

# Climate Change Adaptation in Mauritius: Considering the Role of Institutions

Matthew Gray and Bhanooduth Lalljee

*Department of Agriculture and Food Science, University of Mauritius, Réduit, Mauritius.*

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**Abstract**—Adaptation to climate change is critical in countries like Mauritius which, despite contributing a minute percentage to the world's emissions, is disproportionately vulnerable to their impacts. Rising temperatures are exacerbating the problems of coral reef bleaching, soil and beach erosion, a greater risk of drought and flash floods, intensifying tropical storms, sea level rise and biodiversity impacts. Projections of accelerated warming only increase the urgency for a coordinated framework of adaptive governance in Mauritius. The nature of adaptation needed will require a complex, long-term, and interdisciplinary process of widespread engagement, necessitating effective institutions with shared responsibilities. This paper describes how state and non-state entities have worked to assess impacts and vulnerabilities, facilitate coordination, manage information and establish priorities to build Mauritius' resilience to climate change. Recent progress has been made to establish an institutional framework for adaptation in governance, but challenges remain, especially in coordination, project implementation at the local level and capacity building among all stakeholders.

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## INTRODUCTION

Climate change has profound impacts on people's livelihood and way of life, prompting a response from countries, organisations and individuals. Even if global greenhouse gas (GHG) emissions are significantly reduced, adaptive measures are needed to reduce damage already being inflicted by climate change, and to increase the resilience of natural and human systems to future impacts (IPCC, 2007). Adaptation is especially critical in Small Island Developing States (SIDS) like

Mauritius which, despite contributing only a minute percentage to the world's GHG emissions, are disproportionately vulnerable to the impacts they cause (IPCC, 2007).<sup>1</sup>

Climate change exacerbates existing environmental management issues, making them more urgent, less predictable, and often more costly (IPCC, 2007). In Mauritius, rising temperatures are affecting issues related to coral reef bleaching, soil and beach erosion, a greater risk of drought and flash

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<sup>1</sup> Adaptation measures seek to build livelihood and ecosystem resilience against climate impacts. Examples include planting coastal mangroves for protection against storm surges and to boost fisheries; water conservation to prepare for decreasing precipitation and intensified droughts; and the reduction of water pollution in lagoons to enhance reef resilience to rising temperatures.

floods, intensifying tropical storms, sea level rise, and biodiversity impacts (Mauritius Meteorological Services, 2008).<sup>2</sup> The Tourism Sector Strategy Plan (2009-2015), which calls for an approximate doubling of tourists by 2015, will add stress to an already vulnerable coastline (Government of Mauritius, 2007). These changes will affect the majority of key sectors and livelihoods in Mauritius, including agriculture, fisheries and other marine-based resources, tourism and infrastructure.

Mauritian leadership on climate change reveals a general realisation of the gravity of the problem. In 1992, the Government of Mauritius (Government of Mauritius) was the first country to ratify the United Nations Framework Convention on Climate Change (UNFCCC). In 2005, Mauritius hosted the UN Conference on Small Islands, leading to an international framework to reduce climate vulnerability in SIDS. Despite this active role, projections of accelerated warming only increase the urgency for more focused leadership concerning the problem in this small, densely populated country, extremely dependent on its natural resources (IPCC, 2007). A coordinated national framework for adaptation is needed to minimize the negative impacts and reap any potential benefits of climate change.<sup>3</sup> In recognition of this, the Government is attempting to increase its efforts through the “strengthening of climate change mitigation and adaptation measures (Government of Mauritius, 2011b).” Among other initiatives, its 2011 budget request calls for implementation of numerous integrated coastal zone management (ICZM) measures and improved monitoring for Environmental Impact Assessment (EIA) licensing. These budget priorities build on existing law and policy, including the 2002 Environment

Protection Act and the 2007 National Environmental Policy. In addition, a new Climate Change Office, which includes an Adaptation Unit, was recently established within the Ministry of Environment and Sustainable Development (MESD).

The Mauritian government has also begun to take more ownership in terms of funding. The prevailing view is that developed country emissions largely caused the problem, so they should also solve it. However, countries experiencing the effects of climate change must take greater ownership in solving the problem, no matter how much international funding they are donated. In realizing this, the Mauritian government is supplementing international environment and climate funding from sources like the United Nations, European Commission and Agence Française de Développement, with a fossil fuel tax to support “Maurice Ile Durable (MID)” projects (Government of Mauritius, 2011a). While currently focused on mitigation measures, the MID fund, in combination with other domestic sources, can be increasingly used for projects that build climate resilience (Government of Mauritius, 2010a).

