

DISASTER RISK
MANAGEMENT:
A CAPACITY
DIAGNOSIS

2020

THE REPUBLIC OF
MAURITIUS



UNITED NATIONS
MAURITIUS



caDRi
Partnership
Capacity for Disaster
Reduction Initiative


The CADRI Partnership is a global UN led partnership that works towards strengthening countries' capacities to pursue integrated and coherent solutions to reduce disaster and climate risks across the Sustainable Development Goals (SDGs).

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This report presents the findings and recommendations of the Diagnosis of National and Local Capacities to manage Disaster Risk in the Republic of Mauritius conducted in 2019. The analysis was subsequently complemented with additional technical inputs and updates collected throughout 2020.

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This report presents the findings and recommendations of the Diagnosis of National and Local Capacities to manage Disaster Risk in the Republic of Mauritius conducted in 2019 under the leadership of the National Disaster Risk Reduction and Management Centre (NDRRMC) in close collaboration with the Office of the United Nations Resident Coordinator, with the support of the United Nations Country Team in Mauritius and the CADRI Partnership.



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CONTENTS

TABLE OF ACRONYMS	8
EXECUTIVE SUMMARY	12
1. INTRODUCTION	16
1.1 Mauritius vulnerability and exposure to disaster risk	18
1.2 The rationale for the CADRI Partnership engagement in Mauritius	24
2. UNDERSTANDING DISASTER RISK	30
2.1. Collection and analysis of disaster risk data and information	32
2.2. Risk information management system	42
3. GOVERNANCE TO MANAGE DISASTER RISK	48
3.1 Legislative and policy frameworks for disaster risk management	50
3.2 Institutional framework and coordination mechanisms for DRM	57
3.3. Financing for DRM	61
4. INVESTING IN DISASTER RISK REDUCTION FOR RESILIENCE	64
4.1 Tourism	66
4.1.1 Institutional & policy framework for DRM in tourism	69
4.1.2 Access to information on disaster risk and climate change	73
4.1.3 Investment in disaster resilience	75
4.1.4 Preparedness for response and recovery	77
4.2 Agriculture	80
4.2.1. Institutional & policy framework for DRM in agriculture	84
4.2.2. Access to information on disaster risk and climate change	85
4.2.3. Investment in disaster resilience	87
4.2.4. Preparedness for response and recovery	88
4.3 Environment	90
4.3.1 Institutional & policy framework for DRM in environment	93
4.3.2 Access to information on disaster risk and climate change	96
4.3.3 Investment in disaster resilience	98
4.3.4 Preparedness for response and recovery	99

4.4	Water and sanitation	102
4.4.1	Institutional & policy framework for DRM in water & sanitation	105
4.4.2	Access to information on disaster risk and climate change	108
4.4.3	Investment in disaster resilience	109
4.4.4	Preparedness for response and recovery	112
4.5	Health	114
4.5.1.	Regulatory and Policy framework	117
4.5.2.	Institutional set up	118
4.5.3.	Access to information on disaster risk and climate change	121
4.5.4.	Preparedness for response	123
4.6	Education	128
4.6.1.	Institutional & policy framework for DRM in education	130
4.6.2.	Preparedness for response and recovery	133
5.	PREPAREDNESS	134
5.1	Hazard/ Risk analysis and early warning	136
5.2	Information management and communication	139
5.3	Legal and policy framework for DRM	141
5.4	Institutional framework and coordination mechanisms	142
5.5	Contingency planning	145
5.6	Training & Exercises	146
5.7	Emergency services and prepositioning	148
6.	A FOCUS ON RODRIGUES ISLAND	150
6.1	Managing disaster risk in the agriculture sector	153
6.2	Managing disaster risk in the environment sector	155
7.	BIBLIOGRAPHY	158
8.	LIST OF INSTITUTIONS VISITED	162
9.	END NOTES	166

ACRONYMS

AFD	Agence Française de Développement
AHRIM	Association des Hôteliers et Restaurateurs de l'île Maurice
APMIS	Agriculture Production and Market Information System
ASYREC	Automated System for Relief Emergency Consignments
CADRI	Capacity for Disaster Reduction Initiative
CBD	Convention on Biological Diversity
CBRN	Chemical Biological Radioactive Nuclear risk
CCA	Climate Change Adaptation
CDCU	Communicable Disease Control Unit
CSR	Corporate Social Responsibility
CWA	Central Water Authority
DIA	Drainage Impact Assessment
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
DRU	Disaster Response Unit
EHEU	Environmental Health Engineering Unit
EIA	Environmental Impact Assessment
EPA	Environmental Protection Act
ERP	Emergency Response and Preparedness
ESA	Environmental Sensitive Areas
EU	European Union
EUCP	European Union Civil Protection
EWS	Early Warning System
FAO	Food and Agriculture Organization
FAREI	Food and Agricultural Research and Extension Institute
GCF	Green Climate Fund
GIS	Geographic Information System
HWM	High Water Mark
I / NDC	Intended / Nationally Determined Contributions
IA	Irrigation Authority
IAES	Inter-Agency Emergency Simulation
ICT	Information Communication Technology
ICZM	Integrated Coastal Zone Management
IDRL	International Disaster Response Law
IDSR	Integrated Disease Surveillance and Response programme
IM	Information management



IMU	Infrastructure Management Unit
INFORM	Index for Risk Management
INSARAG	International Search and Rescue Advisory Group
IOC	Indian Ocean Commission
IOM	International Organization for Migration
IPC	Infection Prevention and Control
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resource Management
JEE	Joint External Evaluation
JEU	Joint Environment Unit (UNEP/OCHA)
JICA	Japan International Cooperation Agency
LDA	Land Drainage Authority
MCCI	Mauritius Chamber of Commerce and Industry
MCIA	Mauritius Cane Industry Authority
MIRA	Multi-Cluster/Sector Initial Rapid Assessment
MMS	Mauritius Meteorological Services
MoAIFS	Ministry of Agro-Industry & Food Security
MoD	Ministry of Defence, Home Affairs and External Communications
MoEP	Ministry of Energy and Public Utilities
MoESC	Minister of Environment, Solid Waste Management and Climate Change
MoET	Ministry of Education, Tertiary Education, Science and Technology
MoFA	Ministry of Foreign Affairs, Regional Integration and International Trade
MoFED	Ministry of Finance and Economic Planning and Development
MoG	Ministry of Gender Equality and Family Welfare
MoHL	Ministry of Housing and Land Use Planning
MoHW	Ministry of Health and Wellness
MoLD	Ministry of Local Government and Disaster Risk Management
MoIC	Minister of National Infrastructure and Community Development
MoS	Ministry of Social Integration, Social Security and National Solidarity
MoT	Ministry of Tourism
MoTC	Ministry of Technology, Communication and Innovation
MSB	Swedish Civil Contingencies Agency
MSIF	Mauritius Sugar Insurance Fund
NAP	National Adaptation Plan

NAP	National Adaptation Plan
NDRRMC	National Disaster Risk Reduction and Management Centre
NEF	National Environment Fund
NEOC	National Emergency Operations Command
NGO	Non-governmental Organization
NPPO	National Plant Protection Office
ODA	Official development assistance
PDNA	Post Disaster Needs Assessment
PER	Preliminary Environmental Report
PHC	Primary Health Care
PHEOC	Public Health Emergency Operations Centre
PPG	Planning Policy Guidance
RRTs	Rapid Response Teams
RSIE	Réseau de surveillance et d'investigation épidémiologique
SAMU	Service d'Aide Médicale d'Urgence
SDGs	Sustainable Development Goals
SIMEX	Simulation Exercise
SOP	Standard Operating Procedure
SWMD	Solid Waste Management Division
TGE	Total Government Expenditure
TPSSE	Tracking Public Sector Environment Expenditure
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNCT	United Nations Country Team
UNCTAD	United Nations Conference on Trade and Development
UNDAC	United Nations Disaster Assessment and Coordination
UNDAF	United Nations Development Assistance Framework
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
WASH	Water Sanitation and Hygiene
WHO	World Health Organization
WMA	Waste Water Management Authority
WWTP	Waste Water Treatment Plants



Photo: John O’Nolan

**EXECUTIVE
SUMMARY.**

In 2020, Mauritius graduated to the high-income country status¹. This was a major achievement reflecting the efforts and dedication of the Mauritian population and successive Governments. To achieve this goal, the Mauritian economy has successfully transitioned from a monocrop to a well-diversified economy driven by a variety of sectors, including sugarcane, textile manufacturing, financial services, tourism and ICT.

Climate change and disasters pose a significant risk to the country's economy and social development. The COVID-19 epidemic is a stark reminder that global epidemics, like climate change, know no borders. Despite its success in controlling the epidemic nationally, Mauritius was not spared by the global consequences on tourism and trade which negatively impacted the economy.

Mauritius is located at the tail of the Indian Ocean cyclone belt. A large share of the population and productive assets are exposed to multiple hazards and the risk of flooding is continuously increasing. The frequency of storms of tropical cyclone strength has increased significantly over the past three decades. The country is also vulnerable to different types of hazards: geological (landslides and tsunamis), biological (epidemics, crop and animal pests, and diseases) and technological (industrial pollution, toxic waste, transport accidents in the national port, fires and chemical spills). Furthermore, the country's reliance on international tourism and migrant workers means it is potentially more exposed to pandemics.

The growing impact of climate change is expected to increase the intensity and frequency of cyclones, torrential rains and the resulting flash floods, adversely affecting people's lives and livelihoods, ecosystem services and the economy. However, natural hazards are not the only driver of risk: rapid unplanned urbanization and infrastructure development have increased the frequency of flash flooding, causing destruction of housing, infrastructure and crops, and putting the population at risk of vec-

tor-borne, water-borne and skin diseases. Vulnerable groups are disproportionately affected by the impact of disasters and climate change, especially children, female-headed households and people living with disabilities in low-income communities.

The country is highly sensitive to the need to balance economic growth with environmental stewardship. Like many middle-income countries, it faces a twofold challenge when it comes to structural transformation: (i) creating an environment that allows it to remain competitive and continue to attract foreign direct investment; (ii) enforcing a regulatory framework to protect its people, natural resources, ecosystem services and the economy from the impact of climate change and disasters.

Achieving the ambitions of the country's vision, the Government's economic growth plan and the Sustainable Development Goals (SDGs) requires targeted investment in capacity-building in key sectors to integrate disaster and climate risk reduction measures at the national and local levels.

In 2019, the Government called on the UN Resident Coordinator to mobilize the expertise of the CADRI partnership to conduct a diagnosis of the disaster risk management (DRM) system at the national and local levels. The recommendations from the diagnosis will inform the development of the national disaster risk reduction (DRR) strategy.

The diagnosis has confirmed the strengths of the DRM system. Mauritius is renowned for its investment in cyclone preparedness and its community-based disaster response teams. The Government has put in place a relatively strong regulatory framework for land use, urban planning and environmental protection, which provides a foundation for DRR.

Reducing the exposure and vulnerability of the population and the economy will require additional measures, from increasing access to information on risks to incentives for the enforcement of the regulatory framework.

Improving the understanding of disaster risk

Mauritius produces a wealth of disaster risk data, with surveillance systems in place to monitor various dimensions (water quality and availability, extreme weather events through a network of observation stations, epidemics and crop and livestock diseases). There is a good understanding of the risk from tropical cyclones and some progress has been made in mapping flood and landslide hazards. The country's priorities include further progress in the identification of flood risks. In 2019, the Government prioritized investment to improve the zoning and accuracy of information on flood risks and coastal flooding.

There remain two key challenges to address: Firstly, risk information is not available in the right format for decision makers (open access, digital, spatial and user-friendly data at the right scale); and secondly the assessment of disaster risk does not integrate the analysis of multiple hazards.

A number of gaps in capacity must be addressed to make progress in both areas, including the limited use and application of geographic information systems (GIS) across sectors and the limited information sharing between sector ministries. The establishment of an information sharing framework to provide easy access to selected information on population vulnerability, hazard prevalence, land use and critical infrastructure, as well as data on disaster losses and damages, is a key requirement for improving DRR in Mauritius.

Strengthening the governance of disaster risk

The Government has put in place a relatively strong legal and regulatory framework. The National Disaster Risk Reduction and Management Act, the Local Government Act, the Land Drainage Authority Act and key regulations for urban

planning and environment protection guide DRR across socioeconomic and environmental sectors. Another key example of progress is the budget allocation mechanism set up under the National Environment Fund to finance risk reduction projects submitted by sector ministries or local government.

Despite a strong legal and policy framework, development and informal settlements continue in areas prone to disasters. While local councils have significant responsibilities, they have not been allocated adequate resources to fulfil their DRR mandate. Similarly, the legal and policy framework would need to be strengthened to define clearer obligations for sector ministries. The National Disaster Risk Reduction and Management Centre organizational structure and the operational coordination arrangements for DRR would need to be reviewed in line with the Sendai Framework.

In 2020, there is a unique opportunity to build a more coherent policy framework for disaster risk reduction, climate change and environmental management with the development of the National Disaster Risk Reduction and Management strategies, policies, Strategic Framework and Action Plan, the Climate Change Bill and the new environmental strategy.

Investing in economic, social and environmental resilience

This capacity diagnosis covers six socioeconomic sectors prioritized by the Government: tourism, agriculture, the environment and ecosystem services, water and sanitation, health and education. In the tourism sector, country stakeholders have recommended including provisions for DRR and climate change adaptation in the revised Tourism Authority Act, as well as applying the drainage impact assessment to private sector investment to enable a comprehensive mapping of the risk of coastal flooding and strengthening preparedness plans for the mass evacuation of tourists.

In the agriculture sector, recommendations emphasize better integration of DRR and climate change adaptation, as well as strengthening epidemiology capacities in animal health and crop pests and diseases.

