R. 2010. "Short-run and long-run elasticities of gasoline demand in Mauritius: an ARDL bounds test approach," *Journal of Emerging Trends in Economics and Management Sciences* 1(2): 90-95.	Mauritius
Dubois, R. and Y. Juwaheer. 2012. *Skills for green jobs in Mauritius*.	Mauritius and Switzerland
Khadoo-Jeetah, P. and R. Mohee. 2013. "Bio-ethanol Production from Readily Available Lignocellulosic Biomass in Mauritius through Enzymatic Hydrolysis." In *Climate-Smart Technologies*, 577-586. Berlin Heidelberg: Springer.	Mauritius
McClanahan, T. R., A. Baker and M. Ateweberhan. 2011. "Preparing for climate change in the Western Indian Ocean: Identifying climate refugia, biodiversity responses and preferred management." In *WIOMSA Book Series*, 12.	Kenya
Parry, I. W. 2012. "Reforming the tax system to promote environmental objectives: An application to Mauritius," *Ecological Economics* 77: 103-112.	USA
Gemenne, F. and A. Magnan. 2010. *The Other Migrants, Preparing for Change. Environmental Changes and Migration in the Republic of Mauritius*.	Belgium

It is encouraging to see the variety of different research publications available regarding climate change in Mauritius from this brief Google Scholar search, as well as the fact that seven out of the first 10 publications with the title including "climate change" and "Mauritius" were published within the last two years. Half of the publications were primarily authored by researchers from Mauritius, showing a strong research presence regarding climate change in Mauritius in the international arena. Interestingly, the majority of the Mauritian published work this search revealed was authored by Riad Sultan from the Faculty of Social Studies and Humanities at the University of Mauritius, who is clearly an active researcher in the field of energy, economics, and climate change in Mauritius.

Using a different search engine or search parameters would of course have generated a different set of publications, undoubtedly showing additional Mauritian authors.[15]

4.5.2.2 University-based research

The Mauritius questionnaire and workshop data shows a diversity of university faculty and department involvement in climate change related research, amongst others:

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

Faculty / School / Centre	Department	Programmes / Institutes
Université des Mascareignes Faculty of Sustainable Development and Engineering	Civil and Environmental Engineering Electromechanical and Automation Engineering	Research and training in the field of renewable sources of energy and sustainable development Green construction and engineering; green building materials, use of soil as sustainable building material Use of natural refrigerants in air conditioning and refrigeration Traffic monitoring (fluidity) for low CO_2 emission; rainwater harvesting at the UDM
University of Mauritius, Faculty of Engineering	Engineering – Mechanical and Production	Sustainable forms of energy: Use of coconut oil for electricity production
University of Mauritius, Faculty of Science	Chemistry	Climate change adaptation Environmental and coastal sciences Renewable energy
University of Mauritius, Faculty of Social Studies and Humanities	Department of Economics and Statistics	Climate change and agriculture in Mauritius – cost-benefit analysis of climate change adaptation project Environmental Economics

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

Table 8 above shows both faculty-based diversity and departmental level diversity of participation in climate change related research and teaching at Université des Mascareignes (UDM) and University of Mauritius (UoM). The table also shows that between the universities most of these have some form of climate change related research programme, all of which focus primarily on mitigation and sustainable forms of energy, apart from the Department of Economics and Statistics at UoM which has explored economic aspects of agricultural adaptation, as well as provided training for government officials in this regard.

[15] In the interests of consistency across all 12 countries included in the mapping study, the same Google Scholar search was conducted and included in the respective country reports.

Workshop and questionnaire data indicated research taking place on topics related to CCD, as set out in Table 9.

Table 9: Research projects currently being undertaken in response to CC and the need for CCD

Institution, Faculty, Department	Research project	Researcher/s or Deans / HODs	Type of research project
UNIVERSITY OF MAURITIUS Faculty of Social Studies and Humanities Department of Economics and Statistics	Environmental economics	Riad Mohammed Akthar Sultan r.sultan@uom.ac.mu akthar_rs@yahoo.com	Green Jobs Assessment for Mauritius (Sultan and Hardsorff, forthcoming) Bioethanol as a sustainable fuel for climate policy (CEEPA and papers) Climate change and marine and fisheries resource (PhD thesis ongoing) Sustainable energy as a climate policy Carbon emission and economic growth in Mauritius Sustainable transport as climate change mitigation strategy
UNIVERSITY OF MAURITIUS Science, Chemistry	Climate change modelling and CZM	Dr R. Ramessur ramossur@uom.ac.za	Climate change modelling and CZM
UNIVERSITE DES MASCAREIGNES Faculty of Engineering and Sustainable Development, Department of Civil and Environmental Engineering	Sustainable Engineering	Dr R. Goodary r.goodary@udm.ac.mu	Revision of curriculum to include CCD Transdisciplinary research and actions regarding sustainable development
UNIVERSITY DES MASCAREIGNES Faculty of Engineering and Sustainable Development	Impact of the refrigeration sector on the environment	Mr D. Sooben d.sooben@udm.ac.mu	Energy Efficiency Analysis of the Cold Chain in the Food Industry in Tropical Regions Low CO_2 emission alternatives for the refrigeration sector

Note: Table is based on a limited number of questionnaires and therefore does not reflect the full scope of research projects and programmes relevant to CCD in Mauritius, and is therefore indicative rather than definitive.

Table 9 shows a range of research projects and programmes related to CCD. The mapping study data, which is highly likely to be incomplete, given the constraints of the study and limited questionnaire responses, indicates particular research strength in mitigation, environmental economics and renewable energy areas. An initial relevant project is the wind resource assessment for Mauritius carried out by a lecturer at the University of Mauritius.

The policy documents reviewed do not appear to have made much – or any – use of papers or reports written by Mauritian academics working on climate change – for example, the 2010 SNC list mainly a range of government documents, technical reports prepared by the Mauritius Meteorological Services, and one report written by the Mauritius Sugar Research Institute. It is not clear to what extent the 2013 NCCAPF drew on expertise in the HEIs, but, for example, the indicators set out in this document are drawn from World Bank and UN-Water sources, and do not appear to be contextualised for Mauritius. While there are advantages to drawing on such internationally developed material, there is a further opportunity here for contextualisation of indicators, as well as

other aspects of the framework, though collaboration with local university and other experts. However, the NCCAPF did draw on the 2004 Technology Needs Assessment, which included a couple of contributors from the UoM and from the Mauritius Sugar Industry Research Institute. It does appear, however, as though there are a number of opportunities for enhanced collaboration between government and HEIs on policy development and review in Mauritius.