In sum, the Mauritian government has existing laws and policies addressing climate change, a government office to directly address adaptation, and some funding available to create new projects and buffer existing projects with an adaptive component. Problem solved? Well, not quite. Adaptation presents a series of new, complex governance challenges for most countries, including Mauritius, that are not so easily solved.

Government policies in general are reactive and based on lessons learned from the past. When dealing with climate change, however, the past is not indicative of the

<sup>2</sup> Average temperatures have risen 0.74–1.2°C when compared to the 1961-90 long-term mean (MMS, 2008). Measurements taken over the last decade at four beaches revealed they had been reduced in area by 18,500 m<sup>2</sup> (Government of Mauritius, 2010c). The coastline is receding by 1 m/year in some places. Most erosion, to date, has been due to practices such as deforestation and coastal development, but rising sea level and increased flooding are exacerbating the situation. Severe coral bleaching has been observed in 1998, 2003, and 2009, with about 10% mortality (Government of Mauritius, 2010c).

<sup>3</sup> For example, citizens have reported the benefits of an additional growing season for litchis in parts of the central plateau.

future. Moreover, while a general trend in impacts may seem clear, finer resolution is needed to reduce uncertainty regarding their long-term severity, especially for island states (IPCC, 2007). Unlike climate change mitigation in which progress is calculated largely through one metric (greenhouse gas emissions over time), there is no comparable unifying measure for adaptation (Carpenter *et al.*, 2001; Adger and Barnett, 2009). Therefore, we are dealing with a new type of problem that, by its nature, is technical and dynamic, and in which remediation is difficult to measure and its future is uncertain (McGray *et al.*, 2007). Managing this type of problem is a challenge for all organizations, including governments. These challenges are especially acute for SIDS, whose small populations limit economies of scale, resulting in less available capacity (IPCC, 2007).

Communication is an additional challenge. In general, adaptation governance must deal with 1) activities that exacerbate the effects of climate change, 2) activities that build resilience, 3) impacted ecosystem services and populations and 4) the science of measuring and projecting impacts. These considerations cut across a host of institutions, communities, sectors, and levels of government. Effective management will require extensive coordination between these stakeholders and their joint action in decision-making that is sufficiently transparent, accountable, and inclusive (World Resources Institute, 2009).

While project-based funding is critical, this does not address the need for planning, coordination, or capacity development (World Resources Institute, 2009). Within government, dedicated offices are established to lead these functions, but existing agencies must also integrate climate change risks into ongoing activities (Olhoff and Schaer, 2010). This is the purpose of “mainstreaming” adaptation, or integrating “adaptation responses into relevant policies, plans, programmes, and projects at the national, sub-national, and local

scales (United States Agency for International Development, 2009)”. Mainstreaming is crucial for Mauritius, as in most countries, because adaptation relates to numerous offices and the policies and regulations they administer. The United Nations Development Program (UNDP) has created the Africa Adaptation Programme (AAP) to implement mainstreaming in 20 African countries, including Mauritius, with funding from the Government of Japan. The AAP is designed to “develop the capacity required to design, finance, implement, and monitor long-term and cost-effective adaptation policies and plans (United Nations Development Programme, 2010).”

This paper explores what these governance challenges mean for Mauritius by analysing its institutional foundation developed to reduce climate risks. We focus largely on the framework for addressing adaptation at the national level, where an institutional and legal framework shapes decision-making at all levels (McGray *et al.*, 2007). Effective and sustained efforts to build climate resilience also require active engagement at the local level. As Principle 10 of the Rio Declaration states, “Environmental issues are best handled with participation of all concerned citizens, at the relevant level (United Nations Conference on Environment and Development, 1992).” Therefore, we also analysed the role of institutions more broadly to include key state and non-state entities that have a stake in creating a more climate-resilient Mauritius.

## MATERIALS and METHODS

We used the Adaptation Rapid Institutional Analysis (ARIA) tool to assess the state of Mauritius’ adaptive governance. The ARIA tool, developed by the World Resources Institute, is based on its National Adaptive Capacity Framework.<sup>4</sup> The tool was developed to aid civil society organisations to assess institutions’, especially national governments’, ability to manage adaptation.