In the environment sector, in addition to the integration of risk reduction in the National Environment Strategy for 2020–2030 and the Climate Change Bill, there are two key recommendations: making environmentally sensitive areas data publicly available to protect fragile and valued ecosystems and maintain their DRR functions; and expanding the scope of environmental impact assessments to include the analysis of multiple hazards (beyond flooding and coastal erosion). In relation to water and sanitation, the main recommendation is to close off the sewerage system and upgrade leaking drinking water pipelines to prevent water contamination by sewage during floods. Random testing of industry wastewater is also recommended.

In the health sector, a more effective multi-sectoral coordination and information sharing system must be established to facilitate the implementation of integrated disease and event-based surveillance. In particular it is recommended to establish a real-time reporting/surveillance system with interoperability between the human and animal health sectors to manage the risk of human/animal epidemics across all levels. It is also recommended to establish a laboratory with investigative capacity, as well as a Biosafety Level 3 (BSL-3) laboratory, and finally conduct simulation exercises for large scale epidemics.

In the education sector, recommendations include scaling up existing school safety assessments to cover all schools in the country, expanding the offer of university curricula in infrastructure engineering, together with student exchange programmes, to support the development of resilient infrastructure, and integrating DRR modules into primary and secondary school education programmes.

Improving response and recovery preparedness

Mauritius has a strong legal and institutional framework in place for disaster preparedness and response at both the national and local level, and the DRM structure is well decentralized. The country is well known for its community preparedness, especially for cyclones. There are also funding mechanisms in place to finance preparedness and response efforts and the country has a functioning early warning system for a variety of hazards, such as cyclones, tsunamis, epidemics and, to a lesser extent, flooding and landslides. Significant effort is required to improve the risk identification and information management system and investment is needed to improve the early warning system for flooding.

A number of guidelines and arrangements must be strengthened, ranging from designing simulation exercises to pre-positioning emergency stocks. Finally, the country's current capacity is tailored to manage disasters of an average magnitude and the country must review its system to be able to manage more complex emergencies, such as industrial accidents or epidemics that affect the whole of the island.





Photo: Jorg Angeli

I. INTRODUCTION: CONTEXT & JUSTIFICATION.

1.1 Vulnerability and exposure to disaster risk in Mauritius

The Republic of Mauritius comprises a group of volcanic islands in the South-West Indian Ocean, consisting of the main island of Mauritius, the outer islands of Rodrigues, Agalega, Saint Brandon and Tromelin, and the Chagos Archipelago. According to the 2019 World Risk Report, Mauritius is ranked 47 among the countries with the highest disaster risk.

Climate change and disasters are significant risks to the economy and social development of Mauritius. The country is highly vulnerable to the adverse impacts of climate change and the resulting extreme weather events including cyclones, storms and heavy rains, abnormal tidal surges and swells, dry spells and floods. Mauritius is also increasingly exposed to geological hazards (landslides). In 2020, the widespread impact of the COVID-19 pandemic on the Mauritian economy and the oil spill incident have shown that the island is not immune to biological threats and technological hazards.

Situated at the tail of the Indian Ocean cyclone belt, the country's exposure to cyclones has been relatively limited so far. While most cyclones miss the islands, every year the archipelago is hit by the remnants of big storms, which can cause flooding of low-lying areas, resulting in significant physical damage to buildings, crops and livestock. Mauritius is also increasingly affected by swells that cause the country's port to close operations.

According to the country's disaster risk profile², flooding is the second-largest risk after cyclones, causing 20 percent of direct economic losses associated with disasters. Another emerging risk is landslides, a direct consequence of increased precipitation coupled with deforestation and development on steep slopes.

As a small island developing state (SIDS), Mauritius is highly vulnerable to climate change, in-

cluding rising temperatures³, decreasing annual rainfall (8 percent between 1950 and 2008), rising sea levels (5.6 mm per year), accentuated beach erosion and the loss of biodiversity. Based on temperature trends, the annual temperature is projected to rise by as much as 3.8°C by 2100⁴. Some preliminary projections point to a continued decrease in annual rainfall. The intensification of cyclones in shorter periods of time has also been observed⁵.

Overall, the frequency and intensity of weather-related hazards (cyclones and torrential rains; consecutive flash floods and landslides; and epidemics and zoonotic diseases) are likely to increase.

The increase in disaster risk is not only due to climate change. Rapid urbanization, the development of the tourism industry in coastal zones and the conversion of agricultural land for commercial use are the main drivers of disaster risk.

On the one hand, exposure to hazards is increasing, with a higher concentration of people, property and infrastructure in hazard-prone areas like coastal zones and slopes.

On the other, urbanization and decreased vegetation cover (forests, agricultural land and wetlands) have created new risks. For instance, it is commonly agreed that the sudden increase in flash flooding is largely due to new commercial developments on land used to grow sugar cane, disrupting the natural drainage system and without proper planning of alternative drainage facilities.

The lack of an integrated approach to planning for land development and infrastructure (roads, water, sanitation and drainage) is a major challenge the Government is now attempting to address.

Hazard Profile

CYCLONES & TORRENTIAL RAINS



As the country is situated at the tail of the South Western Indian Ocean tropical cyclone belt, associated hazards such as torrential rains and flash floods regularly affect the country and account for 32.7 percent of nationally reported losses between 1990 and 2014. In 2002, Cyclone Dina caused 50 million EUR losses in the sugar cane production⁶. In 2016 Cyclone Fantala called for the evacuation of the South Island of Agalega. Most recently in January 2019 cyclone Berguitta caused significant damages and power cuts to the main island, followed by Cyclone Gelena in February which led to flash floods and population displacement in Rodrigues Island.

FLASH FLOODS



The risk of flash floods has increased significantly with urbanization and development causing the disruption of the natural drainage system. Flash floods account for 26.2 percent of nationally reported losses between 1990 and 2014. In 2002, 200 flood prone areas were identified compared to 450 in 2019. In March 2013, 11 people were killed by flash floods in Port Louis.

LANDSLIDE



Several areas - Chitrakoot, Quatre Soeurs, Vallée Pitot, La Butte, Chamarel; Corps de Garde's ridge⁷ - ⁸have been identified as high-risk for landslides, with incidences over the past years having led to the destruction of housing and infrastructure. Landslides typically result from increased precipitation patterns⁹ coupled with other factors such as lack of vegetation cover and construction on slopes.

DROUGHT



With climate change, episodes of drought and dry spells are becoming more frequent. Rainfall trends show an increase in the frequency of dry years after the 1990s with most severe dry spells experienced in 1999, 2009 and 2011¹⁰. In 1999 the drought caused a loss of 160 million dollars to the sugarcane sector from 1998 revenue¹¹. In 2011 the water crisis and resulting restrictions on water supply for irrigation caused shortages of vegetables on local markets¹². Droughts accounted for 96.8 percent of combined economic losses of nationally reported losses (1990 – 2014)¹³. Rodrigues is more exposed to long periods of water scarcity.

EARTHQUAKE



Exposure to seismic risk is limited but tsunamis as a result of deep sea earthquakes generated from either Sumatra or Makran could affect Mauritius¹⁴. Wave runup of 2.9m has been measured as effects of the December 2004 Indian Ocean tsunami on Rodrigues island¹⁵.

EPIDEMICS



Mauritius made major progress in the prevention of epidemics. The country is a malaria free country since 1973. An outbreak of Chikungunya was reported in 2005-2006 (272 000 people infected). There are recurrent dengue outbreaks on the main island (300 cases in 2016). Most recently, the country was affected by a measles outbreak (2018) and a dengue fever outbreak (2019). In 2020, the early imposition of confinement measures, the setting up of quarantine centers together with a large communication and community engagement campaign was effective in managing the spread of COVID-19.

FIRES



Uncontrolled fires resulting from the burning of sugar cane fields - as a common practice to ease manual harvesting for cane cutters – have been on the increase over the last decade and accounted for 2.3 percent of combined economic losses as well as 29.9 percent of nationally reported losses in between 1990 and 2014¹⁶. This practice is now less and less common.

TECHNOLOGICAL / INDUSTRIAL HAZARDS



With industrial development, toxic waste and the risk of contamination accidents increase. Studies to assess the impact of chemicals on the environment are scarce despite routine monitoring of chemical pollutants. In particular, the textile industry can cause serious environmental and health harm. Chemicals used in textile are reported to have caused abnormal fish mortality in the northern and eastern regions at the dismay of local fishermen. In 2016, Mauritius faced an oil spill from the carrier MV Benita and in 2020 again from the ship MV Wakashio.

TRANSBOUNDARY ANIMAL, CROP PESTS AND PLANT DISEASES



In 2016, an outbreak of Food and Mouth disease affected Mauritius main island and Rodrigues with 2000 animals affected.

Population Vulnerability to Hazards

Not all Mauritians stand equal in the face of climate change and disasters. Some, particularly the most deprived communities, including women-headed households and children, living in urban slums, or migrants living in informal settlements, are more vulnerable to disasters. The analysis of vulnerability is a critical component of disaster risk reduction.

As of 1 July 2020, the population of the Republic of Mauritius stood at 1,266,000 people, the majority living in the main island (1,221,921), 43,819 in the Island of Rodrigues and 274 in Agalega and St Brandon (Statistics Mauritius 2020).

According to Statistics Mauritius (2016), 14.4 percent of the population is 60 years old or older, with this figure forecast to increase to 20.5 percent by 2026 and nearly one-third by 2051. DRR policies and systems must adapt to these changing demographics to include “age-friendly” and “disabled-friendly” provisions.

It is estimated that around 10 percent of the population (130,500 Mauritians) still live below the relative poverty line¹⁷. According to the Housing and Population Census (2011), there remain 152 pockets of poverty, mostly in urban slums¹⁸. The Poverty Analysis Report (2012) highlighted that poverty is more prevalent among specific groups, including people with low levels of education, the elderly, single parent households and families with three or more children.

People living in poverty tend to live in poor housing conditions, increasing their vulnerability to hazards such as flooding or contaminated water. Squatter settlements are concentrated in the periphery of the capital of Port Louis, as well as in the south-west coastal region.¹⁹ The authorities are considering relocating vulnerable families from areas prone to landslides and floods (Chitrakoot, Camp Manna, Tranquebar, Vallee Pitot and Residence La Cure). Similarly, housing in Rivière Noire (the EDC settlement), Barkly (the Tôle and Planète des Singes settle-

ments) and Roche-Bois (the Karo Kalyptis and Enba Larivier settlements) is reported to be precarious. It is estimated that 4,000 additional homes are needed to address the issue of urban slums²⁰.

The Social Register of Mauritius (SRM), held by the Ministry of Social Integration, Social Security and National Solidarity, is the national database of beneficiaries of the country’s social safety net programme. It uses proxy data from the Household Budget Survey (2017) and includes data disaggregated by gender and age. The register covers 11,222 families classed as living in extreme poverty²¹. According to the Household Budget Survey (2017), poverty is higher among female-headed households (17 percent) than male-headed households (7 percent). As of March 2018, the SRM included 4,150 female-headed households, with a total of 15,346 beneficiaries. Furthermore, 50 percent of the poorest households in the register are headed by women.

Another major determinant of vulnerability to disasters is the lack of access to proper sanitation: only 21 percent of the population is connected to the sewerage system and 79 percent are connected to a private septic tank. Vulnerable groups such as migrants and female-headed households are disproportionately affected by poor access to sanitation services. Septic tanks tend to overflow during floods, putting people at higher risk of vector- and water-borne diseases.

Spatial disparities in the incidence of poverty in the archipelago must also be considered. For example, the population of Rodrigues is proportionally poorer, more vulnerable to disasters and less able to manage disaster risk. Rodrigues has a higher number of female-headed households who make up a large proportion of the poorest group. Its houses, which have pitched iron roofs, often sustain more damage than concrete dwellings. This often results in displacement of poor female-headed households, forcing them to live in evacuation camps.

Mauritius is also home to approximately 40,000 foreign migrant workers, mainly from Bangladesh, India and China, who often live in precarious conditions with limited access to social services²². Female workers tend to work in the garment and textile industry. When disasters occur, migrant workers often face specific obstacles to reaching safety and accessing assistance, meaning they can suffer disproportionately. Their vulnerabilities are exacerbated due to language barriers, lack of social networks to rely

on, lack of awareness of local risks, lost identity or travel documents and isolation. One of the obstacles to migrants accessing protection, getting out of the path of risks or otherwise ensuring their own safety and well-being is their lack of consideration in national disaster preparedness and response planning. There is also internal interisland migration from Rodrigues to the mainland, partially driven by climate change and disasters²³. Many migrants have settled in informal settlements in suburban areas.

Economy exposure and vulnerability to hazards

Mauritius is a high-income country with steady economic growth. The Three Year Strategic Plan foresees significant investments in 10 priority areas, including tourism, manufacturing, ocean economy, and infrastructure (housing, drainage, water and sanitation, ICT). The country is a trade hub and is seeking to further diversify its economy into medical tourism and higher education.

The Mauritian economy is highly vulnerable to disaster and climate change risk. A large share of its productive assets are located on the coastal areas and exposed to the increasing risk of tropical storms and floods. Policies, systems, skills and resources at central and local level must be further strengthened to ensure that those investments are protected from disaster and climate change impact, and do not instead create new risks.

Trade and food security

The country has positioned itself as a trade hub (re-export, logistics and distribution). It also imports most of its national food requirements. This makes Port Louis harbour vitally important to the economy. A disaster affecting Port Louis would disrupt the supply chain and jeopardize the import of vital goods for the population. Port Louis is exposed to multiple risks, including rising sea levels, storm surges and swells and technological hazards related to the management of hazardous materials. In 2018, the port was closed for 40 days due to swells with winds above 70 km/h, directly affecting the economy.

Ecosystem services

The environment is directly affected by climate change, extreme weather events and fires. It is also vulnerable to technological risks, such as hazardous waste and oil spills. The garment and textile industry, which employs a wide range of chemicals, can potentially cause serious harm to the environment. This is reported to have led to abnormal fish mortality at two sites in the north and east of the island, affecting local fishermen.

The loss of forest cover, coastal erosion and the destruction of coral reef all increase the country's exposure to extreme weather events. For example, only 2 percent of its native forest remains and the invasive tree species that have replaced it cannot withstand cyclonic conditions, since they are not adapted to the Mauritian weather system. This reduces the capacity of ecosystems to provide services to communities, such as food and livelihoods (predominantly fish) and protection.