Associated with the research programmes and other smaller scale research initiatives mentioned above are a number of active researchers. See Appendix B for a list of the researchers identified in workshop and questionnaire data. The list is clearly incomplete, but does indicate the predominance of research on engineering related matters, renewable energy, and coastal zone management, as well as economics, as highlighted also in Table 9. However, this is an artefact of the data sources for the mapping study – additional review of the UoM research interests list indicates the following additional areas of research relevant to climate change and CCD:

- **Faculty of Agriculture:** Sustainable agriculture/ organic farming, in the context of climate change and food security; Eco-friendly crop protection; Nutritional and Management Strategies, Housing Systems and Manure-Handling Methods to Reduce Atmospheric Emissions from Livestock Facilities; Agroforestry; Soil/Land Use and Land Cover, and Soil/Land and Water Management and Conservation; Carbon Sequestration; Novel Crops: Agronomy, Physiology and Value-Addition; Postharvest Horticulture: Loss Reduction Technologies for Enhanced Food Security, Shelf-Life and Packaging Studies; Agricultural Impacts and Climate Modelling
- **Faculty of Engineering:** Renewable energy, energy efficient buildings, smart grids, cleaner production, sustainable manufacturing, waste management, remediation of solid waste, life cycle assessments, hydrology and climate change, amongst other research themes
- **Faculty of Law and Management:** Environmental marketing, sustainable tourism, international humanitarian law
- **Faculty of Science:** Climate change and coral bleaching, various marine and coastal science related areas, environmental health, chikungunya research, food science and nutrition, infectious disease modelling, mapping and forecasting; oceanography and climate change, GIS and remote sensing
- **Faculty of Social Studies and Humanities:** Environmental economics and natural resource management; gender, development and societal transformation; amongst others

Gender and PhD profile: All the lecturers responding to the questionnaire were male; however, one of the stakeholders involved in Water and Town Planning research is female, showing some participation of women scientists in climate related questions in Mauritius. From the questionnaire data, the research environment seems to be somewhat male dominated; however, a number of the researchers involved in the additional research areas listed above are female. Most of those responding to the questionnaire had more than four years experience in their disciplines. Four of the respondents had a PhDs, showing that there is institutional and academic support for developing PhD scholars, particularly in climate change and CCD related fields.

Given that the breadth and depth of climate change-related research in Mauritius is much greater than that revealed through the questionnaires and the workshop, expanding this analysis by administering the questionnaire to all academics in all of the HEIs in Mauritius, which could be conducted as an independent in-country follow-up, for example by the Mauritius Research Council,

would provide a fuller picture of the climate change and CCD landscape in the country, and would enable additional identification of collaborative research possibilities to address the identified priorities and gaps in the country.

4.5.2.3 Centres of Expertise and Networks[16]

Some centres of expertise in CCD research in Mauritius were identified as being:

- Indian Ocean Commission (IOC) drought monitoring centre;
- National Climate Change Information Centre (NCCIC);
- MID commission Energy Management office;
- Educational institutions and NGOs like Mauritius Wildlife Foundation; and
- Climate change unit (Ministry of Environment).

However, as one experienced climate change expert noted, at the moment there are no real national centres of excellence on climate change, even though the universities do have specific climate change modules. As he stressed, "Other people are doing bits and pieces, but there is no centre of excellence."

Mauritius research/other networks on climate change and CCD cited include:

- SARUA : Southern African Regional Universities Association;
- ESSA: Education for Strong Sustainability and Agency;
- WIOMSA : Western Indian Ocean Marine Science Association;
- Global power shift;
- Indian Ocean Commission (IOC) drought monitoring centre;
- UNESCO;
- SADC-REEP;
- SADC regional research network on ESD;
- SADC-COMESA-ESA-tripartite / Climate change programme ;
- IISD;
- Africa Adaptation Programme on climate change and UN agencies;
- National network for SD; and
- National climate change coordination committee at MoE&SD.

Again, a note of caution is required: while there are relevant networks, participants do not feel that these constitute the optimal situation, as many of these networks do not focus specifically on climate change, or do not bring together a wide range of stakeholders, or are not properly institutionalised. In the words of one experienced stakeholder:

> *"Yes, there are networks. But they are scattered and fragmented because of the absence of a centre of excellence or a coordinating body."*
>
> Mauritius expert stakeholder on climate change

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

4.5.3 Curriculum innovations and teaching for CCD

The limited university questionnaire respondents indicated that there is some existing work taking place with regard to CCD curriculum innovation in their departments. Questionnaire responses indicate that all the participants from the various universities showed a willingness to get involved in new issues such as climate change and/or climate compatible development with regard to their curriculum innovation and teaching, and the questionnaire data showed that staff ability to get involved was good. The majority of respondents showed that limited CCD issues and opportunities were incorporated into their current curriculum, with no specialised courses in CCD. All respondents indicated that they had little to no experience with regard to inter- and/or transdisciplinary teaching approaches to CCD.

The following specific courses were identified as being on offer (cited in the workshop discussions and questionnaire data). As climate change is often infused into existing courses, it is not easy to 'detect' climate change content in existing course descriptions, unless the courses are specifically 'named' as climate change courses. Thus it is not simply a matter of reviewing all the courses in an institution. Identification of climate change content in courses thus requires engaging with those that teach the courses. Data presented is therefore limited by this factor.