<sup>4</sup> This is a “functions-based” approach that identifies key institutional roles in addressing climate change. The latest information on ARIA can be found at: [www.wri.org/project/access-initiative/aria](http://www.wri.org/project/access-initiative/aria)

It was similarly used in this study for our assessment. The focus here was not on the effectiveness of specific projects, but rather the decision-making process for adaptation.

The first step was to conduct background research on all relevant laws, policies, reports and workplans related to adaptation in Mauritius. In terms of policy, the research was focused on the national government because local governments have minimal policy-making authority. When it comes to policy implementation, however, and more general actions, both the national and local governments were considered. Many documents were obtained from the Government of Mauritius website.<sup>5</sup>

Research was supplemented with 13 stakeholder interviews with numerous organizations.<sup>6</sup> Based on the literature review and interviews, the ARIA tool provided a structure for diagnosing strengths and weaknesses among a set of five fundamental functions necessary for effective adaptation. These included: 1) coordination, 2) vulnerability and impact assessment, 3) information dissemination, 4) planning and prioritization, and 5) capacity building (World Resources Institute, 2009).<sup>7</sup> actors underpinning each function included comprehensiveness, transparency and participation, accountability, enforcement and institutional capacity (World Resources Institute, 2009). While adaptation governance will take different forms from one country to another, the ability to reduce climate risk is dependent on addressing each of these functions. The results included analysis of each of these five fundamental functions.

Formal institutions, including central and local government, civil society, commerce, community groups and others, are crucial in fulfilling adaptation functions. The effectiveness of formal institutions, however, often depends on informal institutions, including the informal rules and norms that shape behaviour and interactions, be it between people or organizations (North, 1990). While this paper focuses on formal institutions, largely because adaptation is a relatively new topic in Mauritius with limited impact to date on public behaviour, the importance of informal institutions is recognized.

## RESULTS

While Mauritius, like most countries, does not have a fully developed structure in place to address adaptation, it is not starting from zero. Mauritius' National Climate Change Action Plan was prepared in 1998 but, to date, most actions "have not been fully implemented due to lack of funding, lack of expertise, insufficient human resources or no designated institution responsible for the action identified (Government of Mauritius, 2011b)."

### Coordination

The Government's 2007 National Environmental Policy states that government will "prepare an integrated action plan to better respond and adapt to impacts of climate change, sea level rise, tsunamis and other disasters (Government of Mauritius, 2007)." In 2010 Mauritius, with \$3 million AAP support, established an Adaptation Unit within the MESD's Climate Change Division

<sup>5</sup> The MUELEX website is a clearinghouse of information on Mauritian environmental law, policies, and multilateral agreements: [www.gov.mu/portal/sites/legald/index.htm](http://www.gov.mu/portal/sites/legald/index.htm)

<sup>6</sup> Interviews with the following organisations were conducted between 18 January 2011 and 8 February 2011: Government consultants on budget and climate change, International Organisation for Migration, Ministry of Environment and Sustainable Development, Mauritius Meteorological Services, Mauritian Wildlife Foundation, Maurice Plateforme Environnement (environmental consortium), United Nations Development Program, University of Mauritius.

<sup>7</sup> The ARIA tool lists "Climate Risk Reduction" as the fifth function. This paper focuses on the capacity building aspect of this overarching topic.

to lead development of this plan and act as a National Implementing Entity for the UN's Adaptation Fund.

One of the primary purposes of AAP is to establish an institutional framework to mainstream adaptation by building information resources and engaging relevant stakeholders in a coordinated fashion. In general, the large number of stakeholders and sectors implicated in adaptation allows programme management to take different forms according to type of impact (e.g. sea level rise), impacted sector (e.g. agriculture, water, tourism, etc.) or along

institutional or ministerial lines (IPCC, 2007). The coordination approach in Mauritius is ostensibly sectoral but, in reality, is conducted very much along ministerial lines. Ministry representatives and external consultants participate in Working Groups such as those involved in strategy formulation. The Working Groups include Disaster Risk Reduction, Education, Fisheries, Agriculture, Tourism, and Rodrigues.<sup>8</sup> These groups report directly to the Climate Change Division through a Steering Committee that oversees implementation and coordination of the AAP project.