Agriculture

The main hazards facing the agriculture sector are hydro-meteorological in nature (torrential rains, floods, storm surges), dry spells and water scarcity, and biological (animal diseases, including outbreaks of foot and mouth disease, plant pests and diseases, and invasive species).

Tourism

The tourism sector, which accounted for 8.5 per cent of the GDP in 2018, is one of the main drivers of growth.

The GDP growth was negatively impacted by the far reaching consequences of the global COVID-19 pandemic on the sector. The sector is also highly vulnerable to the impact of climate change, extreme weather events, as well as environmental accidents such as the 2020 oil spill into a wildlife sanctuary after the ship MV Wakashio struck a coral reef.

The physical assets of the sector are primarily located in coastal zones (90 percent of hotels in Mauritius are on the beachfront), where they are directly exposed to storm surges and floods, coastal erosion and the loss of biodiversity (especially coral bleaching).

1.2 The rationale for the CADRI Partnership engagement in Mauritius

The CADRI Partnership was mobilized in response to the request submitted by the Minister of Environment, Solid Waste Management and Climate Change (formerly Ministry of Social Security, National Solidarity, Environment and Sustainable Development), to the UN Resident Coordinator on 18th December 2018.

- How to adopt a cross-sectoral and inclusive approach to DRR.
- Information management system (data production/collection, data sharing protocols, access to risk information; flow of information between various sectors).
- How to strengthen evidence of disaster impact to advocate with decision makers – methodology for loss and damage accounting and required capacities.
- Identification of possible bottlenecks to the validation of policy and planning instruments (national policy, contingency plan) and moving from policy to implementation.
- How to operationalize cross sectoral coordination & increase sector ministries' ownership of DRR.

During the CADRI Partnership scoping mission conducted in February 2019²⁴, government institutions and partners identified a number of areas that would require a contextual analysis to identify feasible and realistic recommendations for capacity enhancement in disaster risk reduction:

- How to strengthen vertical integration between the central & district level (more specifically how to empower and incentivize district / village disaster management committees in a resource constrained environment).
- How to further strengthen operational efficiency in preparedness and response at national and local level.

During the scoping mission, government institutions and partners identified ten priority sectors to guide the design of the capacity diagnosis methodology:

- | | | | | |
|--|-----------|---------------------------|------------------|----------------|
| 1. | 2. | 3. | 4. | 5. |
| Infrastructure (roads, building codes, drainage systems) | Tourism | Housing/ urban planning | Environment | Health |
| 6. | 7. | 8. | 9. | 10. |
| Agriculture & Food Security (including fisheries) | Education | Water Resource Management | Climate Services | Human Mobility |

Additional capacity development priorities were highlighted for further consideration by the CADRI Partnership:

- Risk transfer mechanisms.
- Minimum Preparedness Actions (for instance to develop a harmonized multi-sectoral needs assessment methodology, SOPs etc.).
- Accessing international assistance at times of disaster.
- Early warning system for floods.
- Procurement fast tracking and financing for disaster relief (including private sector)

The capacity diagnosis supported by the CADRI Partnership is expected to produce realistic recommendations to inform the development of the national disaster risk reduction strategy as well as a capacity development plan to underpin its implementation.

The CADRI Capacity Diagnosis Methodology

Definition

Disaster risk management refers to the application of disaster risk reduction policies and strategies to prevent new disaster risk, reduce existing disaster risk and manage residual risk, contributing to the strengthening of resilience and reduction of disaster losses²⁵. A holistic understanding of disaster risk management thus comprises: prevention, mitigation, preparedness, response, recovery and reconstruction. In this report, the term “disaster risk management” is used interchangeably with “disaster risk reduction”.

Methodology





The diagnosis of DRM capacities is guided by the CADRI Capacity Diagnosis and Planning Tool. The tool comprises a modular questionnaire that serves as a guiding analytical framework for the capacity diagnosis: it provides the basis for conducting a diagnosis based on semi structured interviews and secondary data analysis.

The CADRI tool considers several dimensions of capacity: policies; organization, institutional arrangements & coordination at national and sub-national levels; skills and competencies; tools, methodologies, SOPs; financing. The analytical tool is applied to 10 socio-economic sectors, developed by the CADRI partner agencies²⁶. Depending on the selection of sectors, the semi-structured interviews are conducted with private sector actors, civil society actors including academia.

The capacity diagnosis is derived from a self-assessment by country stakeholders of the strengths and weaknesses of the DRM system at national and local level across socio-economic sectors. Information collected from interviews of country stakeholders (government, districts and municipalities, private sector, civil society) and desk review of reports is triangulated by the CADRI Partnership team.



Figure 1. The ten CADRI assessment and planning modules in connexion with the SDGs

CUSTOMIZED	GOVERNMENT LED	PARTICIPATIVE	DURATION
			
The questionnaire is customized to the country context based on the selection of issues, hazards, and sectors by the Government.	The capacity diagnosis is undertaken under the leadership of the Government.	The capacity diagnosis was facilitated by a team of government experts, UN Country Team experts, and experts mobilized through the CADRI Partnership.	The CADRI diagnosis in-country mission spans over 2 weeks. It is complemented by a desk review of key documents (laws, policies, national programmes, municipality development plan, reports, curriculum etc.) after the mission.

The capacity diagnosis is presented according to the four priority areas of the Sendai Framework for Disaster Risk Reduction (2015-2030):

<p>PRIORITY 1 Understanding Disaster Risk</p>	<p>PRIORITY 2 Strengthening governance to manage disaster risk</p>
<p>PRIORITY 3 Investing in economic, social, cultural, and environmental resilience</p>	<p>PRIORITY 4 Enhancing preparedness for effective response and recovery</p>

Capacity diagnosis team composition

The capacity assessment was jointly carried out by a multi-disciplinary team composed of 15 selected experts from FAO, IOM, UNOCHA, UNDP and WHO as well UNDAC, MapAction and the EU Civil Protection mechanism together with Government representatives from the National Disaster Risk Reduction and Management Centre.

GOVERNMENT

NDRRMC Office, Mr. Heman Bissessur
NDRRMC Office, Mr. Venoo Sunnassy
NDRRMC Office, Mr. Dookharansing Seetohul,
seconded from Mauritius Meteorological Services

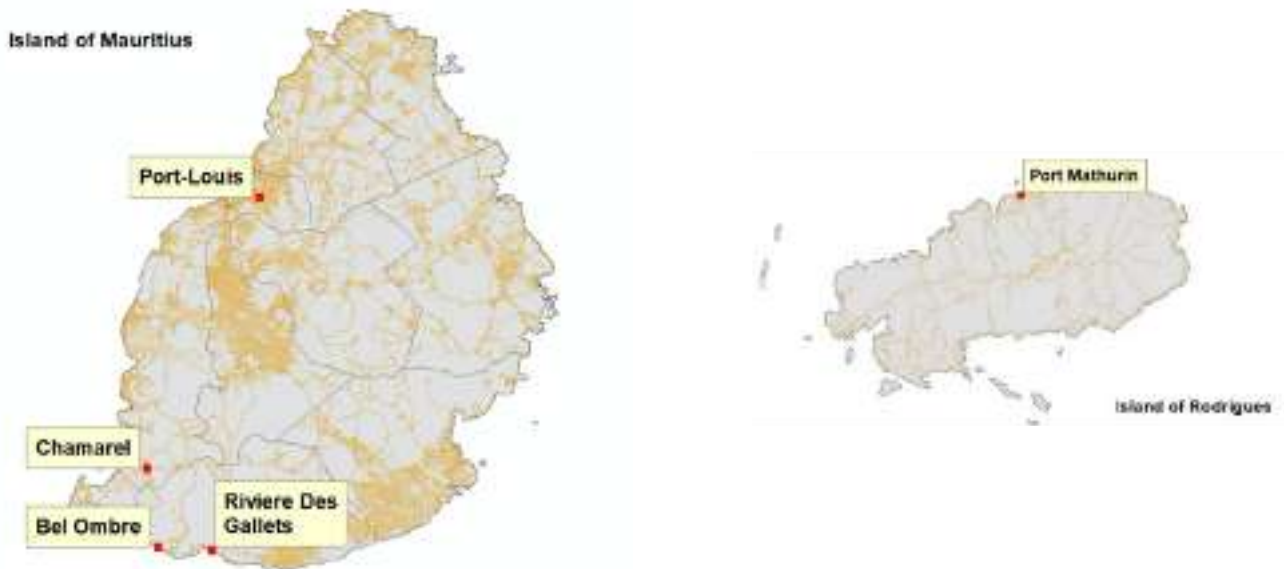
UN COUNTRY TEAM

UNDP, Mr. Madookur Desha

CADRI / UNDAC INCOMING TEAM

FAO, Ms. Olga Buto
IOM, Mr. Bogdan Danila
UNOCHA, Mr. Rija Harivelo Zoelisoa Rakotoson
UNDP, Ms. Cecilia Aipira
WHO, Ms. Tasiana Mzozo
UNDAC, Ms. Odeda Benin
UNDAC, Mr. Arjun Katoch
EU Civil Protection, Mr. Karin Stibbe
Map Action, Mr. Mark Gillick
CADRI Secretariat, Ms. Sophie Baranes
CADRI Secretariat, Mr. Mario Behrens

Localities visited during the CADRI capacity diagnosis




Limitations in the application of the CADRI capacity diagnosis methodology in Mauritius

There have been a number of limitations in the conduct of the capacity diagnosis including:

- The limited participation of UN Country Team experts made the triangulation of information difficult.
- The unavailability of the Mauritius Red Cross Society (MRCS).
- The limited number of meetings (6) with private sector actors to provide a balanced view of capacities within private sector to manage disaster and climate risk.
- The limited number of meetings with civil society groups to provide a balanced view of capacities within civil society to manage disaster and climate risk.

The findings and recommendations contained in this report are the outcome of consultations with country stakeholders (central government, local government, civil society, private sector, charities, NGOs, multilateral and bilateral agencies) and triangulation of information. The recommendations are derived from suggestions gathered from national and local stakeholders.

A satellite photograph of a tropical cyclone, showing a well-defined eye and a dense, swirling cloud structure over a dark blue ocean. The cyclone is the central focus of the image, with its eye appearing as a bright white spot in the center of a darker, more textured cloud core. The surrounding clouds are lighter and more diffuse, extending outwards in a spiral pattern. The ocean surface is visible as a dark blue area with some whitecaps and smaller cloud formations scattered across it.

“Policies and practices for disaster risk management should be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment.

Such knowledge can be leveraged for the purpose of pre-disaster risk assessment, for prevention and mitigation and for the development and implementation of appropriate preparedness and effective response to disasters”.

Sendai Framework Priority for Action I.

2. UNDERSTANDING DISASTER RISK.

When we analyze the capabilities of public and private sector actors to understand risk, what are we considering?

- Regulatory frameworks to conduct hazard and risk assessments/analysis.
- Availability of raw data (soil, geology, inventory of infrastructure, satellite imagery etc.).
- Hazard information (hazard maps, epidemics patterns etc.).
- Population vulnerability information (sex & age disaggregated data, migrants, displaced, disabled, single headed households, orphans, women, children, elderly, people living with AIDS) & vulnerability mapping (e.g. food insecure areas or slums).
- Integration between humanitarian and development data sets.
- Integration between Climate Change and Disaster Risk Management data sets.
- Mechanisms to share and access information easily, by all stakeholders at national and local level (including public and private sector and the general population and media).

Overview:

The Republic of Mauritius produces a wealth of disaster risk data. Surveillance systems monitor various dimensions of risk (water quality and water availability; extreme weather events through a network of observation stations; epidemics; crop and livestock diseases). There is a good understanding of tropical cyclones risk and there has been some progress in mapping flood and landslide hazards. Making further progress in the identification of flood risk is a national priority. In 2019 the government prioritized investment to improve the zoning and accuracy of information on flood and coastal inundation risk. There remain two main challenges to address: i) risk information is not available in the right for

mat for decision makers (open access, digitalized, spatial data, at the right scale, targeted at users) and ii) the assessment of disaster risk does not integrate the analysis of multiple hazards. A number of capacity gaps need to be addressed to make progress on both fronts. In particular, the limited use and application of GIS across sectors, and the limited information sharing between sector ministries. The establishment of a risk information system to centralize selected information on population vulnerability, hazard prevalence, land use and critical infrastructure, as well as data on disaster losses and damages, is a key requirement to improve disaster risk reduction.

2.1. Collection and analysis of disaster risk data and information

Since 2012 hazard maps are available for riverine floods, coastal high waves inundation, landslides. Records of hazard frequency (including tropical cyclones, heavy rains, swells, floods due to heavy rains) are maintained by the Mauritius Meteorological Services. Climate bulletins are issued for farmers and fishermen. The Social Register of Mauritius maintains data on vulnerable households.

In 2019, the Government initiated a major effort to update available disaster risk data and improve its accuracy. The Lidar survey launched

by the Land Drainage Authority using a high-resolution Digital Elevation Model maps the water catchment areas and the network of drains, and flood risk maps are being updated. A vulnerability study to seismic hazards and tsunamis is on-going. The mapping of ocean floor topography will help develop coastal inundation maps for tsunamis.

The review of the regulatory framework and institutional and technical capacities has highlighted a number of areas for further strengthening to build a stronger system for risk identification.

2.1.1. Existing capacities

The regulatory framework for risk identification

Mauritius regulatory framework for the identification, evaluation and mapping of disaster risk consists of three main regulations:

The Disaster Risk Reduction and Management Act (2016) is the overarching legal framework for DRR and includes in the mission of the National Council the promotion of “scientific research and technical capacity in multi-hazard risk assessments” and the “publication and dissemination of information concerning disaster risk reduction and management”. It stipulates that the Director-General of the National Center may “cause any department or agency to conduct investigations, surveys, researches and analysis related to risks and hazards to disasters”.