Table 10: Courses oriented towards climate compatible development – based on questionnaire and workshop data only

Course/s being developed and run	Who is involved	Type and Level of Course
University of Mauritius, Engineering Mechanical and Production Engineering: Civil engineering and environmental engineering department – environmental aspects (2nd yr); environmental management (3rd yr); sustainable building design (Masters) [in preparation]	Abdel Anwar Hossen Khoodaruth a.khoodaruth@uom.ac.mu	Undergraduate and postgraduate (MSc)
Université des Mascareignes, Mauritius – Faculty of Engineering and Sustainable Development: Module such as Sustainable Energy Management for MSc Building Service Engineering.	Abdel Isker Mudhawo amudhawo@udm.ac.mu	Undergraduate
University of Mauritius, Faculty of Social Studies and Humanities, Department of Economics and Statistics, Environmental Science Course	Riad Mohammed Akthar Sultan r.sultan@uom.ac.mu akthar_rs@yahoo.com	Undergraduate
University of Technology of Mauritius (UTM) MSc Sustainable Environmental Management (Core concept of climate change provided) – BSc (Hons) Environmental Planning and Management (Core Concept of climate change provided) – BSc (Hons) Green Information and Communication Technologies (core concept of CC provided in relation to technology)	Dr S. Bokhoree sbokhoree@umail.utm.ac.mu	Undergraduate and postgraduate

Course/s being developed and run	Who is involved	Type and Level of Course
1. Environmental planning 2. Environmental management systems 3. Coastal zone management 4. Coastal engineering 5. Environmental technology and management systems 6. Water resources 7. Water and Wastewater Resources 8. Solid Waste 9. Environmental Management Tools 10. Climate Change 11. Sustainable Development 12. Environmental Hazards and Risks	Dr M. Nowbuth m.nowbuth@uom.ac.mu Dr D. Kistamah dharma@uom.ac.mu Prof K. Elahee elahee@uom.ac.mu A. Khoodaruth a.khoodaruth@uom.ac.mu	Undergraduate and postgraduate

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

The data also shows that most of the lecturers involved in climate change-related research are involved in some sort of curriculum innovations in this area. This highlights the need to understand more clearly the relationship between climate change and CCD research and curriculum innovation, which implies a need to examine *how research drives curriculum innovation* in new knowledge areas such as CCD in universities.

As can be seen from Table 10, both University of Mauritius and Université des Mascareignes have dedicated climate change modules within their courses at postgraduate level. For all the universities the dominant pattern of practice appears to be to 'integrate' aspects of CCD into existing courses. It is difficult to examine the scope and focus of such integration without a detailed curriculum analysis. The table above also shows that it may be productive to examine CCD integration within *all faculties and all departments* within the university. The university-based questionnaire (especially Section C) in Appendix C can be used for this purpose. The questionnaire would, however, need to be introduced to all staff in the university, preferably at departmental level to obtain a clearer view of how CCD is / is not being integrated into teaching, and where the 'gaps' are for new development of CCD content into either existing programmes or the design of new programmes. Such a process would need to be led by the Academic Registrar of the university to ensure consistent and comprehensive data.

It is important to note that beyond academic courses offered, lecturers are also involved in training on climate change and CCD outside of the universities – for example, Riad Sultan has conducted training for government officials on cost-benefit analysis of climate change adaptation projects.

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

- Present computer generated scenarios to raise consciousness of impeding catastrophes caused by climate change;
- Identify specific sustainable development and CCD projects. Get students involved and guide them from initiation till completion of project. Apart from the curriculum development, invite guest speakers from NGOs/ministries/others who are actively participating in CCD programmes;
- Formal and informal methods can be used to teach climate change development in the courses. Use of case studies showing alternative approach with concepts of CCD;
- MPhil programme and postgraduate research and inquiry;

- Learning-by-doing. Film viewing. Simulation. Field visits to organisations where CCD has been applied;
- Company-based projects; and
- Face to face. Online/distance learning course.

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

4.5.4 Community and policy outreach

Questionnaire data showed some examples of university staff contributing to the policy processes. These were primarily provided by Riad Mohammed Akthar Sultan, an Economics lecturer in the Faculty of Humanities and Social Science, who mentioned that the University of Mauritius is involved in several projects that are contributing to policy, including:

- Green Jobs Assessment for Mauritius (forthcoming);
- Bioethanol as a sustainable fuel for climate policy (CEEPA and papers);
- Sustainable energy as a climate policy;
- Carbon emissions and economic growth in Mauritius; and
- Sustainable transport as a climate change mitigation strategy.

Moohaboob Peermamode Mahejabeen from the Université des Mascareignes mentioned her university contributing to a green policy document for universities in Mauritius.

While questionnaire responses provided limited information on contribution of HEIs to CCD policy, an examination of the Mauritius 2010 Second National Communication to the UNFCCC shows that B. Lalljee of the UoM was the main contributor on education, training and public awareness. The SNC further lists contributions from various Ministries and Departments, Universities and NGOs. Apart from government departments, the document notes the contribution of the Mauritian Wildlife Foundation, the Association pour le Development Durable, and the UoM, but does not provide specific details of UoM experts.

As noted in section 4.5.2, it does appear that there are a number of opportunities for enhanced collaboration between government and HEIs on policy development and review in Mauritius.

4.5.5 Student involvement

The only student organisation that was cited as having potential for engaging more with CCD issues was the Student Union of Université des Mascareignes, in which students work in groups on topics related to CCD issues on the island. Little detail was provided regarding these activities.

4.5.6 University collaboration and networking

While researchers responding to the questionnaire and discussions in the workshop identified felt that current collaboration and networking amongst universities on climate change was low, there were some interesting findings of specific incidences of collaboration. For example, there is specific inter-departmental collaboration amongst the three departments of the UDM's Faculty of Sustainable Development and Engineering (namely the **Civil and Environmental Engineering**, **Electromechanical and Automation Engineering,** and **Applied Electrical and Electronic Engineering**

departments) to develop low-cost, low-maintenance environmental gauging systems (such as sea temperature, sea level rise, wave surge speed, amplitude and frequency, continuously recording main gauges etc.). There was also mention of collaboration between the civil engineering and the chemistry department. UDM noted that it also interacts with policy makers, and invites guest speakers from NGOs and government departments to contribute to their teaching.

Workshop participants noted specific instances of the need for greater collaboration, and unpacked what this would mean. For example, in the context of the effects of climate change on the marine ecosystem, participants highlighted the needs for more horizontal integration amongst institutions, a multidisciplinary approach, sharing of data, a regional approach, and for enhanced collaboration between ministries, research institutions and NGOs.