<sup>8</sup> Rodrigues, a Mauritian dependency located 560 km to its east, faces numerous challenges due to extreme climatic conditions, including lack of fresh water and soil erosion (Government of Mauritius, 2007).

Table 1. Ministerial roles in addressing climate change impacts in Mauritius.

Ministry	Flooding, droughtsa	Cyclones	Coral bleachingb	Sea level rise, erosion	Biodiversityc
Prime Minister's Office* (not a ministry)	P	P	P	P	P
Agro Industry and Food Security*	P	S	S	-	-
Education and Human Services	S	S	S	S	S
Energy and Public Utilities*	P	S	-	-	-
Environment and Sustainable Development*	P	P	P	P	P
Finance and Economic Development	S	S	S	S	S
Fisheries and Rodrigues*	S	S	P	S	S
Foreign Affairs, Regional Integration and International Trade	P	P	P	P	P
Health and Quality of Life	S	S	S	S	-
Housing and Lands	S	S	-	P	-
Local Government and Outer Islands	P	P	P	P	P
Public Infrastructure, National Development Unit, Land Transport and Shipping	S	S	-	P	-
Tertiary Education, Science Research and Technology*	P	P	P	P	P
Tourism and Leisure	S	S	P	P	S

P = Primary role,

S = Supporting role

a) Extreme droughts and flooding have consequences for agriculture, including sugar cane production

b) Coral bleaching leads to direct impacts on the health of the fisheries

c) Biodiversity impacts include additional stress on endangered species and the potential need for species migration

\* Ministries leading development of the chapter on adaptation in the Second National Communication to the UNFCCC.

Given Mauritius' small size of 2040 km<sup>2</sup>, a population of less than 1.3 million, and its centralized form of government, one might assume that coordination would be relatively simple (World Bank, 2012). Research and the interviews suggested otherwise. Table 1 illustrates the complexities of adaptation coordination, highlighting the fact that 13 government ministries are involved in dealing with the five key climate issues in Mauritius. We assigned primary (P) or secondary (S) roles to these based on ministerial mission and function. The Prime Minister's Office plays a crucial leadership role as well, housing key divisions like the Meteorological Services, the National Disaster Management Centre and the Oceanography Institute. Intra-ministerial coordination also poses a challenge. The MESD alone contains eight offices related to adaptation (see Table 2). Likewise, five different offices are responsible for some aspect of water quality monitoring (Government of Mauritius, 2010b).

Dozens of committees and advisory bodies, mostly mandated by legislation, also influence adaptation governance, some more active than others (see Table 2). These committees implement laws and policies, about 20 of which relate to adaptation. The Local Government includes four district councils, five municipal councils, and 124 village councils that can play a key role in project implementation and policy formulation. Non-state institutions are crucial as well, including environmental organizations, community groups, funding groups, and commerce.<sup>9</sup>

Mauritius is not new to its role of preparing for climate-related issues. In 1991, a National Climate Committee prepared the Initial National Communication to the UNFCCC. However, after the Prime Minister submitted this report, the committee did not meet regularly. Then, in 2002, the passage of an Environment Protection Act created a series of coordinating bodies for environmental protection (Table

2). These committees have their own function but none provide the foundation for sustained coordination of adaptation. The Prime Minister chairs the National Environmental Coordination Commission but meetings are held infrequently (about every six months according to interviews). The ICZM Committee is sustained but, by its nature, it is not comprehensive.

In 2010, the Climate Change Division and the Adaptation Unit were established, the latter, in particular, to assign full-time, dedicated staff the responsibility of coordinating the complexities of adaptation. Respondents believed the new office will help to:

- Transfer climate change knowledge to more stakeholders.
- Improve communication and transparency between ministries (e.g. share budgets to better enable prioritization and minimize duplication of effort).
- Clarify roles and responsibilities within committees and ministries.
- Develop tasks that require multi-institutional collaboration in their implementation.

Respondents hailed institutionalising the Climate Change Division as a positive step towards enhancing cooperation, but its limited resources and authority mean that implementation must mostly occur elsewhere. Concern was also expressed that the AAP funds would run out, leaving the office depleted of resources. The MESD's limited authority over other ministries led multiple respondents to stress the need for strong leadership by the Prime Minister's Office, this because all major policy and priority decisions as well as funding are directed by the Prime Minister's Office, in coordination with the Ministry of Finance and Economic Development on budget issues. Without this leadership, ministries may tread lightly in working with the MESD to avoid conflict. Adaptation is also a relatively new issue without a specific

<sup>9</sup> The tourism sector is especially critical, considering its dependence on stable coastlines and healthy reefs and fisheries. The coastal zone generates just under 74 billion Mauritian rupees (3 billion US dollars) of revenue, equivalent to 36% of GDP, 99% of which comes from tourism (Government of Mauritius, 2010c).

legislative mandate. Progress, as a result, can be slow if stakeholders do not take ownership due to limited capacity or expertise.