The Environmental Protection Act (2002) requires ‘major undertakings’²⁷ to complete an Environmental Impact Assessment (EIA) license prior to their authorization. To a certain extent, the EIA process includes an analysis of disaster risk, but EIA remain limited to large scale investments.

The Policy and Planning Guidance (PPG) under the Planning Development Act (2004) is the main regulation that includes provisions for risk analysis in investment, as stated in the Land Use Design Guidance (2004 - revised 2006). In subsequent years, several PPG were developed with provisions for risk assessment, including the PPG on hotels and integrated resort development (2011), or more recently the PPG 9 to guide development on slopping sites and landslide hazard areas (2016) which makes provisions for risk assessment for development on slopes over 10%.

Other pieces of legislation and policies are relevant for the production for data and information relating to hazard and vulnerability including the Land Drainage Authority Act (2017), the Mauri-

tius Meteorological Services Act (2019) and the Open Data Policy (2017).

The **Land Drainage Authority Act (2017)** establishes the Land Drainage Authority with the responsibility to undertake a hydrometeorological and hydrographic survey, undertake research on watershed management, and produce a flood risk map. Under the Land Drainage Authority, the government²⁸ is planning to introduce a Drainage Impact Assessment (DIA) as part of the EIA for Morcellement projects to assess the potential increase in flood risk elsewhere.

The Mauritius Meteorological Services Act (2019) establishes the Mauritius Meteorological Services as the “sole official authority responsible for providing climate services for the sustainable socio-economic development of Mauritius; record, process and archive meteorological and other related observations for climatological, environmental and research purposes, monitor, assess and conduct research on climate change, in particular on the science of climate change and sea level rise”.

The country, under the auspices of the Ministry of Technology, Communication and Innovation, has also recently adopted a **progressive policy framework on open data** which, while it is not directly related to disaster risk, contains important provisions to guarantee the availability of disaster data to the general population.

The Open Data Policy (2017) states that all government data is open by default and identifies 29 quick win data sets, the majority of which are spatial and relate to risk management. A Mauritius Open Data Readiness Assessment carried out in 2017 explicitly recognised that the National Disaster Risk Reduction and Management Centre (NDRRMC) holds valuable risk information pertaining to floods, landslides, inundation and public facilities.

Institutional & technical capacities for risk identification

Six institutions play a critical role in the production of disaster risk analysis and maps:

The **Ministry of Housing and Land Use Planning (MoHL)** produces spatial data and offers GIS services to government institutions and businesses. It has a cartography section with a team of skilled cartographers with GIS capacity that produces 3D large scale digital maps using aerial imagery. It produces Aerial Imagery and Digital Elevation Model (DEM) in ASCII format (see below), and updates and maintains the Digital Cadastral Database (see below). Maps are produced in 1/25,000 scale series which cover the island in 13 map sheets. It produces critical risk information such as hydrographic surveys currently being undertaken at Rodrigues, or the seven topographic maps completed to inform the identification of land slide zones.

The **Mauritius Meteorological Services** records, analyzes and archives meteorological data. It has some 100 staff, and relies on a network of 30 automatic station and 200 rainfall stations (the later not providing real time data). The Meteorological Services also monitor tide gauges for the risk of storm surges. It is the sole institution responsible for issuing warning – including for non-meteorological events - for cyclone, torrential rains, tsunamis, high waves, strong winds.

The Mauritius Meteorological Services produces various climate services products based on the analysis of meteorological data, including: a 24-hour weather forecast issued three times a day, a 7-day weather forecast issued daily, observations of temperature, humidity and wind speed at 21 locations, the past 24 hour figures for rainfall, a monthly agro-climatic bulletin and seasonal forecast for farmers; precipitations for the national water authority/ water monitoring committee; daily bulletins for fishermen in the whole archipelago, national coast guards, the national Port Authority and the aviation. The Mauritius Meteorological Services possesses a well curated

archive of over 50 years of climate data collected by a network of stations distributed spatially (some rainfall stations have records of over 100 years.) including synoptic stations on Rodrigues, St Brandon and Agalega. The data includes daily and monthly figures for rainfall, temperature (including maximum and minimum), relative humidity, wind direction & speed, visibility, cloud, sunshine, atmospheric pressure, vapor pressure, soil temperature and thunderstorm days.

Sea surface temperature data have been compiled monthly and yearly since 1971 and sea level data has been collected at Trou Fanfaron, Port Louis, since 1987. Most of this data is available in electronic format and is regularly extracted on request. Mauritius Meteorological Services normally charges for the supply of this data at a price to reflect the labor and other costs of extracting, checking and distributing the data (information can be made available free for research). It also produces localized historical data upon request for private sector (construction industry for proof of delay; fishermen compensation scheme; investors in solar / wind renewable energy). For many years, there was serious need of new weather forecast radar which could calculate the volume of water in a cloud mass. The radar is now established at Trou aux Cerfs.

The **Ministry of Environment, Solid Waste Management and Climate Change (MoESC)**²⁹ monitors forest and mangrove cover changes, costal erosion and beach profiles, and is responsible for technological hazards such as oil spills and river pollution by chemical.

The **Ministry of Social Integration, Social Security and National Solidarity (MoS)** is the main institution producing information on population vulnerability. The latest Household Budget Survey (2017) includes gender and age disaggregated data. It is the basis for the Social Register of Mauritius which maintains information on the most vulnerable households.

The **Ministry of Social Integration, Social Security and National Solidarity (MoS)** is the main institution producing information on population vulnerability. The latest Household Budget Survey (2017) includes gender and age disaggregated data. It is the basis for the Social Register of Mauritius which maintains information on the most vulnerable households.

Statistics Mauritius is responsible for collection, analysis and dissemination of social, economic and environmental data. It produces the census. It also produces digests of statistics such as the Environment Digest which are relevant to the identification of disaster risk.

The **National Disaster Risk Reduction and Management Centre (NDRRMC)** has collected data on historical events for the last 30 years including location, deaths and damage. This data was taken from newspapers and is not geo-coded. It is not yet available in an open format or on the Centre's website. A Disaster Information Management System is being set up on a pilot basis to systematize the recording and analysis of disaster losses and damages.

The **Ministry of Agro-Industry & Food Security (MoAIFS)** has a surveillance system in place to monitor the risk of animal / plant diseases that is described in detail in the following chapter on agriculture. The National Plant Protection Office provides services in Laboratory Analysis and Diagnostics for Pest and Disease identification which covers a wide spectrum of diseases. The Veterinary Services Division provides 24 hour-free service to all breeders of animals at the Animal Health Laboratory. The Albion Research Centre conducts screening of potentially toxic fishes and harmful microalgae/ ecological surveys and monitor water quality for the conservation of aquatic biodiversity and the marine environment. The National Parks and Conservation Service & Forestry Service monitor/control the invasive/alien species of animal and plants.

The **Ministry of Energy and Public Utilities (MoEP)** monitors dam security and has established modelling and scenario building for disaster risk management. The Central Water Authority (CWA) maintains a water table to monitor daily the quality and quantity of water in the reservoir system. The Waste Water Management Authority monitors the industrial disposal into the rivers.

The **Ministry of Health and Wellness (MoHW)** has an established surveillance system for epidemics that is described in detail in the following chapter on health. Public health laboratories typically provide all essential services including disease and outbreak detection, environmental monitoring and disease surveillance

Overall, there are relatively solid surveillance systems in place to monitor various dimensions of risk (extreme weather events such as drought through a network of weather/rain fall stations cyclone/tsunami early warning; epidemics; crop and livestock diseases, water quality and water availability). There is a good understanding of tropical cyclones risk which are well documented.

With respect to technical capacities, there is a good understanding across ministries of the use and potential of GIS and cartography for application to land use planning and disaster risk management. There is a reliable cartographic service (MoHL, Mauritius Oceanographic Institute) and GIS capacity (MoESC & MoHL).

Mauritius is active in regional fora on disaster risk reduction and climate change adaptation. Mauritius is a member of the RA I Tropical Cyclone Committee for the South-West Indian Ocean for which Mauritius is a sub-regional centre, and the South West Indian Ocean Climate Outlook Forum (SWIOCOF). Mauritius is also an active member of SADC and contributes to the Monitoring of Environment and Security in Africa (MESA) programme of SADC which uses satellite Earth Observation (EO) data and land-based monitoring technology to monitor drought, wild fire and flood risk.

KEY CHALLENGES:

- Risk information is not available in the right format for decision making
- There is no comprehensive hazard profile of the archipelago

CAPACITY GAPS:

• **Regulatory framework**

The legal and regulatory framework for risk identification across sectors is relatively patchy. The PPG and the EIA include regulations for risk identification, but they do not systematically apply. There is a lack of clarity with sector ministries on the applicable regulation for risk identification, and limited knowledge about the applicable legal framework, regulations and methodologies to conduct risk assessment prior to planning.

The Disaster Risk Reduction and Management Act does not clearly articulate the provisions for the conduct of multi-hazard risk assessments. The Act neither refers to the Policy and Planning Guidance nor to the Environmental Impact Assessment. It mentions the importance of “multi-hazard risk assessment” without clarifying the institution(s) responsible to carry them out. Most importantly the Act does not articulate the role and function of the NDRRMC with respect to risk information. There is not mention of the requirement of a risk information sharing system.

The Open Data Policy, which states that all government data is open by default, is not fully implemented when it comes to spatial data and risk information. When accessing the government open data portal, no data is available in a spatial format.

• **Risk information is not produced based on an analysis of user needs**

The production of risk information products such as maps or risk assessment - by institutions such as MoHL or MoESC - is not underpinned by an analysis of user needs in public and private sector in particular in the growing sectors of tourism, industry, trade & transport, ICT.

The Mauritius Meteorological Services developed a few risk information products targeting farmers and fishermen, but no specific information is produced for other sectors such as health.

• **Research capacity in disaster risk reduction and climate change**

There is very limited research capacity in DRR and CC within the Ministry of Environment as well as in the University of Mauritius. Limited research has been performed in the area of DRR and CC³⁰. There is limited human resource, technical capacity and equipment (for instance statistical software, climate database).

Mauritius is outside the CORDEX (Coordinated Regional Climate Downscaling Experiment) which a global partnership to support countries develop regional climate downscaling models which can provide climate projections on much smaller scales to support climate change adaptation and understanding of trends of extreme weather events.

There is still a heavy reliance on external consultancy services to conduct risk assessment and hazard mapping with limited involvement of local research institutions. The reliance on consultancy services results in the application of multiple methodologies for hazard mapping and analysis.

• **The network of observation stations is insufficient**

The number of automatic weather stations and the number of river gauges to monitor river levels need to be increased to improve flood, including flash flood forecasting. Similarly, the network of sea level monitoring stations could be increased to monitor wave heights and provide timely information to fishermen of main island and Rodrigues.

- **Lack of geo-spatial data due to limited GIS capacity**

Despite recognising the benefits of GIS, there is not enough use of GIS nor staff with GIS skills within the various sector ministries and district/municipalities. The concentration of GIS capacity within Ministry of Housing and Land Use Planning and the practice of selling information such as maps does not promote a culture of application of spatial data. Where it exists, GIS software is not used to its full potential. Critical institutions like the Mauritius Meteorological Services do not have GIS software for drawing contour, iso-lines, layering.

- **Limited access to digitalized data**

Data collection is often paper based rather than digital (although Statistics Mauritius plans to use digital collection systems for the next census). Data is often in the form of files (SHP, TIFF etc) stored on a mixture of local and centralised file systems. Data capture and sharing is often done via non-spatial formats such as XLSX or non-geographic formats such as CAD files. Overall there is a limited use of standard data management principles (such as the use of unique identifiers, place codes, naming conventions, and machine-readable formats). Metadata is not widely implemented.

Desktop GIS is the main form of GIS and is a mixture of ESRI ArcMap 10.x (proprietary) and QGIS (open source) with no use of the ESRI ArcGIS Pro (ESRI's ArcMap replacement). Neither server GIS (i.e. ESRI's ArcServer or Geo/Map Server) nor cloud GIS (i.e. ESRI's ArcGIS Online) are used. Neither desktop or server technology licensing is covered by a central government Enterprise License Agreement (ELA). In the health sector, laboratory records are still paper-based, and laboratory results are dispatched by vehicles or by post.

- **National mapping scale**

The regulation that sets the national mapping scale at 1:25,000 causes problems when discussing legal boundaries of responsibility as a 1cm error on the map is equal to a 250m error on the ground. The scale of 1:50 000 for the river-

ine flood map (2013) was not appropriate for proper flood risk management.

- **Datasets are rapidly outdated**

With climate change impact and fast paced development, hazard maps must be regularly updated. Sea level rise, costal erosion, change in marine eco-systems, change in land use (in particular sugar cane land conversion and urbanization) can induce changes in hazard localization. As indicated above, the Government already initiated a major effort to address the obsolescence of maps in 2019 with the Lidar survey and the updating of the riverine flood and coastal zone inundation maps.

- **Information on disaster losses and damages is not recorded systematically**

Some data, for example sugar cane losses in the agricultural sector, is collected and archived. There is a lack of well-defined institutional mechanisms to guide and address issues associated with collection of disaster loss and damages data across various socio-economic and environmental sectors.

- **Lack of a comprehensive national disaster risk profile**

The first attempts to map prevailing hazards and to institutionalize surveillance systems have focused primarily on the main island of Mauritius. More recently hazard mapping has included Rodrigues and Agalega. Still, even on the main island, the mapping of the main hazards – floods, landslide, coastal inundation - is limited to certain areas. Given the size of the country, it is feasible to carry out a multi-hazard assessment considering hydrometeorological, geological and technological hazards, with the view to update the disaster risk profile initiated in 2012 ³¹.

2.1.2. Recommendations

Public and private sector stakeholders highlighted the strengths of the surveillance system and stressed the need to increase awareness on the applicable regulation for risk assessment, as well as the need to increase the quality and accuracy of risk information to inform emergency preparedness and development planning.