4.5.6.1 Potential knowledge co-production partners

Based on the priorities and gaps identified, and the range of skills and expertise present amongst Mauritian HEIs and other stakeholders, the institutional analysis indicates a high level of *potential* for knowledge co-production partnerships, with some knowledge partners already existing for CCD knowledge co-production in Mauritius. Table 11 shows these 'mapped' out, with ascribed roles (as per workshop discussions)

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

Research organisations	Civil society organisations	Private Sector	Government	Regional organisations	International organisations
▪ Civil Engineering / Faculty of Engineering UOM ▪ Faculty of Engineering and Sustainable Development, UDM ▪ Faculty of Business and Management, UDM ▪ Mauritius Institute of Education – Social Studies Department ▪ Mauritius Oceanography Institute	▪ EPCO - Environment Protection and Conservation Organisation ▪ Mauritius Wildlife Society	▪ Not specified	▪ Ministry of Environment and Sustainable Development ▪ Ministry of Agriculture ▪ Ministry of Education and Human Resources ▪ Central Electricity Board ▪ Meteorological Services	▪ Drought Monitoring Centre ▪ Indian Ocean Commission ▪ WIOMSA : Western Indian Ocean Marine Science Association ▪ Global power shift – Indian ocean team ▪ SADC-RCCP ▪ SADC REEP ▪ SADC-COMESA-ESA-tripartite / Climate change programme ▪ SADC Research Network on ESD ▪ CDKN : Climate and Dev Knowledge Network	▪ ESSA: Education for Strong Sustainability and Agency ▪ GEF ▪ Africa Adaptation Programme on climate change UN agencies ▪ UNFCC: United Nations Framework Convention on Climate Change ▪ UNCCD: UN Convention to Combat Desertification UNESCO

Different roles were ascribed to different partners involved in the knowledge co-production process.

Table 12: Roles ascribed to the university sector involved in the knowledge co-production process

Research and Knowledge Dissemination	Capacity Building and Training	Mainstream CC in Curriculum and Research	Leadership Role for Paradigm Shift
▪ Design and encourage research programmes geared towards CCD ▪ Creation of research centre and dissemination of knowledge ▪ Undertake basic and applied research to cope with and build resilience to climate change ▪ Multidisciplinary and inter-faculty research on climate change, for coherence and a holistic approach ▪ Community and other stakeholder services (e.g. policy making support) ▪ Facilitate understanding of CC to allow dissemination of knowledge within family and community: integrate CC theoretical and practical knowledge in university curriculum; more explicit and compulsory	▪ Capacity building from academics to students ▪ Organise training of trainers workshops- empower existing academics ▪ Capacity building among academics with research facilities ▪ Ensure that students are given up-to-date and relevant training based on the country's needs and vulnerabilities ▪ Awareness among staff and students, building research groups ▪ Developing and adopting a green culture policy	▪ Compulsory CC module in all programmes or cross-cutting ▪ Stand-alone programmes on CC ▪ Integrate CC studies/ modules across faculties ▪ Mainstream CC in curriculum (research) ▪ Leadership	▪ Arouse interest of youth about CC: make them realise it is their reality and it is their future at stake – highlight urgency of the issue and show how they can and must act ▪ Educate, empower, sensitise and conducting research ▪ Universities should become one of the major actors in CCD ▪ Initiator of a major paradigm shift ▪ Facilitate the transfer of technology

Additionally, workshop participants ascribed the following roles to different partners involved in the knowledge co-production process:

- Government including Ministry of Environment and Sustainable Development – set policy direction, provide data;
- Existing NGOs, CSOs, CBOs – Liaise with the MACOSS, NEF (National Empowerment Foundation) and MID Commission and Ministry of Education;
- Mauritius Oceanographic Institute – Student internship and collaborative research;
- MRC for research in the sector as well as funding of projects;
- Research Institutions – Exchange of students, informal interactive sessions with practitioners to gain exposure of what is happening in the field;
- Private sector for sharing of data and research facilities in the field and funding of projects;
- NGOs – outreach projects, bottom-up approach; and
- Ministries, NGOs, consultants –share research findings.

An overriding theme in this list of roles is the need for greater sharing of information amongst organisations, including sharing of data and research findings, again highlighting a common theme of the mapping study in Mauritius – the need for a repository to facilitate sharing of information, better coordination and collaboration, and dissemination and awareness raising.

Earlier sections of this report have indicated the different areas of CCD experience at the HEIs, which indicate good depth of expertise in some research and technology development areas, such as renewable energy and energy efficiency, with a relatively wide range of research expertise from education and curriculum innovation to climate modelling, thus indicating a landscape for collaborative research across the disciplines. There is also clearly scope for enhanced collaboration on the part of HEIs for CCD knowledge co-production with other universities in the SADC region, and further afield in Africa. Section 5 provides further discussion on barriers and constraints to collaborative research.

4.5.7 University policy and campus management

The participants from the different universities did not provide any information on known policies aligned with CCD. Only the University of Mauritius mentioned they adopt green technology within the university; however little detail was provided of what these green technologies entail. The Université des Mascareignes is working on a Green Campus project that will promote the use of climate compatible technologies. The objective of the Green Campus project is to act as a showcase to provide specific, experience based guidance for maximising cost effectiveness of high performance building designs. As they lead the challenge in the implementation of the Green Campus, they wish to constitute a database of a continually evolving and expanding library of successful approaches, technologies and lessons learned based upon lived experience. Through this Green Campus project, the Université des Mascareignes wishes to further maximise environmental responsibility and promote human health, while minimising capital and operational costs in the long run.

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

4.6.1 A multi-faceted process, needing an integrated approach

Discussions in the workshop on ‘who is doing what and how’ led to some reflections on the status quo, and what could be done differently. These show that Mauritius stakeholders, researchers and lecturers have a very clear understanding of what needs to be strengthened and what could be done differently when it comes to CCD in research, teaching, outreach and networking in their contexts. The outcomes of the workshop and questionnaires indicate that identified priorities for an enhanced response to climate change are not confined to the particular research discipline, or institution, of the respondent, but rather range across a variety of fields and encompass cross-cutting issues such as the need for enhanced information management, awareness raising and communication. This shows that responding to the current situation in Mauritius with a view to ‘doing things better’ requires an integrated approach, and will require especially the participation of university and government leadership, but also leadership of other stakeholders (e.g. business).