## **Vulnerability and Impact Assessment**

Like many countries, Mauritius' first step in addressing the consequences of climate change was to complete a vulnerability and impact assessment. In May 1999, Mauritius became one of the first African countries to submit its initial National Communication to the UNFCCC (Government of Mauritius, 1999). This communication provided a national-level summary of vulnerabilities in Mauritius and associated adaptation options.<sup>10</sup> The MESD, with support from bodies such as the University of Mauritius, led development of the second National Communication to the UNFCCC, released in 2011. Many of the key ministries were involved in the drafting and peer review process (see Table 2), along with selected representatives from industry and civil society. Respondents suggested that sufficient funds had been made available to complete this report.

The development of vulnerability and impact assessments requires processed climate, socioeconomic and environmental data. With regard to climate, primary data are collected by the Mauritius Meteorological Services (MMS) and validated before they are shared internationally through the World Meteorological Organization. The MMS normalizes the data series in order to analyse climate trends. Projections have been made for the period 2020-2100 with respect to the baseline reference period of 1961-1990, in accordance with International Panel on Climate Change (IPCC) recommendations (Mauritius Meteorological Services, 2008). Within the WIO region, respondents

considered Mauritius second only to South Africa in the detail of its modelling.

At the same time, there is growing recognition that climate change is not an environmental problem that can be considered in isolation, but a development problem strongly linked to socio-economic conditions. For example, the MESD has published many adaptation-related statistics (e.g. domestic water consumption per capita, land use by category, annual catch in the coastal fisheries) with socio-economic statistics (e.g. respiratory diseases, human development index, adult literacy rate) (Government of Mauritius, 2010b). The second National Communication also linked climate vulnerability with the affected communities. For example, it went beyond stating that erosion is a problem in general to identifying coastal communities that experience the greatest erosion (Government of Mauritius, 2010c). Consensus among respondents still suggested the need for improved regional climate models and statistical downscaling to simulate local climate characteristics better, thereby yielding more accurate assessments (Government of Mauritius, 2010a).

Nevertheless, while valuable socioeconomic and environmental information is available, key data are still missing. For example, data on poverty and livelihoods are limited at the community level, including migratory flows of people affected by deteriorating environmental conditions (International Organisation for Migration, 2011). Missing environmental data, for instance, prevent insight into the source of water losses in the distribution system, or how coastal zones and forest reserves are being affected by changing development patterns and a warming climate (Government of Mauritius, 2010a, b). These limitations prevent more informed, evidence-based decisions regarding adaptation priorities (Marshall *et al.*, 2010).

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<sup>10</sup> Other key documents published by the MESD include *Staking out the Future* (Government of Mauritius, 2004), *A National Capacity Needs Self-assessment for Global Environmental Management* (Government of Mauritius, 2005), and the *Mauritius Strategy for Implementation: National Assessment Report* (Government of Mauritius, 2010a).

Table 2. Key legislation, policies, and government bodies related to adaptation.