2.1.2.1. Increase awareness on applicable regulations to conduct risk assessment across government entities.

2.1.2.1.1. NDRRMC to develop a guideline to clarify the legal provisions, regulations and available guidance and methodologies to conduct risk assessment and disseminate the guideline to all public institutions.

2.1.2.1.2. Training and awareness of applicable legal provisions and regulations to conduct risk assessment across government entities.

2.1.2.1.3. Include legal provisions for the conduct of risk assessment and hazard mapping (at least for hydro-meteorological hazards and related hazards) in the Climate Change Bill currently under development.

2.1.2.2. Undertake comprehensive risk assessment that responds to the needs of government, economic and civil society actors.

2.1.2.2.1. NDRRMC to undertake a mapping of needs for risk information including: municipalities, line ministries, tourism, industry, trade & transport, ICT sectors. This should also include a review of the needs for more refined vulnerability analysis and other informa

tion required to improve preparedness and emergency response systems. This can be done through an on-line survey with multiple choice answers to be validated in a multi-stakeholder workshop. Such mapping can be informed by the inventory of climate services completed at the Mauritius Meteorological Services in late 2019.

2.1.2.2.2. Based on analysis of user needs, complete a comprehensive multi-hazard risk assessment in relevant areas of the country. This should entail preparing comprehensive maps in appropriate scales for the main prevailing hazards, including technological hazards; and the generation of scenarios based on historic data and the inter-connectiveness of risk (for instance floods and epidemics) and assessing potential losses based on the exposure of property, livelihoods, critical facilities, infrastructure etc.

2.1.2.2.3. Standardize methodological guidance to conduct vulnerability analysis, hazard mapping, risk assessment that become part of a national guideline.

2.1.2.3. Increase availability of geo-spatial & digitalized data through investment in GIS capacity across government.

2.1.2.3.1. Increasing investment in GIS software's and training starting with NDRRMC, Mauritius Meteorological Services, and key line ministries with the view to develop more GIS analysis for application to disaster risk reduction. A detailed capacity development strategy for a GIS mature government is included in the box below. **PRIORITY.**

2.1.2.3.2. Improve the mapping scale (1:5,000 instead of 1:25,000) for hazard mapping and systematically make it available to users as a GIS ready file format. Other data sets associated with the housing and population census are also cited as needing sharing in GIS ready file formats.

2.1.2.3.3. Increase access to open source data (in line with the national open data policy by implementing the recommendations of the Mauritius Open Data Readiness Assessment ³²with respect to the free access to datasets on hazards and public facilities to be made available on OpenDataMauritius.

2.1.2.4. Increase capacity in climate modelling and observation.

2.1.2.4.1. Increase the number of automatic weather stations, river gauges and sea level monitoring stations as well as budget allocation for maintenance and monitoring.

2.1.2.4.2. Consider joining the CORDEX (Coordinated Regional Climate Downscaling Experiment) to develop regional climate downscaling models to improve understanding of trends of extreme weather events.

2.1.2.4.3. Systematically involve University of Mauritius and other local research institutes in risk assessment outsourced to consulting firms.

2.1.2.4.4. Invest in capacity of the University of Mauritius and the Food and Agricultural Research and Extension Institute (FAREI) to conduct research on climate.

Focus: A GIS capacity development strategy for disaster risk reduction

Why is GIS important in disaster risk reduction?

Geographical Information Systems (GIS) are an important part of disaster risk reduction (DRR) as it provides the technologies and techniques for the digital recording, analysis and dissemination of information pertaining to risk, with a specific emphasis on location.

To some degree all spatial information is related to understanding and managing risk. This added element of location allows for many different and unrelated data sets to be integrated and brought together to understand past, present and future scenarios pertaining to risk. This allows for the modelling of potential strategies for mitigating and reducing that risk, adapting to the environmental changes and long-term integrated planning. The results of such spatial activities are often visualised as a map.

For example, holding information about the location and type of drainage assets and the built environment allows for the modelling of different rain/flood scenarios to predict where a drainage system can or cannot cope with a particular volume of water and importantly which other assets in the built environment would be affected by success or failure of the drainage system.

The information used in a GIS is often diverse in terms of its theme and format. Information comes as either raster (image) or vector data (points, lines or polygons (2d) and volumes (3d)) and represents real world objects such as emergency shelters, roads, drains, urban/rural areas, buildings, land use types and topography.



The specific challenges and opportunities addressed by this strategy should include:

- What desktop and server-side GIS technology and applications should be used?
- How can GIS technologies be purchased and budgeted for?
- What data storage and management standards should be applied to GIS data?
- What skills are needed to get the most value from GIS?
- How should GIS data be shared?
- Where can data be collected digitally using GIS?
- How can GIS support digital journeys, workflows and transformation?
- What role does the cloud play in GIS?
- How can the cost-effective use of GIS be widened within government and across society?



Principles

Wherever possible open source GIS technologies should be used - free and open by default. Potential open source and free GIS data system could include the tools developed by the Cima Foundation³³, which are increasingly used by other countries in the region.

Proposed priorities and actions

DATA MANAGEMENT POLICY

Establish a policy/framework for the standardised management of spatial data across government. Such standards should align very closely with open data standards and involve the stipulation of where data should be stored, in what format, what metadata standards to use and how to make the data interoperable i.e. naming conventions, unique identifiers/place codes, controlled vocabularies and machine-readable attribution.



SKILLS & TRAINING

Carry out a GIS skills audit to identify areas of existing and required GIS capability across all levels of government. Develop a business case for the improvement of GIS skills and establish a centralised mechanism whereby GIS skills can be gained and shared using online systems or peer training.

NATIONAL SPATIAL INFRASTRUCTURE

Prioritise the development of the National Spatial Data Infrastructure and provide a centralised hosting service for all government spatial data. Provide a map-based portal to this data for government, business and citizens alike.



DESKTOP GIS

Replace ArcMap GIS desktop software with a mixture of QGIS (open source software for standard users) and ESRI's ArcGIS Pro (proprietary software for power users). In regard to the proprietary software investigate and assess a government Enterprise License Agreement.

DATA COLLECTION

Investigate the use of cloud-based GIS technologies to improve environmental monitoring and data collection by using networked sensors/switches and digital data collection forms.



Credit: slidesgo/freepik

2.2. Risk Information Management System

2.2.1. Existing capacities

There is a wealth of risk information produced across various institutions and sectors. However, there is no central system to access information on prevailing hazards and vulnerabilities. As a result, there is a patchy knowledge of disaster risk data availability, ownership and sharing across ministries and institutions.

There are various information systems that can be useful to improve availability and access to disaster and climate risk information:

The **Climate Change Information Centre** (<http://ccic.govmu.org/>) established under the Ministry of Environment is expected to act as a data repository for climate change information and a knowledge-based platform and provide controlled access to real time data from Agromet & Agricultural Decision Support System (ADSS) and its seven agro-meteorological stations. It remains unclear whether the Center is fully functional since data have not been updated since 2018 and are only available in word and excel files (with the exception of the “measurable, reportable and verifiable” greenhouse gas (MRV) Framework draft report of October 2019).

Statistics Mauritius has established an interactive statistical data portal <http://dataportal.statsmauritius.govmu.org/> which enables the public to access data on forest cover, waste water treatment, terrestrial and marine protected areas. Publications are distributed free of charge to Ministries and Government Departments.

OpenData Mauritius is an open data portal launched by the Ministry of Technology, Communication and Innovation in line with the e-Government Strategy and the Open Data Policy, which houses and provides links to various Government Agencies’ datasets in an open format accessible to the whole of government,

citizens and businesses.

Neither the Disaster Management Scheme (2015) nor the Disaster Risk Reduction and Management Act (2016) make provisions for a risk information management system.

NDRRMC collects data on historical events for the last 30 years including location, deaths and damage. This data is not geo-coded. NDRRMC has datasets on various types of disasters (e.g. flooding, landslides, inundation) that are available as Shapefiles. NDRRMC stores data sets on laptops with data informally backed up (no cloud).

NDRRMC organigram (2019) includes an information management and early warning unit falling under the Response Directorate. It is composed of three officers: ICT specialist; Information & Communication Manager and a Disaster Monitoring Officer (DMO). The NDRRMC DMO TOR includes information management related tasks such as “liaising with the Mauritius Meteorological Services in the monitoring of climatic concerns and weather patterns; provide timely advice on disaster threats both before and during a response; evaluate activities relating to the monitoring and forecasting and disasters”. The TOR does not require specific competencies neither in information management nor in GIS. The position is vacant since 2018 and the organization has encountered difficulties to recruit competent personnel with specialized skills³⁴.

KEY CHALLENGES:

- Limited open access to risk information.
- Limited risk information sharing between sectors & absence of central risk information system.
- The collective impact of disasters is not compiled, and the trend and patterns on disaster losses are not analysed and available for decision makers and investors.

CAPACITY GAPS:

- There is no centralized data / information system and therefore limited awareness of what disaster & hazard data is available from whom.
- There are various monitoring and surveillance systems implemented but not networked.
- Data sharing protocols and mechanisms have still to be developed. As such no institutional setup exist to undertake these tasks at NDRRMC.
- There is shortage of staff and skills in information management system in the country. NDRRMC does not have an expert in information management and GIS.
- Data on the extent of losses and damages caused by different disasters have not been systematically collected and archived. The NDRRMC does not yet have the expertise to collect and manage national statistics on losses and damages as per international standards.
- The country does not yet have a laboratory information management system (LIMS) in place.
- An electronic real-time reporting/surveillance system with interoperability between the human and animal health sectors to manage human/animal epidemics risk currently does not exist (the case-based form used for notification of priority diseases are sent from the local health centres to the central level via fax or email³⁵).

2.2.2 Recommendations



2.2.2.1 Establish a central database to centralize and enable open access information on disaster risk.

2.2.2.1.1 NDRRMC to establish a central data base to centralize selected risk information on household and community vulnerability, hydrometeorological, geological, technological / environmental, biological hazards; hazard maps; disaster loss and damages data from all sectors; data on land, infrastructure and utilities. The database must be linked to OpenData Mauritius and to the Climate Change Information Centre.

Alternatively, the central data base on disaster risk information could be hosted on the Climate Change Information Centre provided resources are made available for that. It could become the Climate Change and Disaster Information Centre and provide access to data on climatic and non-climatic hazards.

2.2.2.1.2 Operationalize the Disaster Information Management System established in 2019 to systematically collect and analyse disaster loss and damages including through the recruitment of data collectors and the conduct of annual training on collection of loss data in all sectors. Understanding disaster risk based on historical loss and damage data and assessment of hazard and vulnerability, as well as an estimation of risk levels is required to make sound decisions in planning public and private investment across sectors. The disaster loss and damages data collection system must evolve into a central database open data system.

2.2.2.1.3 NDRRMC to work with the Ministry of Technology, Communication and Innovation to develop risk information sharing protocols to facilitate information sharing between sector ministries and identify confidential and public domain information.

2.2.2.1.4 Establish an Information Management Unit at NDRRMC directly reporting to the Director General with the responsibility to perform information management and communication functions in support of preparedness, response and prevention activities. The Information Management Unit must be equipped with GIS cloud capacity and be allocated a budget line for regular GIS training for junior technical staff at NDRRMC.

2.2.2.2 Establish an integrated information system for biological risk.

2.2.2.2.1 Set up a health information management system.

2.2.2.2.2 Set up a an interoperable, interconnected, electronic real-time reporting system across all levels in the context of One Health (agriculture, environment, water and health sectors).

2.2.2.3 Develop the National Spatial Data Infrastructure.

2.2.2.3.1 A National Spatial Data Infrastructure (NSDI) will maintain accurate spatial data on land, infrastructure, utilities and the environment and would support the Government in addressing environmental degradation, flooding, and other hazards.

The list of hazard and vulnerability data collected, and information produced which are relevant to the identification of disaster risk in Mauritius is included below:

Inventory of available disaster risk information produced in Mauritius		
Disaster Risk data	Institution responsible	Periodicity
5-7 days weather forecasts, recording of rainfall, temperature, wind direction, sea level rise; lightning strikes;	Meteorological Services	Daily, weekly
Heavy swell warning; Storm surge warning; Cyclone warning; Heavy rains warning.	Meteorological Services	
Bulletin for fishermen and national coast guards	Meteorological Services	Daily
Winds and swells forecast / warning for the Port Authority	Meteorological Services	Daily
Seasonal outlook	Meteorological Services	Seasonal
Agro-climatic bulletin for farmers & Meteo Agricole	Meteorological Services	Monthly Daily
Census data disaggregated by age and gender	Statistics Mauritius	Updated periodically
Social Register of Mauritius (SRM) database on population vulnerability	Ministry of Social Integration, Social Security and National Solidarity	Updated periodically based on the Household Budget Survey
Topography, geology; historical air photography; administrative areas, land use, building footprints (3d)	Ministry of Housing and Land Use Planning	Periodically
Water availability data (but not in GIS format yet)	Water Resource Unit	Weekly
Dam safety analysis survey	Water Resource Unit	2019-2020
	Ministry of Environment	
Building footprints	Minister of Local Government, Disaster and Risk Management	
Civil engineering datasets	Minister of National Infrastructure and Community Development	
Major roads, bridges, tunnels, risk indexes, road administration areas	Road Development Authority	
Rivers, canals, reservoirs, water pipes, sewage pipes, water management zones, boreholes, dams, power stations, waste and drinking water plants/systems	Ministry of Energy and Public Utilities	
Plant pest and disease, animal disease, sugar cane loss assessments	Ministry of Agro-Industry & Food Security	
Epidemics surveillance	Ministry of Health and Wellness	
Vulnerability study to seismic hazards and tsunami (BRGM French Geology Bureau)	Mauritius Oceanographic Institute	In development until 2020
- Forest and mangrove cover changes - Biodiversity monitoring - Coastal zone monitoring - Beach profiles	Ministry of Environment	
River pollution by industry / chemicals	Ministry of Environment	