4.6.2 Co-ordination, collaborative research and improved partnership building:

There is generally a need to improve internal co-operation, collaboration and improved partnership building in Mauritius. Improved motivation and interest from government departments, and their willingness to collaborate with research institutions was cited as a key area of concern. The data shows that universities in Mauritius are already providing climate change and CCD related curricula, or are in the process of establishing these. Participation by the private sector and government in this growing research community is required, to provide their insights and expertise as well, and to further prepare their own systems and strategies to accommodate the growing individual capacity for climate change and CCD in Mauritius. In addition, as noted above, opportunities for enhanced collaboration between government and HEIs on policy development and review in Mauritius should be actively identified and enabled.

Mauritian universities recently participated in a workshop, as part of the MID programme, on how to integrate sustainable development into curricula and programmes. This promising approach, through the far-reaching and multi-disciplinary MID programme, can be built on to ensure that climate change and CCD are specifically included in a range of sectors and strategies. The development of an integrated research strategy could further help to promote greater collaboration on climate change and CCD in Mauritius. This would be in line with the NCSA, which calls for the formulation of a national research plan to undertake research and development on climate change impacts (while adopting an integrated approach and compliant with commitments under the Rio conventions). This national research plan would promote the development of climate change indicators, projections of future climate changes and sea level rise, and vulnerability assessment for the vital economic sectors.

> *"The SARUA consultation was a very good platform to have everyone together, as we have seen the different groups and their priorities, so we should move forward and really do something about this, take some actions on climate compatible development."*

4.6.3 Strengthen and expand understandings of CCD

As shown in section 4 above, many Mauritian stakeholders participating in the mapping study have a strong understanding of CCD, while this is a relatively new concept to some stakeholders and university researchers. From the workshop and questionnaire data it can be seen that the concept of CCD also has different meanings, and lends itself to a diversity of contextual interpretations. It is also multidisciplinary, and 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 unfolding climate change and emerging global and regional development paradigms related to climate. Further discussions revealed the need to see CCD not as a static concept, but rather an emergent and evolving research area that needs to include indigenous forms of mitigation and adaptation.

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

a linked point, on the need to change mindsets and for behavioural change; for example, the potential role for 'energy stewards' to unlock behavioural changes, to promote renewable energy development and uptake.

> *"How many of us in this hall want to act differently? It is just a question of changing our mindsets and habits, this is a cultural transformation that we need to do, and I don't think it is going to be very easy, but we have to embark on it."*
>
> Mauritius government stakeholder

4.6.4 Capacity building for CCD and staffing

The mapping study in Mauritius has found a strong call for capacity building on climate change and CCD, particularly for undertaking research but as mentioned above, also for integrating CCD into curriculum and teaching. As this is a multidisciplinary issue, such capacity building should take both a specialist (to develop specialist research capacity) and a multidisciplinary approach that allows for knowledge exchange and the development of collaboration. There currently seems to be little experience in multidisciplinary research and capacity development; consequently, enabling these capacities in Mauritius should be considered a key priority moving forward.

4.6.5 Curriculum development and curriculum innovation

There are a number of organisational innovations that unlock curriculum innovation in Mauritius – a primary example is the Faculty of Sustainable Development and Engineering at the Université des Mascareignes, specifically set up to promote a more holistic and interdisciplinary approach, and into which climate change considerations are now being included.

As shown in the institutional analysis above, CCD is currently mainly being 'integrated' into existing courses. This mapping study has identified a strong CCD expertise in mitigation and sustainable and renewable energy research and subsequent curriculum development around this; while the study has found less evidence on adaptation research, this may be related to the limitations of the particular data set. A further step would be to expand the mapping study to cover more fully the range of research and teaching across the HEIs, and then to explore the adaptation side of things more fully.

> *"What was achieved today was that even if we were aware of the problems of climate change in Mauritius, we as academics had never thought of including this in our curriculum, so we will do so now."*
>
> Mauritius university professional

4.6.6 The role of university leaders

The role that university leaders play in supporting CCD research and development was discussed in the workshop and in the questionnaires. Questionnaire data reveals the following roles assigned to university leaders and managers:

- Need to strengthen industry-university links through "business-motivated" research (sponsored research);
- Implement CCD policies;
- Encourage inter-faculty collaboration to implement CCD projects;
- Build knowledge networks involving all universities, NGOs, ministries of Environment and Education, as well as the private sector;
- Plan, develop and implement curriculum on CCD, develop policies regarding CCD, setting up to CCD units in universities with academics, non-academics, students and industrials as stakeholders;
- Stress to policy makers and politicians the scientific research and outcomes regarding 'climate compatible development' issues;
- Co-ordinate the issue among all stakeholders and make funds available;
- Catalytic role between R&D production and the other CCD stakeholders (private sector, authorities, media, youth/clientele) and other educational sectors;
- Steer the university into conducting active research in climate compatible development;
- Networking and design of climate change programmes;
- University managers must provide the overall leadership towards achieving such as development model. This will encourage researchers and the educational communities to probe into creating knowledge which could be imparted to policy makers and students. Identity the local needs and formulate training accordingly.

Participants in the workshop suggested the university leaders should highlight the urgency of the issue and show how they can and must act. They are encouraged to take responsibility for empowering CCD-related research in their universities. University managers were seen to be responsible for creating compulsory climate change modules in all programmes across the university, as well as having stand-alone programmes on climate change and CCD.

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.[17] 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.[18]

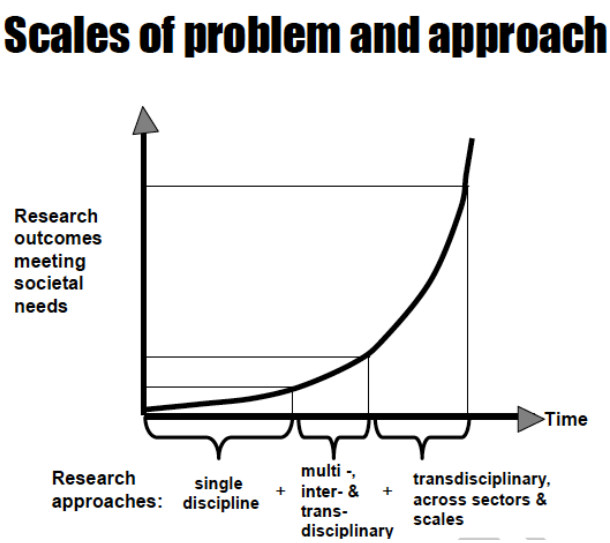

Figure 5: Research approaches

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

[18] 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[19].