Ministry	Divisions	Committees / Advisory Councils	Legislation / Policies
Prime Minister's Office (not a ministry)	<ul style="list-style-type: none"> <li>- Mauritius Broadcasting Corporation</li> <li>- Mauritius Oceanography Institute</li> <li>- Mauritius Ports Authority</li> <li>- Mauritius Meteorological Services</li> <li>- National Disaster Management Centre</li> </ul>	<ul style="list-style-type: none"> <li>- Central Cyclone and Other Natural Disasters Committee</li> <li>- National Environmental Coordination Commission*</li> </ul>	
Agro Industry and Food Security	<ul style="list-style-type: none"> <li>- Agricultural Research Extension Unit</li> <li>- Food and Agricultural Research Council</li> <li>- Forestry Services</li> <li>- Irrigation Authority</li> <li>- Mauritius Sugar Industry Research Institute</li> <li>- National Parks and Conservation Service</li> </ul>	<ul style="list-style-type: none"> <li>- Board of Agriculture and Natural Resources</li> <li>- Board of Irrigation Authority</li> <li>- Forestry Coordinating Committee</li> <li>- Land Conversion Committee</li> <li>- Wildlife and National Parks Advisory Council</li> </ul>	<ul style="list-style-type: none"> <li>- National Biodiversity Strategic and Action Plan (2006-2015)</li> <li>- National Forestry Policy, 2006</li> <li>- Plant Protection Act, 2006</li> <li>- Wildlife and National Parks Act, 1993</li> <li>- Forests and Reserves Act, 1983</li> <li>- Chemical Fertilizers Control Act 1980</li> <li>- Irrigation Authority Act, 1978</li> <li>- Board of Agriculture Act, 1977</li> </ul>
Energy and Public Utilities	<ul style="list-style-type: none"> <li>- Central Water Authority</li> <li>- Wastewater Management Authority</li> <li>- Water Resources Unit</li> </ul>	<ul style="list-style-type: none"> <li>- Water Resources Monitoring Committee</li> </ul>	<ul style="list-style-type: none"> <li>- Central Water Authority Act, 1971 (amended 2005)</li> <li>- Waste Water Management Authority Act, 2000 (amended 2004)</li> <li>- Ground Water Act, 1973</li> </ul>
Environment and Sustainable Development	<ul style="list-style-type: none"> <li>- Climate Change Division</li> <li>- Environmental Assessment Division</li> <li>- Environmental Law</li> <li>- ICZM Division</li> <li>- National Environmental Laboratory</li> <li>- Police de L'Environnement</li> <li>- Policy and Planning</li> <li>- Pollution Prevention</li> </ul>	<ul style="list-style-type: none"> <li>- Environment Coordination Committee*</li> <li>- Environmental Impact Assessment Committee</li> <li>- EIA/PER Monitoring Committee</li> <li>- Integrated Coastal Zone Management Committee*</li> <li>- Maurice Ile Durable Steering Committee</li> <li>- National Network for Sustainable Development*</li> <li>- Coordinating Committee on Implementation of the Multi-Lateral Environmental Agreements*</li> </ul>	<ul style="list-style-type: none"> <li>- Environment Protection Act, 2002 (Amended 2008)</li> <li>- National Environmental Policy, 2007</li> </ul>
Fisheries and Rodrigues		<ul style="list-style-type: none"> <li>- Rodrigues Environmental Committee</li> </ul>	<ul style="list-style-type: none"> <li>- Fisheries and Marine Resources Act, 2007</li> </ul>
Housing and Lands		<ul style="list-style-type: none"> <li>- National Planning and Development Commission</li> </ul>	<ul style="list-style-type: none"> <li>- Planning and Development Act, 2004</li> <li>- National Development Policy, 2003</li> <li>- Removal of Sand, 1982 (Amended 1997)</li> </ul>
Local Government and Outer Islands	<ul style="list-style-type: none"> <li>- Beach Authority</li> <li>- Local Police</li> <li>- Solid Waste Management</li> <li>- 4 District Councils</li> <li>- 5 Municipal Councils</li> <li>- 124 Village Councils</li> </ul>	<ul style="list-style-type: none"> <li>Councils have committees for finance, works, planning, and others, including environment</li> </ul>	<ul style="list-style-type: none"> <li>- Local Government Act, 2003</li> <li>- Beach Authority Act, 2002</li> </ul>

\* key environmental coordinating bodies created by the Environment Protection Act.



## Information Dissemination

Along with data collection and analysis, information management remains incomplete without dissemination. The National Environmental Policy states that government will increase its participation in and accountability for environmental performance, and ensure that citizens are “given better access to environmental information (Government of Mauritius, 2007).” A majority of respondents believed that the government has improved in this respect. The Central Statistics Office is responsible for publishing data from the various ministries into downloadable reports accessible to the public. While limited in scope, this constitutes an important coordination function for adaptation because information is housed in a host of different ministries. Ensuring data quality, however, is not a core function of this office, but rests largely with the originating ministries.

Numerous non-governmental organizations cited difficulty, be it long delays or refusals, in obtaining data, which must be officially requested from individual ministries. This can hamper external research and education. For example, maps depicting areas at risk to landslides and tsunamis were apparently developed but not made publicly available. Regardless of the reasons for withholding information, be it fear of misinterpretation by the public or media, or a negative effect on development, government makes the final decision on what information is released.