Oil spill	Ministry of Environment	
Disaster loss and damages spreadsheets	NDRRMC consolidates information received from line ministries and other relevant institutions	Annual
Census population data	Statistics Mauritius	
Digest of Environment Statistics	Statistics Mauritius	
Hazard Mapping & Risk Assessment	Institution responsible	Periodicity
Environmentally Sensitive Areas (ESAs) and including coastal zones and wetlands ³⁶	Ministry of Environment	
National Risk Profile for Mauritius main island & Rodrigues (SGI Studio Galli Ingegneria) including: - Riverine Flood Hazard map - Coastal inundation Hazard scenario - Landslide Hazard study Including map with names and locations of infrastructure (schools, health centers, hotels, fire stations, industrial sites)	Ministry of Environment	2012
Riverine flood hazard 1:50 000 scale	Ministry of Housing and Land Use Planning	2013
Hydrographic surveys Rodrigues	Ministry of Housing and Land Use Planning	2019
Topographic maps	Ministry of Housing and Land Use Planning	2015
Digital aerial imagery	Ministry of Housing and Land Use Planning	2019
Lidar survey (with technical assistance from AFD) High resolution Digital Elevation Model (DEM) to map catchment areas, and collect GIS coordinates of national and local drains	Land Drainage Authority	Baseline survey in 2019-2020
Flood risk zones 250 flood prone zones already mapped, and 47 sites identified as high risk for life & for critical infrastructure	Land Drainage Authority	Baseline survey in 2019-2020
Landslide risk assessment in Chitrakoot Quatre Soeurs, Vallée Pitot, La Butte, (with technical assistance from JICA)	Ministry of Public Infrastructure & Land Transport (current Minister of National Infrastructure and Community Development)	2015
Landslide susceptibility assessment Chamarel; Corps de Garde's	Ministry of Environment & Università degli Studi "G. d'Annunzio" Chieti-Pescara	2019
Roads, bridges, tunnels	Road Development Authority	
Water course network	Water Resource Unit	
Minor roads and drains, community level mapping	Local Authorities	
Schools in hazard areas, evacuation routes	Ministry of Education, Tertiary Education, Science and Technology	
Emergency shelters	Minister of Gender Equality and Family Welfare	
Hospitals and Health Centers	Ministry of Health and Wellness	
Mapping of ocean floor topography to develop coastal inundation maps for tsunami	Mauritius Oceanographic Institute	Currently being updated
Coastal zone vulnerability analysis in 6 priority zones, with technical assistance from AFD	Ministry of Environment	2020

Information management system	Institution responsible	
District Health Information Software (DHIS2)	Ministry of Health and Wellness	
Land Administration and Valuation Information System (LAVIS) and its associated Digital Cadastral Database	Ministry of Housing & Land Use Planning	
Drain Information Management System (DIMS)	Land Drainage Authority	
Climate Change Information Centre	Ministry of Environment	Not updated regularly
Agricultural Decision Support System (ADSS) allows farmers to access real time agro-meteorological data from seven agro-meteorological stations	Ministry of Environment, Ministry of Agro-Industry and Food Security & Mauritius Meteorological Services	

“Disaster risk governance at the national, regional and global levels is of great importance for an effective and efficient management of disaster risk. Clear vision, plans, competence, guidance and coordination within and across sectors, as well as participation of relevant stakeholders, are needed.

Strengthening disaster risk governance for prevention, mitigation, preparedness, response, recovery and rehabilitation is therefore necessary and fosters collaboration and partnership across mechanisms and institutions for the implementation of instruments relevant to disaster risk reduction and sustainable development.”

Sendai Framework Priority for Action II.



Photo: NDRRMC

3. G O V E R N A N C E T O M A N A G E D I S A S T E R R I S K.

When we assess risk governance capacities, what are we considering?

- Awareness (government, private sector, population)
- Legal and policy framework assigning roles and responsibilities
- Organizational and institutional arrangements effectiveness
- Coordination (inter-ministerial, central-local, public-private, DRR-CC)
- Financing

Overview:

The Government has put in place a strong legal and regulatory framework with the adoption of the 2016 DRR/M Act and key regulations for urban planning and environment protection which create the foundation for disaster risk reduction. Development (e.g. smart cities & household informal settlements) continues to be situated in risky zones. The legal and policy framework does not set clear obligations for sector ministries and does not allocate resources for local councils to fulfil their DRR functions.

The policy framework for DRR needs to be updated in line with the Sendai Framework for Disaster Risk Reduction. Similarly, NDRRMC organizational structure and the operational coordination arrangements for DRR must be reviewed. In 2020, there is a unique opportunity to better integrate and promote stronger coherence between the DRR, CC and Environment policy frameworks with the development of the national DRR strategy, the preparation of the CC Bill, National Climate Change Plan and the development of the new environmental strategy.

3.1 Legislative and policy frameworks for disaster risk management

3.1.1 Existing Capacities

The Legislative and regulatory framework

The national regulatory and legislative frameworks for DRR is contained into the National Disasters Scheme (NDS); the National Disaster Risk Reduction and Management Act (2016), the Local Government Act and its amendment (2018) as well as various pieces of legislation such as the Policy and Planning Guidance (PPG) under the Planning Development Act (2004), the Building Code Act (2012) and most recently the Land Drainage Authority Act (2017) and National Migration Policy and Action Plan (2018).

In addition, there are two pieces of legislation that include provisions for DRR: the Mauritius Meteorological Services Act (2019) and the Climate Change Bill (2020 – under development).

Numerous sectoral legislations - animal diseases, dangerous chemical control, environment protection, forest and reserves, rivers and canals, fisheries and marine resource, ground water, public health to name a few - contain legal provisions for reducing risk. They are being analyzed in following chapters.

The **National Disasters Scheme** (revised 2015) was the main regulation that detailed agencies' roles and responsibilities in the management of various hazards: cyclone, tsunami, landslide, torrential rains and floods, high waves, earthquake and water crisis. It assigns the National Disaster Risk Reduction and Management Council ("the Council") under the chairmanship of the Minister of Environment and Sustainable

Development, to coordinate the DRR/M policies, and the DRR/M Strategic Framework and Plans developed by the National Disaster Risk of the Minister of Environment and Sustainable Development, to coordinate the DRR/M policies, and the DRR/M Strategic Framework and Plans developed by the National Disaster Risk Reduction and Management Centre (NDRRMC). Despite its usefulness, legal mandates and systems could not be solely determined in function of specific hazard and the Government identified the need to develop a proper Act to legislate DRR/M.

The **National Disaster Risk Reduction and Management Act (2016)** provides the foundation for disaster management in Mauritius. It is the legal basis for the institutional set up for DRR. It legislates the role of the National Disaster Risk Reduction and Management Council (“the Council”) and the NDRRMC. The DRR/M Act is strong in many respects. It provides great clarity on the structures to be activated in crisis situations such as the national crisis committee, the national emergency operations command (NEOC), the disaster response unit (within the mobile forces), the local DRR/M committees, and the local emergency operation command (LEOC). It also clarifies the institutional set up for Rodrigues. It includes legal provisions for the establishment of a multi-hazard early warning system and assigns clear responsibility to the Mauritius Meteorological Services to “develop and improve warnings and advisories systems for all-natural hazards affecting Mauritius and implement a national multi-hazard emergency alert system to provide accurate and timely advice to the public and key stakeholders”.

The **Local Government Act (2011)** gives local authorities – municipal council or district council-specific responsibilities relating to disaster risk reduction including: the responsibility for the issuance of building and land use permits (BLUP) and the enforcement of the building codes, as well as the responsibility for waste management, and the construction and maintenance of drains. For instance: “A Municipal City Council, Municipal Town Council or District Council shall have the power to authorize the construction of drains in privately owned land

where storm water accumulates and represents flooding risks”.

The **Local Government (Amendment) Act (2018)** makes provision pertaining to illegal constructions and development and giving more powers to local authorities. It also provides for the increase of penalties for illegal constructions and development; and mandatory pulling down orders by District Courts for illegal constructions and development.

The **Building Control Act (2012)** establishes basic requirements for buildings, including safety requirements, the duties of developers and design teams to obtain permits, and establishes a Building Control Advisory Council responsible to advise on permits and formulate policies. The building control act makes provisions for the elderly, disability and gender specific requirements. The building code however does not include specific provisions relating to the risk of flood, land slide or earthquake.

The **Land Drainage Authority Act (2017)** establishes the Land Drainage Authority with the responsibility to undertake an inventory and mapping of the drainage infrastructure, produce a flood risk map, implement a land drainage master plan; coordinate the construction of drainage infrastructure by the local authorities, public bodies and any other relevant stakeholder; and ensure upgrading and maintenance of the drainage infrastructure. Under the Land Drainage Authority, the government³⁶ is planning to introduce a Drainage Impact Assessment (DIA) as part of the EIA for Morcellement projects to assess, amongst other things, the potential of increased flood risk elsewhere.

The **Policy and Planning Guidances (PPG)** under the Planning Development Act (2004) are an important piece of the legal framework for DRR. Provisions for risk analysis / risk assessment exist in the PPG on Land Use Design Guidance (2004 - revised 2006), in the PPG on Hotels and integrated resort development (2011), or in the PPG on Development on slopping sites and landslide hazard areas (2016).

The **Mauritius Meteorological Services Act** (2019) establishes the Mauritius Meteorological Services as the “sole official authority responsible for providing climate services” and the “sole institution responsible for issuing warning” – including for non-meteorological events - for cyclone, torrential rains, tsunamis, high waves, strong winds. It also monitors tide gauges for the risk of storm surges.

The **Climate Change Bill** is still under preparation and is expected to be introduced in 2020.

The **National Migration Policy and Action Plan** (2018) led by the Prime Minister’s Office through an inter-ministerial Migration & Devel-

opment Steering Committee, highlights that in line with SIDS Accelerated Modalities of Action (SAMOA) Pathways, it is important to “establish and maintain, where necessary, governance and management structures for sustainable tourism and human settlements that bring together responsibilities and expertise in the areas of tourism, environment, health, disaster risk reduction, culture, land and housing, transportation, security and immigration, planning and development, and enabling a meaningful partnership approach among the public and private sectors and local communities”³⁷.

Key elements of the legislative framework for disaster risk reduction in the Republic of Mauritius

- Rivers and Canals (Amendment) Act (1868)
- The River Reserves (Control of Vegetation) Act, 1946
- Animal Diseases Act (1925)
- Public Health Act (1925)
- Citizenship Act (1968)
- Ground Water Act (1970)
- Immigration Act (1970)
- Central Water Authority Act (1971)
- Forests and Reserves Act (1983)
- Wildlife And National Park Act (1993)
- Non-citizen work permit regulation (1994)
- National Parks and Reserves Regulations (1996)
- Waste Water Management Authority Act (2000)
- The Environment Protection Act (2002)
- Dangerous Chemicals Control Act (2004)
- Planning Development Act (2004) making provisions for Policy and Planning Guidance (PPG)
- Fisheries & Marine Resources Act amended (2007)
- Declaration of Environment Laws amendment regulations (2009)
- Combatting Trafficking in Persons Act (2009)
- Piracy and Maritime Violence Act (2011)
- Local Government Act (2011)
- Building Control Act (2012)
- National Disasters Scheme (revised 2015)
- National Disaster Risk Reduction and Management Act (2016)
- Land Drainage Authority Act (2017)
- Economic Development Board Act (2017)
- Mauritius Fire Code (2017)
- Local Government (Amendment) Act (2018)
- Mauritius Meteorological Services Act (2019)

The Policy framework

Both the National Disasters Scheme and the DRR/M Act make provision for a “national disaster risk reduction and management policy” and a “National DRR/M Strategic Framework” to articulate the country vision and a “national plan” to include prevention and preparedness measures, operational arrangements, provisions for the integration of DRR at local level and the roles and responsibilities of every ministry, department, local authority and stakeholder.

Mauritius developed its guiding policy framework for climate change and disaster risk reduction in 2012³⁸.

The **DRR strategic framework and action plan** (2012) sets nine priorities for the country; amongst others: the prioritization of flood, coastal inundation and landslide hazard in addition to cyclone; provisions for coastal zone and marine eco-systems preservation, the need to implement a national platform for DRR, to develop a national DRR strategy, to adopt a spatial data infrastructure and to establish an emergency fund for response and recovery.

The **National Climate Change Adaptation Policy Framework** (2012) is a guiding framework to integrate and mainstream climate change into various sectors: water, agriculture and terrestrial ecosystem, fisheries and marine ecosystem and tourism and coastal management, with gender and health as cross-cutting. It includes a National Climate Change Adaptation Policy (time frame: 20 years), (2) a Climate Change Adaptation Strategy and Action Plan (time frame: 10 years), (3) a Climate Change Adaptation Investment Plan (time frame: 3 years). It covers the main island of Mauritius as well as Rodrigues. It includes provisions for DRR especially in relation to flood risk management.

The **Nationally Determined Contribution (NDC) Strategy** (2015) highlights smart use of natural resources (marine water, forests, coastal areas), waste management, and DRR as some of the measures to meet its adaptation and mitigation goals.

The **National Migration and Development Policy** (2018) highlights the need to strengthen data collection on migration and corresponding environmental impact, assess the role of migration for adaptation and devise methods to assess the effectiveness of disaster risk reduction or management strategies vis-à-vis immigrants (e.g. access to information, communication in a language they understand).

There are important **sectoral policies** that contain provisions for DRR such as the National Environmental Policy (2006), the national forestry policy (2006), the strategic plan for the food crop, livestock and forestry sectors (2016-2020), the tourism strategic plan (2018-2021), the national health sector strategy (2017-2021) or the National Biodiversity Strategy and Action Plan 2017-2025, which are presented in the following chapters.

A positive aspect of the legal DRR framework in Mauritius is that while the Local Government and its 2018 Amendment make provision pertaining to illegal construction and informal settlements, there are also some provisions for community consultation and safeguards in the relocation process. In 2004, a policy was introduced towards regularizing residential squatters and as such 2700 squatters have been regularized and now hold long term leases³⁹. Mauritius also established a squatter unit to intervene when squatters are in hardship and need to find a shelter and security. Squatters in vulnerable areas are regularly surveyed and relocation / contingency plans are prepared.