These emerging approaches to research are clarified below.

Multidisciplinarity

This involves using different disciplinary studies to address a common empirical focus or problem. Existing disciplinary methods and structures are not changed in multidisciplinary research. Multidisciplinary research helps to develop different 'angles' or different understandings of a problem, from the vantage point of different disciplines.

Interdisciplinarity

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

Transdisciplinarity

This entails using strategies from interdisciplinary research, but it also involves taking this further into development of new theoretical understanding and new forms of praxis that are needed across sectors and at different scales. These are based on an inter-penetration of disciplinary perspectives or understandings, and a 'creative re-deployment' of these in contexts of practice[20]; 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[21] across sectors and at different scales.

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[19] 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.

[20] 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.

[21] 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.[22] 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.[23] Knowledge co-production is also referred to as knowledge co-creation. This requires working to bring together different contributions in the knowledge production process.

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

During discussions on the current status of multi-, inter- and transdisciplinary approaches to research and knowledge co-production, participants noted that although many are hoping to move towards a transdisciplinary approach to their research, this approach has largely not yet been adopted in Mauritius. There was consensus that researchers, government departments, managers, fundraisers and others need to work towards such research programme/ projects that conduct this form of research. This would also require funding and participation on the part of all stakeholders. This being said, some participants mentioned a climate change project in which research was undertaken mainly under the Mauritius Research Council, which welcomed experts from different fields. One participant raised the concern that climate change research is seen to be restricted to environmental or technical people only, but this should rather be a matter of understanding the role of the content knowledge of each individual, and seeing the relevance of all the disciplines. Funding was felt to be a major constraint hindering transdisciplinary projects.

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

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

5.1.3 Possibilities

A variety of key enablers were suggested in the workshop to ensure knowledge co-production for CCD, cross-discipline research and use of knowledge networks for sharing databases. Firstly, an awareness of the activities of other institutions is needed, as is making data available through repositories. Building networks among key players in CCD for sharing information and encouraging inter-university collaboration and sharing of knowledge was seen as crucial. There is also a need for research grants for specific transdisciplinary training (academic and students) and developing a research culture among academics that is more cooperative and promotes sharing of information and experience. There are also administrative hurdles for setting up of a CCD unit that cuts across all the HE sector/ institutions; thus a detailed enabling framework needs to be established. Participants were united on the need for such research, and that multiple research partnerships are possible within the stakeholder networks interested in CCD research. There is furthermore an understanding of the societal benefit of such approaches to research. However, research systems and cultures of practice in universities are not 'set up' to support such research innovation.

There is policy support for these ideas: for example, the NCCAPF highlights the need for information sharing in the fisheries and marine ecosystems thematic area to include *convening interdisciplinary researchers to exchange information on observations and results*.

In the next section, a possible CCD knowledge co-production pathway is mapped out based on the analysis in sections 2, 3 and 4. If expanded, this approach could provide a way forward to develop a broad-based research agenda for CCD in Mauritius, which would need to be co-designed and refined at a local level by participating organisations and groups.

6 SUMMARY AND CONCLUSION

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

As a small island state, with the world's third largest coral reef, Mauritius has high levels of vulnerability to climate change but also unique assets to protect. The republic's marine biodiversity is under threat from sea level rise, coral bleaching and ecosystem damage. It is feared that 50 percent of the beaches in Mauritius could disappear by 2050, should current global emissions levels continue unabated. This, together with impacts on the water resources and agricultural systems, would have severe effects on the economy and on many people's livelihoods. Many Mauritians who participated in this mapping study showed a strong understanding of the need for CCD and of the gaps in the national response, which went beyond their disciplines or mandates to reveal a broad understanding of climate change that bodes well for a more interdisciplinary response.

Within this context, the needs analysis for Mauritius revealed that despite existing emerging expertise in the field, 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 this study could be helpful in future policy development and implementation in Mauritius, building on the 2013 Mauritius National Climate Change Adaptation Policy Framework.

6.1.1 Broad adaptation and mitigation needs

A clear set of broad priority areas distilled from the workshops, the questionnaires and policy documents comprises Coastal Zone, Agriculture, Water Resources, Human Health, Tourism and Marine Resources. Sectors already impacted upon are: infrastructures that support community livelihoods, water resources, coastal areas, coral reefs, fisheries and other marine-based resources, agriculture, tourism, human health and biodiversity.

6.1.2 Specific knowledge and research gaps

Key prioritised **knowledge gaps** encompassed adaptation, mitigation and larger cross-cutting themes. Within the Energy and Industry, key priority areas highlighted included: **transport sector energy consumption, renewable energy**, **energy efficiency** and **building design**. Education and Planning priorities consisted of a need for **increased public awareness** on the concept of climate change; **mainstreaming CC in curriculum** at all levels from pre-primary to tertiary levels; **capacity building** of all stakeholders at all levels and **community engagement.** Participants felt that key marine and coastal management priorities included: marine **biodiversity** management (mining and fishing industries), exploring the effect of climate change on the **marine ecosystem**; examining the effect of climate change on the **coastal zone** and finally the effect of climate change on **fisheries.** Prioritised **research gaps** raised concern about the need for exploring the impact of climate change on different sectors and improving communication strategies to share findings. Research into curriculum development and the need for multidisciplinary and interdisciplinary research was highlighted. Mitigation research focusing on sustainable energy technology in transport and

construction was a key focus, as was research into natural resource management, and monitoring sea level rise and its effect on development.

Cross-cutting needs: Data was found to be a critical cross-cutting issue: establishing benchmarks and baseline long-term studies to generate such data was constantly cited, as was the need to improve access to and sharing of knowledge, and expanding knowledge resourcing across sectors, specifically marine resource management, tourism and education. Standardisation and harmonisation of data between research institutions was also required – for example, in the context of the impacts of climate change on marine biodiversity. Underlying human capacity and resource constraints included a significant need for training to develop the necessary skilled personnel, including capacity development of Higher Education staff. Further cross-cutting gaps were the need for increased public awareness and community engagement; and mainstreaming climate change into the curriculum at all levels.