Dissemination of course involves more than posting reports on-line and efforts are being made to get climate-relevant information to those who need it. The Agricultural Research Extension Unit (AREU) has a Short Message Service (SMS) system to disseminate information to farmers. Artisanal fishers are notified of bad weather, and compensated for this through a pension. Respondents nevertheless cited outreach to farmers and fishers as an area needing improvement, e.g. in educating farmers on how to drain their fields of excess water after heavy rains.

It is clear that all stakeholders have a role in the dissemination of information, but the details for each are still being worked out. To date, sensitizing communities regarding their vulnerability to (and opportunities within) climate change has fallen largely to environmental organizations. However, given the centralized nature of Mauritian governance, there is growing recognition that central government can provide more leadership in this regard. In Rodrigues, for example, government partnered with Shoals Rodrigues, a local environmental organization, to sensitize schools on climate change issues. Staff and students were taught, among other topics, how to measure water levels and construct small retaining walls. The University of Mauritius, a parastatal organization, is also working to embed climate change into more curricula. Still, climate change needs to be integrated into the primary and secondary curricula to reach the majority of students (Government of Mauritius, 1999).

## Planning and Prioritization

Developing the needs, priorities, and strategies for adaptation requires not only robust vulnerability and impact assessments, but also an understanding of current and completed projects. This information will help to coordinate bodies and prevent duplication of effort, and promote sharing of data and lessons learned. At present, there is no national-level inventory of ongoing projects in Mauritius. Information sharing on individual projects has thus been limited without such a national adaptation coordinating body. This is not to say there is no coordination. For example, the UN Small Grants Programme (SGP), which funds many civil society projects related at least in part to adaptation, strives to communicate these efforts broadly. The SGP, however, does not have the mandate or resources to coordinate all current adaptation activities in the country. This function naturally resides within the MESD’s new Adaptation Unit.

A comprehensive inventory of projects and associated lessons learned, combined with inclusive stakeholder engagement, will make strategy development and prioritization easier and less reactive. While substantial reports on climate change and the state of the environment have been issued, Mauritius lacks comprehensive adaptation strategies at the national level. Respondents perceived the assessment and prioritization process as a largely top-down exercise, without substantial consideration being given to community-based assessments and priorities. At the same time, respondents claimed little or no participation in prioritizing government-funded environmental and climate change projects, including MID projects. They expressed a desire for a more systematic, inclusive and transparent process in adaptation strategy development and prioritization.

Adaptation governance also requires a system to review and revise the processes for the incorporation of climate issues in decision-making. The government recently institutionalized Programme Based Budgeting (PBB), which may be a useful mechanism to commence addressing these challenges (Government of Mauritius, 2010a). PBB has established a three-year planning framework (as opposed to one year), in which an initiative's performance will be based more on beneficial outcomes to citizens. This budgetary process will serve to embed a form of accountability in the development and implementation of targeted policies, national strategies and action plans for adaptation.

### Capacity Building

A key barrier to capacity building to deal with climate change issues "is the unavailability of resource persons to service the proposed training of trainers (Government of Mauritius, 2011b)." Based on research and the interviews, this barrier is making it difficult to build capacity in Mauritius for mainstreaming at the national level and implementation at the local level.

Whereas a relatively small number of experts can complete a national-level vulnerability and impact assessment, the work

of prioritizing, implementing and managing projects requires institutionalization. Table 1 illustrates how climate change issues involve the majority of ministries. To mainstream adaptation in a sustained manner, expertise must be expanded to more state and non-state stakeholders (World Resources Institute, 2009). Currently, limited resources have led to the same people participating in meeting after meeting on a wide range of climate topics.

A current practice of rotating civil servants among different offices has added to the challenge in building up institutional knowledge on complex issues like adaptation. While this practice has some benefits, it makes it difficult for staff to develop issue- or sector-specific expertise. For example, ministries defend budgets to the Ministry of Finance and Economic Development, but limited climate expertise among reviewers has made it difficult to ensure effective project prioritization. Other institutional problems include the lack of management experience required of ministers and office managers and a lack of performance reviews in senior management.