An emerging opportunity to strengthen the policy framework for DRR is the development of the national environment strategy 2020-2030 which should be closely aligned with the new Climate Change Bill.

KEY CHALLENGES

- Lack of clarity on accountability lines and clear obligations for sector ministries in prevention and mitigation.
- Ensuring coherence in the legal and policy framework across sectors (part of which is outdated).
- Lack of clear legislation and policy on land use planning and urban planning is a major impediment to DRR.
- The key to effective local institutional structures to support DRR is that they have clear legal mandates and authority, matched with dedicated resources and capacity. The DRR/M Act neither elaborates on the local government responsibilities (except for the outer islands) nor does it clarify the resources allocated for the fulfillment of their function.
- Overall the DRR/M Act remains vague on budget provisions for DRR: “every Ministry, Government department, local authority shall allocate an adequate budgetary provision for that purpose within its annual budgetary estimates.” It is unclear on responsibilities and resource allocation for post disaster recovery or contingency planning.

CAPACITY GAPS

A DRR/M law is dedicated to i) clarify institutional mandates; ii) establish the responsibility and accountability of relevant actors across sectors and levels – including local government responsibilities; iii) ensure allocation of dedicated resources, iv) ensure the participation of civil society and private sector in DRR. Ideally, it should also include legal provisions for risk assessment and regulate early warning.

While acknowledging its many strengths, there are some gaps in the DRR/M Act:

- The DRR/M Act does not elaborate on NDRRMC responsibilities and resources to perform the function of coordination of disaster prevention and mitigation efforts.
- The Act remains vague on responsibilities and accountabilities of sector ministries in the implementation of disaster prevention and mitigation activities. In this respect, the National Disasters Scheme is useful to specify roles and responsibilities of different government agencies and other actors but it is focused on hazard preparedness.
- The Act does not clarify the accountability lines between institutions: only local committees and NDRRMC Director General are expected to submit a report on the implementation of their DRR mandate.
- It does not include legal provisions for risk assessments or for guaranteeing citizens access to risk information.
- It does not set clear obligations for private sector actors.
- Like in most countries, the legal framework for DRR is contained in many sectoral legislations. There is however little evidence of coordination between sectors when developing the legislation. Environmental legislation appears to be administered separately from building and spatial planning regulations and also from DRR/M Act.
- The Town and Country Planning Act dating back to 1954 is still in force, while the planning and development Act enacted in 2004, which provides for a national spatial framework, is not yet fully implemented. Despite the urban outline schemes (PPG), there is no proper urban policy. In the absence of proper land use planning and urban planning, Mauritius miss a critical policy instrument⁴⁰ to enforce risk informed development.

- The Building Code reveals some gaps in relation to DRR and more specifically to the management of landslide, floods or earthquake hazards. Most importantly, responsibility for building code enforcement is held by the local government but insufficient capacity and resources at this level of government, combined with a lack of a ‘culture of compliance’ are identified as the two capacity gaps in implementation.
- The DRR Strategic Framework and Action Plan neither includes a financing strategy nor an M&E Framework.
- The policy framework for DRR is outdated: the DRR Strategic Framework and Action Plan, the National Environment policy and the National Climate Change Adaptation policy framework need to be updated taking into account the availability of new climate and disaster data, the development of the industry sector, and the changing nature of risk (pandemic, technological hazards, floods).

3.1.2 Recommendations



3.1.2.1 Build a coherent legislative and policy framework for disaster risk reduction.

3.1.2.1.1 NDRRMC and the Climate Change Division (CCD) to conduct a light legislative and policy review to identify DRR & CCA provisions in existing sector legislations and policies with the view to achieve consistency and inform the development of the Climate Change Act, the revision of Climate Change Policy Framework, the new Environmental Strategy 2020-2030 and the new National DRR Strategy.

3.1.2.1.2. The DRR/M Act & the CC Bill should have consequential amendments for each sector to clarify their obligation and accountability, including provisions for risk assessment / identification within each sector.

3.1.2.1.3 NDRRMC to contribute to the development of the Climate Change Bill & revision of Climate Change Policy Framework to harmonize provisions for DRR & CCA across sectors.

3.1.2.1.4 NDRRMC to contribute to the development of the new Environmental Strategy 2020-2023 (notably to explore the possibility to revise the EIA guideline to better integrate risk assessment).

3.1.2.1.5 Funding arrangements for DRR must be part of the legal framework, not only for annual recurrent expenditure, but also for emergency response, for recovery, and for investment in prevention across sectors and at local level (could be a % of annual sector budget allocation).

3.1.2.1.6 When there is a revision of the Building Code, DRR provisions must be included.

3.1.2.2 Conduct a nationwide public education campaign on applicable DRR & CCA related regulations.

3.1.2.2.1 NDRRMC together with the Land Drainage Authority (LDA) and the Climate Change Division (CCD) to implement a nationwide awareness / public education campaign on applicable DRR & CCA regulations.

3.1.2.2.2 NDRRMC, LDA and CCD to implement training of applicable legal frameworks across government institutions and local government entities.

3.1.2.2.3 NDRRMC, LDA and CCD to disseminate updated hazard zoning information as part of the education campaign on applicable regulations. Training for construction companies and builders can also improve compliance.

3.1.2.3 Develop a national DRR strategy and action plan that sets clear objectives and targets for sectors and actors.

3.1.2.3.1 NDRRMC should lead the development of a national DRR strategy and action plan that considers the ten principles highlighted in the Words Into Action Guide on Developing National Disaster Risk Reduction Strategies⁴¹ including: adopting a multi-hazard approach; promoting inclusion of vulnerable groups; building coherence with climate change, mainstreaming DRR within and across sectors; and promoting alignment between the central and local level DRR efforts.

3.1.2.3.2 The DRR Strategy must be contextualized to address the country specific risk faced by the population and economy of Mauritius. It must be informed by an analysis of population and

vulnerability trends and identification of major hazards including technological hazards (oil spills and chemicals) and biological hazards (pandemics).

3.1.2.3.3 The DRR Strategy must be reflective of the needs and demands of vulnerable groups such as disabled, migrants⁴², displaced people⁴³ and adoption of AU Kampala convention⁴⁴ singled headed women households, children, the elderly) as well as the needs and demands of private sector stakeholders (construction, tourism, ICT, trade, for instance). Gender equity and women empowerment must be a motor for the implementation of the DRR Strategy through: promoting the systematic production of gender disaggregated data on losses and vulnerabilities; the promotion of women participation in planning and prioritization processes; the design of gender sensitive risk informed strategies as well as gender sensitive preparedness, response and recovery plans.

3.1.2.3.4 The DRR Strategy should be developed through a series of inclusive consultations leading to the prioritization and sequencing of measures. Such process must involve all sector ministries, as well as a diverse representation of local authorities and public/private sector stakeholders. A functioning National Platform for DRR can serve as a consultative mechanism for the development of the DRM Strategy provided the membership includes both Emergency Response focal points as well as Directors of Planning from different sector ministries to cover aspects of prevention.

3.1.2.3.5 The DRR Strategy should be consistent with the NDS, the new climate change policy, and other policy frameworks for water, environment, coastal zone, agriculture and urban planning, to name a few.

3.1.2.3.6 The DRR Strategy shall include a clear M&E Framework linked to the Sendai Monitor and supported by a participatory M&E mechanism, as well as a communication plan and budget for its dissemination to sector and stakeholders.

3.1.2.4 Develop clear policy on land use and urban planning.

3.1.2.4.1 The new National Development Strategy must include land use planning and urban master plan. The implementation of such policy must be underpinned by the establishment of the National Spatial Data Infrastructure (NSDI). This is expected to foster an integrated approach to spatial planning between infrastructure development (roads, cities), drainage and environment protection.

3.2. Institutional framework and coordination mechanisms for DRM

3.2.1 Existing Capacities

Key Institutions

The **National Disaster Risk Reduction & Management Centre (NDRRMC)** has been administratively set up since 23 October 2013 after the deadly 2013 flash floods that affected Port Louis. It operates under the Ministry of Local Government and Disaster Risk Management⁴⁵. It acts as the institution for the planning, organizing, coordinating and monitoring of disaster risk reduction and management activities at all levels and is responsible to develop the national DRR Framework and Action Plan. In addition to the coordination role, NDRRMC plays an advisory role in the review of large development projects, and in some cases of building & land use permits (BLUP). It has a regular annual budget allocation for running costs.

NDRRMC organizational structure is still under development. It is divided into three directorates (Preparedness, Response and Recovery) and six sub-units: training & education (under recruitment), community mobilization (fully staffed); information management and early warning; NEOC; Engineering and Socio-Economic Recovery (both teams under recruitment). Out of the ten professional staff budgeted for, six were still under recruitment in 2019. Additionally, the three director positions are still vacant as well as the Director General position. To remedy

the lack of qualified staff, an ad hoc arrangement has been put in place: ten staff are seconded from the Police Forces to perform, de facto, some of NDRRMC functions. This includes the Deputy Commissioner of Police, acting as OIC for NDRRMC, until NDRRMC Director General is nominated. Additionally, NDRRMC has concluded a MOU with Mauritius Meteorological Services to have a full-time secondee to NDRRMC HQ renewed every year, which can be considered as a best practice. The team seconded from the Police Forces, under the leadership of the Deputy Commissioner of Police, has allowed the newly established NDRRMC to perform core functions of coordination of preparedness for response efforts (including through the organization of regular SIMEX), community education and awareness raising, as well as an advisory role to the whole-of-government on various issues such as review of EIA for morcellement projects and guidance to risk assessment initiatives. NDRRMC senior management played a lead role in elevating the issue of flood risk management as a top development priority. NDRRMC professional staff and seconded staff from the Police Forces are motivated and dedicated professionals who work under significant pressure in the absence of the professional positions not yet recruited.

Municipal and District Councils have legal responsibility to manage disaster risks at the local level. Through their planning division, health division and infrastructure division, local authorities are expected to play a critical role in DRR, notably through their authority to approve the building and land use permits. Local authorities are tasked to map flood prone areas, take preparedness and mitigation measures such as cleaning dams and rivers and conduct SIMEX. Since 2018, twelve (12) Coordinators have been appointed to advise district / municipality councils, which is a significant progress in the implementation of the Law enacted in 2016.

The Rodrigues Disaster Risk Reduction & Management Centre was also established, and Disaster Management Coordinators are appointed for Rodrigues and the outer islands St Brandon and Agalega. All Municipal and District Councils meet before the beginning of the cyclone season, to review their SOP, and to identify the preparedness and mitigation interventions such as cleaning of drainage system, repair of overall infrastructure and logistics.

The newly established **Land Drainage Authority** (LDA) is expected to play a critical role in the reduction of disaster risk, through the development and implementation of the land drainage master plan for the central and local drainage network. In particular the introduction of a Drainage Impact Assessment (DIA) - as part of the EIA for Morcellement projects – is expected to help assess and manage the risk of flood.

The **National Development Unit** (NDU) has an important mandate for DRR. It is expected to promote a more integrated approach to infrastructure planning (drains, roads etc.) working closely with the LDA and the Road Development Authority.

The **Mauritius Meteorological Services** plays a key role in DRR: it the “sole official authority responsible for providing climate services” and “for issuing warning” – including for non-meteorological events. It is a well-established and respected institution in Mauritius

staffed with about 100 meteorological experts. It used to fall under the Prime Minister Office and now falls under the Ministry of Local Government and Disaster Risk Management.

The **Climate Change Department** (CCD) established under the Ministry of Environment de facto also plays a role in the institutional set up for DRR. It produces climate adaptation policies - such as the National Climate Change Adaptation Policy Framework and the NDC Strategy – which contain provisions for DRR across different sectors, and it also maintains the Climate Change Information Centre which de facto centralizes important information for DRR.

Coordination mechanism for DRR

The Council is the main coordination mechanism for DRR in Mauritius. A Cabinet decision on 30th August 2013 established the National Disaster Risk Reduction and Management Council (the Council), which is now under the chairmanship of the Minister of Local Government and Disaster Risk Management⁴⁶.

The Council consists of the Minister (Chairperson), the Commissioner of Police, and representatives from the ministries of agriculture, civil service, education, external affairs, communications, finance, fisheries, gender equality, health, home affairs, housing and lands, local government, oceanography, public infrastructure, public utilities, social security, tourism, as well as the Chief Fire Officer, Mauritius Fire and Rescue Service, Mauritius Meteorological Services, Mauritius Ports Authority, Business Mauritius, the Mauritius Red Cross Society and Mauritius Council of Social Service. The Council is responsible to formulate the policy and ensure that DRR is integrated into sectoral policies. It meets at least once every month. It can set up advisory or technical sub committees to support its mission. The Council has met regularly since its establishment with relatively good representation of the sector ministries. It has served as a good consultation mechanism between the sector ministries.

Another coordination body that plays a role in ensuring synergies between sector interventions in DRR is the **Climate Change Committee** under the Ministry of Environment which gathers the different sectors and actors involved in the development and implementation of the climate change policy (cited above). The Ministry of Finance and Economic Planning and Development also coordinate a mechanism to coordinate resource mobilization efforts.

At the local level, **Local Disaster Risk Reduction & Management Committees** (LDRRMC) have been established within all Municipal and District Councils along with the appointment of Local Disaster Management Coordinators. In the localities visited, there is evidence that the committees have been meeting regularly under the leadership of the mayors.

There is overall a good level of integration between the central and local / municipal level. This is one notable strength of the DRR system in Mauritius.

KEY CHALLENGES

- NDRRMC organizational structure & anchoring limits its efficiency.
- Coordination between sectors and between state and non-state actors is not effective.