6.1.3 Notable themes

In Mauritius, these included the commonly cited need to change mind-sets, including a sense of stewardship towards the environment, which would engender behavioural change; and the focus on energy, industry and transportation research areas.

6.1.4 Individual capacity gaps

Both the policy assessment and the workshop discussions highlighted a variety of key individual capacity gaps, that focused primarily on climate services, specifically identifying climate trends, forecasting, handling existing climate models (including GCMs), downscaling from regional scale to island scale, and scenario building; as well as expertise in communication, education and management being the most commonly cited capacity needs. There is a general shortage of qualified and experienced staff in the executing agencies with responsibility for policy formulation, management and enforcement in Mauritius. Overall participants felt that there were insufficient specialised skills in climate change research and CCD: key areas highlighted were in developing and using environmentally friendly technology such as renewable energy, transportation technologies, green building and a number of industrial areas; as well as advanced capacities in instrumentation use in Meteorology/ Energy/ Transport/ Water Resource Assessment. The mapping study further found the need to shift mindsets and behaviours of people at different levels, including for citizens to realise the severity of the situation, and for researchers to prioritise addressing identified challenges.

6.1.5 Institutional capacity gaps

A key institutional capacity gap across all data sources related to enabling climate change and CCD knowledge sharing and access to information, including developing a repository for climate change data, research and knowledge. Generally, workshop participants called for a more active involvement of institutions in enabling climate change and CCD research in Mauritius, as well as local networking of climate change researchers and the development of institutional synergies within this field. They also highlighted the need for improving arrangements for transboundary marine environmental plans; developing institutional structures for improved feedback loops on

environmental outcomes; and institutional prioritisation to develop a curriculum framework incorporating CCD.

6.2 Synthesis perspective on the institutional assessment

This mapping study has identified existing initiatives amongst the HEIs in Mauritius and their partners where activities such as research, teaching, policy engagement and community outreach are addressing climate change-related needs. The study has shown that HEIs in Mauritius do have relatively good expertise and capacity for responding to climate change and moving towards CCD, as do other stakeholders. Active researchers identified in this mapping study are listed in Appendix B, and CCD areas of expertise in Mauritius, mainly with respect to universities, are summarised in the table in Appendix E.

The combination of an engaged growing policy movement and a broadening understanding of the particular needs for climate change and CCD in Mauritius creates a fertile environment for the development of knowledge co-production possibilities. Even with the growing engagement of government, participants felt this was not enough and a more attentive, motivated and well resourced approach was required from government. In general, an integrated approach to knowledge, research, individual and institutional capacity development was called for in Mauritius. Alongside this improved **transfer of knowledge** and dissemination of research and more dedicated funding and **resourcing of CCD** in Mauritius was highlighted. In further developing knowledge co-production opportunities, two key priority areas were established. These included **curriculum development**/ awareness raising and improved involvement of government and policy makers in revising and **expanding policy and legislation** for CCD. A further need identified by the mapping study was for a coherent and strategic research plan / strategy on climate change and CCD, which would be consistent with the NCCAPF. From these and other interventions, appropriate research agendas and curriculum development can arise, further enabling the wider climate change and CCD related research community in Mauritius.

6.3 A broad map of Mauritius 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 Mauritius. One example is offered here (Table 13) for a key CCD priority area in Mauritius, namely the effect of climate change on fisheries. This is an important adaptation priority for the country. The table provides a synthesised perspective of key knowledge, research, individual and institutional capacity gaps for Mauritius for this priority area, providing insight into the research, capacity building and institutional development pathways needed for enhancing future contributions to CCD.

Table 13: CCD Knowledge, Research, Capacity Building and Institutional Capacity Gap Analysis for one of the Mauritius Adaptation Priorities: Effect of climate change on fisheries co-production

CCD PRIORITY	Knowledge and research gaps (Research agenda)	Individual capacity gaps (Education and training agenda)	Institutional capacity gaps (Institutional development agenda)
Adaptation: Effect of climate change on fisheries	▪ No dedicated studies on impacts of climate change on fisheries (artisanal or open sea) and commercial marine organisms ▪ Long term monitoring of catches, species composition, migration routes, spawning patterns ▪ Effects of elevated sea temperature on fish composition and diversity ▪ Changes in coral and the reef ecosystem	▪ Train scientists, obtain equipment ▪ Insufficient specialised skills, e.g. modelling skills, statistical analysis, GIS, taxonomists ▪ Environmental economists ▪ Stewardship and ownership ▪ Change of mind-sets	▪ Proper mainstreaming of climate change issues into development by decision makers ▪ Horizontal integration amongst institutions ▪ Multidisciplinary approach ▪ Sharing of data ▪ Regional approach ▪ Enhanced collaboration between ministries, research institutions and NGOs ▪ Enforcement capacity ▪ Lack of resources (financial, technical and technological) ▪ Logistics ▪ Strengthening of the central database centre (NODC)

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

Workshop participants felt that as the SARUA workshop enabled networking among different stakeholders with a range of perspectives, this could be the beginning of an important national platform on climate change and CCD. To further develop this, critical issues to be addressed for Mauritius 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 13), to guide further action at country level.
- Expand the capacity of the research institutions that have been identified as having some capacity and expertise for research, teaching and learning on CCD. Develop strategies for strengthening individual research competence, so that individual interest and research capacity can grow into a 'node of expertise' and then into a 'centre of expertise', and potentially a Centre of Excellence.
- Strengthen the collaborative, transdisciplinary potential within Mauritian universities and other institutions to improve the opportunities for more reflexive and dynamic forms of research that can contribute to meaningful CCD in Mauritius.
- Strategic policy support from the climate compatible development policy community and the Higher Education community will be needed to facilitate such capacity building pathways in Mauritius.
- Improve co-operation, communication, knowledge management and shared access to data at all levels.
- Develop motivation and incentives for researchers, especially for engaging in multi-, inter and transdisciplinary research approaches. Support capacity development of researchers in these areas.
- Strengthen research partnerships and research infrastructure, including research funding and incentives for students.
- Support ongoing processes of curriculum innovation to mainstream CCD into existing courses and programmes, and engage in development of Masters degree curriculum design, potentially in partnership with other southern African universities.
- Strengthen existing policy and community outreach activities within a knowledge co-production framework, building on promising activities; and develop tools for monitoring and dissemination to make the impact of such work visible within the university system.
- Develop campus management policies and practices that demonstrate commitment to CCD at the institutional level, and support student organisations that are beginning to tackle CCD-related matters.