### DISCUSSION

The process of assessing vulnerabilities to and the impacts of climate change, facilitating coordination on the related matters, managing the associated information, establishing priorities and building capacity to deal with it serve one primary purpose: reduce the risks posed by climate change. As discussed, Mauritius has made progress in recent years in establishing the institutional framework needed for this purpose but considerable challenges remain. These challenges are especially acute in the areas of coordination and capacity building.

Effective adaptation requires not only top-down leadership from central government but also engagement and implementation from the bottom-up (McGray *et al.*, 2007). In policies and projects that affect communities, it is important for local government and the communities to be actively involved, especially given capacity constraints within the central government. The

National Environmental Policy adopts this philosophy, stating, “On the principle that local environmental problems should as a general rule be solved locally, the local authorities must be given additional responsibilities (Government of Mauritius, 2007).” This policy recognizes that little administrative and budgetary authority has devolved to the local level, making it difficult to implement, much less assess and prioritize projects locally. This is one reason why AAP work has been directed almost solely at the central government. Of course, changing this institutional structure would take many years, but many respondents see it as essential for effective adaptation governance in the long-term.

Outside of local government, civil society and community organizations play a key role in sensitizing and engaging people through advocacy, education and project implementation. In La Chaumière, a neighbourhood near the capital of Port Louis, communities and environmental organizations successfully opposed a proposed waste incinerator. In south-eastern Mauritius, a highway was proposed to pass through the largest stand of indigenous forests remaining in the country, but community opposition helped stop the project. The Mauritian Wildlife Foundation, in coordination with international organizations, has been successful in saving many indigenous bird species from the brink of extinction.

Despite some success, respondents identified a need to strengthen civil society on climate change issues, pointing to the generally weak public awareness regarding environmental and health concerns associated with climate change. A host of Mauritian environmental organizations work on a range of related topics, many of which deal with adaptation, including coral reef protection, alternative livelihoods (e.g. for artisanal fishers), and environmental sensitization. The majority of these organizations, however, have staff and resources, making it difficult to develop widespread and sustained initiatives. Some respondents pointed to the need for consolidation among environmental organizations dealing with climate change, giving them one voice and the ability to scale

up initiatives. Indeed, some of the success of the Mauritian Wildlife Foundation can be attributed to its larger size.

At the same time, community and environmental organizations perceive that they are given limited attention by government for collaboration in developing and implementing policy. For example, NGOs complained about limited forums for meeting with government officials and, when meetings are called, they are given very little advance warning. These institutional issues have resulted in little community-based action on adaptation-related work, such as community-based assessments. Enhancing the involvement of non-state entities, and building their trust in government, would aid in policy development and local implementation.

Environmental impact assessments (EIA) provide a barometer of the effectiveness of environmental governance in Mauritius. Law requires that the MESD ensures that EIAs are undertaken to assess the adverse and beneficial environmental impacts of proposed development projects. Guidelines, which include the consideration of climate change impacts, have been compiled to aid implementation. Nevertheless, the institutional capacity needed for effective implementation and enforcement of this is lacking. Assessors are not trained to incorporate current and projected climate change into EIAs, so this is often omitted. Respondents point to limited expertise within the MESD to evaluate EIAs. Finally, while EIAs require a public comment period, this generally results in little or no comment. When comments are submitted, they often originate from the business sector interested in moving the proposed project forward; a lack of public awareness and limited capacity within civil society regarding adaptation limit the public response. Often, public comments are further discouraged because EIAs take the form of large files downloadable from the web only one chapter at a time (15 chapters in one case). Finally, there is a perception that comments are not given full consideration by reviewers.

## Conclusion and Recommendations for Future Work

Effective adaptation is thus not simply a matter of passing laws, developing policy and allocating project funding to accomplish its execution. The nature of adaptation – the complex, long-term, and interdisciplinary challenge requiring widespread engagement – requires effective institutions with defined and shared responsibilities. Mauritius has made progress in establishing an institutional framework to address the impacts of climate change, but many challenges remain before the coordination and implementation of projects will be effective at the local level and capacity is built among all stakeholders.

Mauritius could draw upon the experience of countries similarly facing the challenge of adaptation governance, such as the other AAP countries or the nine countries participating in the World Bank's Pilot Program on Climate Resilience (PPCR). There is potential for cross-country comparison and information exchange. The Mauritian government is building up its Climate Change Division, including the Adaptation Unit. Future analysis can thus more deeply investigate elements of this burgeoning framework and assess the growing role of informal institutions in effective adaptation governance.

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