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

Climate Change and CCD research and teaching in Mauritius includes expertise in both adaptation and mitigation-related fields, as well as greater depth than many other countries in the region in some interesting mitigation and cross-cutting climate change related knowledge production niches, such as work on sustainable consumption and engineering related work. Particular areas of strength identified in Mauritius include:

- **Climate change adaptation research**: Building resilience in the coastal zone, including through vulnerability and risk assessment
- **Climate change mitigation research**: Sustainable Engineering, reduction of CO_2 emissions**,** sustainable and renewable energy
- **Integrated adaptation-mitigation research:** Mapping and assessment of renewable energy sources e.g. wind and photovoltaic; sustainable consumption

- **Cross-cutting issues research:** Environmental economics, integrating climate change into ESD
- **Systems of social change research**: Green Jobs Assessment for Mauritius
- **Teaching and curriculum innovation:** Renewable energy, environmental planning, environmental management systems, coastal zone management, coastal engineering, environmental technology and management systems, water resources, wastewater

"We need all the actors to work together to address this global problem. This concerns all the Mauritian actors, and it is an interdisciplinary project that concerns also the Mauritian economy. We need to sensitise the entire public on climate change, from the youngest schoolchildren upwards. We are developing interdisciplinarity here, which is an essential element for climate change, as is a systems approach. I hope that this culture of research will develop further here."

University manager, Mauritius

APPENDIX A: WORKSHOP ATTENDANCE LIST

List of participants at the Mauritius workshop, 11-12 September 2013

ROSE HILL CAMPUS, UNIVERSITÉ DES MASCAREIGNES

Name	Department /Faculty / Organisation	Designation	Contact number/s	Email address
A.Isker Mudhawo	Faculty of Engineering and Sustainable Development UDM	Head of Department	5773 2898	abdelisker@gmail.com
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Name	Department /Faculty / Organisation	Designation	Contact number/s	Email address
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Sachooda Ragoonaden	Association pour le Developpement Durable	Vice-President	465 0116	rajouma@yahoo.com
Sanjay Sookhraz	CEB	Environmental Affairs Officer	5257 4188	sanjay.sookhraz@ceb.intnet.mu
Sheik Abbass	Mauritius Institute of Education	Lecturer	5783 8273	b.sheikabbass@mieonline.org
Sunil Dowarkasing	MID Project Coordinator	Prime Minister Office	5259 6886	dowrka@hotmail.com
T. S. M. Cunden	University des Mascareignes	Lecturer	5752 1752	tcunden@UdM.ac.mu
V. Ramchandhur	MOI	Research Scientist	427 4434	
Y. Baguant Moonshiram	Civil Engineering / Faculty of Engineering University of Mauritius	Senior Lecturer	403 7858	k.baguant@uom.ac.mu

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

Table 14: Active researchers contributing to CC/CCD related research activities in Mauritius

Name and qualification	Department / Area of expertise	Years of experience: Years of experience in CC research	Contact details
Chetanand Ramma (MSc)	Environmental Engineering	12 years: 2 years	Universite des Mascareignes Faculty of Engineering & Sustainable Development Civil Engineering JayRamma@udm.ac.mu JayRamma@email.com
Nazeezah Sheik Abbass (PhD)	Business Education	6 years: 2 years	Institute of Education Mauritius Arts and Humanities b.sheikabbass@mieonline.org
Abdel Anwar Hossen Khoodaruth (PhD)	Renewable Energy	10 years: 4 years	University of Mauritius Engineering Mechanical and Production a.khoodaruth@uom.ac.mu
Roshan Ramessur (PhD)	Renewable Energy-Climate Change Adaptation	25 years: 5 years	University of Mauritius Faculty of Science, Chemistry Department ramessur@uom.ac.mu
Riad Akthar Sultan Mohammed (MSc)	Environmental Economics	11 years: 5 years	University of Mauritius Faculty of Social Studies and Humanities Department of Economics and Statistics r.sultan@uom.ac.mu akthar_rs@yahoo.com
Manta Nowbuth (PhD)	Water and Town Planning	24 years: 10 years	University of Mauritius Mauritius Civil Engineering mnowbuth@uom.ac.mu
Darmanaden Sooben (MSc, ongoing PhD)	Refrigeration and Air Conditioning	16 years: 10 years	Université des Mascareignes d.sooben@udm.ac.mu

Note: Table is not complete, but based on best available information obtained in this mapping study, and is therefore indicative rather than definitive.

APPENDIX C: UNIVERSITIES QUESTIONAIRRE

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 MAURITIUS

Table 15: Identified sources of expertise for CCD in Mauritius

University/ organisation	Nodes of expertise	Centres of expertise	Centres of excellence	Active CCD related research networks
University of Mauritius	▪ Faculty of Science: Chemistry Department – research on climate change modelling and CZM ▪ Oceanography and climate change ▪ Faculty of Social Studies and Humanities: small research group in the Dept of Economics and Statistics on energy, economics, and climate change ▪ Faculty of Agriculture ▪ Sustainable agriculture and soil and water management in the climate change context, insufficient information available		▪ No SADC accredited centres of excellence were identified in Mauritius	▪ Mauritius Ile Durable ▪ Indian Ocean Commission ▪ SADC Drought Monitoring Centre ▪ Mauritius Wildlife Foundation ▪ ESSA: Education for Strong Sustainability and Agency ▪ WIOMSA : Western Indian Ocean Marine Science Association
Université des Mascareignes	▪ Faculty of Engineering and Sustainable Development ▪ Research and training in the field of renewable energy sources (wind resource assessment, photovoltaic, rain water harvesting), online daily traffic fluidity monitoring, ongoing project for the setting up a green campus, use of natural refrigerants in air conditioning and refrigeration, and environmental engineering courses	Mauritius Institute of Education ▪ Includes a group focused on teacher education for ESD; curriculum review for CCD; consultancy on national and international programmes		▪ Environmental Protection and Conservation Organisation (EPCO) – community-based climate change preparedness in coastal communities

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 Mauritius.

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