CAPACITY GAPS

- NDRRMC anchoring under the Ministry of Environment created a number of hindrances in the fulfillment of its functions. The fact that NDRRMC did not have a Permanent Secretary specifically appointed for Disaster Risk Reduction sometime caused administrative bottlenecks. The location of the national disaster management office has major implications for effective horizontal connections across ministries. Case studies clearly identify the advantages of locating the NDMO in the Prime Minister's or President's office. The primary advantage is that it provides the

NDMO with greater authority in coordinating and integrating the inputs from various line ministries. When the NDMO is located in a line ministry, it may not be able to guarantee the representation and participation of the other line ministries. In the case of Mauritius, it has been noted that sometimes the ministries are not represented at adequate decision-making level on the National Council. With the recent change of institutional anchoring of NDRRMC now falling under the Ministry of Local Government and Disaster Risk Management, it remains to be seen whether this will improve NDRRMC administrative and operational efficiency and increase its convening power.

- NDRRMC organizational structure is based on an ad-hoc arrangement relying on secondments from the Police forces. While this arrangement has allowed the institution to perform key functions during its first five years of existence, the transition to a full-fledged team of DRR/M professionals is now urgent.
- Linked to the above, NDRRMC has faced difficulties to recruit, attract and retain qualified professionals (for instance engineer, information management specialist with GIS expertise, or socio-economic recovery expert).
- With the renewed focus on risk reduction and prevention in line with the Sendai Framework for Disaster Risk Reduction, NDRRMC organizational structure is not aligned with the Sendai Framework and is not conducive for the implementation of a Disaster Risk Reduction strategy. The division into three directorates (Preparedness, Response and Recovery) does not provide leadership and operational support to the coordination of prevention and mitigation efforts.

- The information management and early warning unit must serve all directorates and should therefore be a transversal function. While NDRRMC is expected to play a key role of monitoring and oversight of the implementation of the Act and National DRR Strategy across the whole of government, it is unclear where the monitoring function seats in the organigram. In this respect, the review of the TOR for some of the professional positions reveals that in some cases the functions and responsibilities could be further clarified.
- While the coordination arrangements for disaster response - the NEOC- have proven to be efficient (please refer to Priority IV on Preparedness for Response & Recovery), there is no operational body for the overall coordination of DRR efforts across sectors. The National Council plays a critical role as a national high-level oversight and consultative body to consult and build consensus on measures to address critical threats. There remains the need to establish a national multi-stakeholders DRR platform with an operational mandate in DRR to jointly implement a workplan. It was also noted that the sub-committee on flooding established under the National Council was not given enough authority.
- Additionally, coordination and collaboration between NDRRMC and CCD is limited. Other institutions with a mandate in infrastructure planning are not always working holistically – for instance NDU and RDA.

3.2.2 Recommendations



3.2.2.1 Establish NDRRMC organizational structure with a full-fledged team of DRR/M professionals.

3.2.2.1.1 Review NDRRMC organigram in line with the Sendai Framework. Several organizational structures can be considered. While there is no blue print, it is recommended to consider merging preparedness & response, as well as mitigation, prevention and recovery. It is also recommended to establish a separate unit for information management and training that reports directly to the Director General and provides services to both preparedness, response, prevention and recovery directorates.

One option under consideration could be: A Director General supported by a Deputy Director General who oversees:

- One direction of prevention, mitigation and recovery.
- One direction of preparedness and emergency operations / response.
- One direction of policy, planning and monitoring, international relations.
- One unit of information management & training reporting directly to the DG.
- One unit of human resource, finance and procurement.

3.2.2.1.2 Review TOR in line with the revised organizational structure.

3.2.2.1.3 Recruit full team of professional including at least 30% women by the end of 2020 to support the implementation of the new national DRR strategy. If the organization is not able to attract qualified personnel, recruit junior staff and invest in capacity development of junior staff over a three-year period.

3.2.2.1.4 Make a modest but recurrent budgetary provision for a 3-year capacity development programme for NDRRMC staff at all levels, including the 12 local coordinators, providing equal opportunities to men and women for training (including training abroad).

3.2.2.2 Establish a national multi-stakeholder DRR platform.

Establish a national DRR platform (or equivalent) as an operational body to implement decisions made by the National Council. The national platform will be responsible to prepare the annual workplan to implement the national DRR strategy and follow up / report on its implementation to the Council. Such multi-sectoral body should be linked to CC technical committee through joint meetings, and joint work plan activities.

3.3 Financing for DRM

3.3.1 Existing Capacities

The DRR/M Act (2016) remains vague on budget provisions for DRR: “every Ministry, Government department, local authority shall allocate an adequate budgetary provision for that purpose within its annual budgetary estimates.” It is unclear on responsibilities and resource allocation for post disaster recovery or contingency planning. It does not clarify the resource allocation for local government authorities to fulfill their functions.

The NDRRMC receives an annual budget allocation and has a budget for the recruitment of the team of 12 professionals.

While the Act does not make specific provisions for DRR, the Government set up the National Environment Fund (NEF), a yearly revolving fund that offers funding allocation to projects submitted by various sector ministries or local government institutions in the area of climate and disaster risk management and environment preservation.

The NEF, established in 2002, was revamped in 2018-2019 as an attempt by the Government to consolidate under Ministry of Finance and Economic Planning and Development different budget allocations for resilient development and risk reduction. Initially 2 billion rupees were allocated for risk reduction, that have been distributed to:

- Construct drain infrastructure in more than 25 flood prone regions across the country.
- Equip the 12 Local Authorities to undertake maintenance and cleaning of drains, rivers and canals.
- Acquire the high resolution and aerial 3D imagery Digital Elevation Model to update the flood map and prepare the Land Drainage Master Plan.
- Rehabilitate, protect and manage beaches, lagoons and coral reefs.
- Carry out the Clean Up Mauritius and Embellishment Campaign – “Moris Nou Zoli Pei” .
- Expand Solid Waste Management facilities.
- Undertake Landslide Management initiatives.

While the government has not yet implemented a DRR budget tracking tool, Mauritius is one of the few countries to have carried out two estimates of public environment and climate expenditures. Following the preliminary Public Environment Expenditure Review (PEER)

in 2015, the Environment and Climate Expenditures completed in 2018 indicate that expenditure tagged to climate change adaptation and mitigation represent about 7% of Government Expenditure with 77% of these expenditures earmarked to adaptation.

3.3.2 Recommendations



3.3.2.1 Increase percentage of allocation of NEF funding to local government to enable the councils to fulfill their DRR functions. Consider blended financing modalities under the NEF to attract private sector CSR financing.

3.3.2.2 Institutionalize climate change / DRR expenditure review methodology to track environment and climate expenditures through a customized training program for key line ministries.



“Public and private investment in disaster risk prevention and reduction through structural and non-structural measures are essential to enhance the economic, social, health and cultural resilience of persons, communities, countries and their assets, as well as the environment. These can be drivers of innovation, growth and job creation. Such measures are cost-effective and instrumental to save lives, prevent and reduce losses and ensure effective recovery and rehabilitation”

Sendai Framework Priority for Action III.





4. INVESTING IN DISASTER RISK REDUCTION FOR RESILIENCE.





Photo: Dan Freeman

4.1. TOURISM.

When we assess DRM capacities in the tourism sector, what are we considering?

- Awareness (government, private sector, population)
- Legal and policy framework assigning roles and responsibilities
- Organizational and institutional arrangements effectiveness
- Coordination (inter-ministerial, central-local, public-private, DRR-CC)
- Financing

Introduction:

The tourism sector has been growing steadily over the past decades increasing from 1,8% of GDP in 1976, to 8,5% of GDP in 2018, representing 10% of total employment. This sector is one of the principal drivers of growth.

In 2018, around 1.4 million tourists visited Mauritius, and the government foresees this number to increase to over 2 million arrivals by 2030⁴⁷.

Notwithstanding, the government's vision on the sector is highly at peril as the tourism sector is also one of the most vulnerable sectors to impacts of disasters and climate change. The net contraction of GDP growth in 2020 as a result of the global COVID-19 pandemic on the sector and the MVWakashio environmental emergency are stark reminders of this vulnerability.

Tourism is principally centred around the coastal zone, with 90% of the hotels in Mauritius disposing over a beachfront⁴⁸. Therefore, major hazards are cyclones, storm surge and floods. The likelihood of the occurrence of these hazards is projected to increase with growing impact of climate change on the coastal zone of Mauritius. For instance, increased ocean temperature led to an increase in coral bleaching. The reefs around the main island of Mauritius have been functioning as natural wave breakers, but with reduced capacity, storm surges have a stronger impact on the coastal zone and beach erosion is increasing.

For example, over the past decade some of the beaches in Mauritius have lost over 10m of their width⁴⁹ which poses an increasing threat to Mauritius as an attractive island tourism destination.

Another consequence of increasing climate change impact is reflected in seasonality changes with higher precipitation patterns in the first four months of the year which has led to an increased flood risk as to a reduced number of tourist arrivals in the same period.

In addition, apart from being increasingly exposed to disaster risk, the strong growth of the tourism infrastructure in the coastal zone has led to a significant increase of flood risk in some parts of the island where former natural drainage systems have been impacted by unregulated infrastructure development.

4.1.1 Institutional & policy framework for DRM in tourism

4.1.1.1 Existing Capacities

Institutional framework

The institutional set up for disaster risk reduction and climate change adaptation relevant for the tourism sector stretches over several ministries, committees and coordination bodies.

The former **Ministry of Social Security, National Solidarity, and Environment and Sustainable Development, now Ministry of Environment, Solid Waste Management and Climate Change** was the largest institution working on Disaster Risk Reduction (DRR)⁵⁰ and Climate Change Adaptation (CCA) programming relevant for the tourism sector.

Under the new Ministry of Environment, Solid Waste Management and Climate Change (MoESC), it is specifically the Climate Change division as well as the division for Integrated Coastal Zone Management (ICZM) working on coastal zone erosion and coral reef restoration.

In 2002, the **ICZM Committee**, with representatives of different Ministries, parastatal bodies, NGOS and Private sector was established under the Environment Protection Act (2002) in order to strengthen the coordination between different actors related to activities in the coastal zone of Mauritius. Under ICZM Committee, different subcommittee such as the sub-committee on coral reefs have been formed to ensure coordination and follow up of measures between all involved stakeholders. Despite this good practice, it was highlighted that the cooperation between different departments remains to be strengthened.

Other committees of relevance for DRR in the tourism sector within MoE are:

- **Environmental Impact Assessment (EIA) Committee**

Under the EIA committee, all requests for an EIA license are reviewed, which are needed for all tourism development within 11km of the coastal zone (EPA 2002, amended 2008).

- **EIA/Preliminary Environmental Report (PER) Monitoring Committee**

This committee is responsible for EIA follow up to ensure implementation of mitigation measures that are proposed in the EIAs to keep environmental impact to a minimum.

The **Beach Authority** under the MoESC is responsible for the management and control of all public beaches in Mauritius and Rodrigues, amongst others for the implementation of projects relating to the conservation and protection of the environment of public beaches⁵¹. Similar to the committees and subcommittees under the MoESC, the Beach Authority disposes over a management board representing government stakeholders from all relevant ministries, which governs the work of the authority.

The **Ministry of Tourism** in Mauritius is responsible for the development of a longer-term vision of the tourism sector. Under the current strategy, its objective is to propel the tourism sector as a key engine of growth and to maintain Mauritius as a top-class tourism destination. Furthermore, the ministry's task is to promote an increased awareness for sustainability across the tourism sector. Representatives of the ministry are participating in the ICZM Committee and are included in the review process of EIAs.

The ministry however does currently not have any direct responsibility for DRR and CCA policy development and implementation. Within the ministry, stakeholders dispose over an understanding of the current climate threats and hazards affecting the tourism sector but currently, this does not translate into risk sensitive policy making within the ministry.

It is only the **Mauritius Tourism Authority** that disposes over predefined responsibilities laid out in the National Disaster Scheme (2006) to alert and coordinate response efforts in tourism areas in case of cyclones, storm surge, etc.

The **Ministry of Housing and Land Use Planning** responsible for land management develops the Planning Policy Guidance (PPG) for infrastructure planning across Mauritius. The work of the ministry is of strong relevance for DRR in the tourism sector, especially the issuance of building codes within the coastal zone.

Policy and legislative framework

The **Three-Year Strategic Plan 2018-2021** as well the **Tourism Strategic Plan 2018-21** re-iterate the importance of the tourism sector for the national economy and acknowledge the growing exposure of the sector to natural hazards as well as climate change impact. Whereas the three-year strategic plan provides insight into the overall vision of the government across all sectors in Mauritius, the Tourism Strategic Plan sets up key performance indicators and goals that are to be implemented in the three year period and acknowledges that there is a

growing threat of especially tidal waves and surges and that the deterioration of coral reefs may reduce the attractiveness of the destination in the longer term.

It is emphasized that it is of critical to find a balance between economic development and environmental sustainability in order to meet the challenges of growing climate change impact and recommends coastal rehabilitation as well as re-engineering as the principal measures to be taken.

However, the strategy remains silent on how to address disaster and climate change risk and does not propose any measures to be taken to reduce exposure of the sector to climate and disaster risk. Furthermore, the current tourism strategic plan 2018-2021 needs stronger coherence in a sense that it recognizes the challenges posed by coastal zone erosion and increased risk of natural hazards but Strategic Objective 12 on beach erosion neither contains a budget nor key performance indicators for success measurement of implementation.

Mauritius' **Third National Contribution to the UNFCCC** provides a very detailed information of the climate risk the tourism sector in the island is exposed to. Current legislation as well as policy within the tourism sector is only to a very limited extend informed by the document.

While there are limitations in policy guidance on DRR within the tourism sector, there is other legislation, policies and measures that influence or contribute to the resilience of the tourism sector:

A best practice example for DRR in the tourism sector is the enforcement of the Supplementary Policy and Planning Guidance (PPG)⁵² in the coastal zone developed under the Ministry of Housing and Land Use Planning. All buildings constructed within the coastal zone are obligated to adhere of a setback of currently 30m from the High-Water Mark (HWM) (Initially the setback has been set at 15m, but was adapted in 2014).

Through the implementation of the building code, tourism infrastructure exposure to coastal flooding case of storm surge is actively reduced. A project carried out by Japan International Cooperation Agency (JICA) recommended to adjust the HWM in some of places with severe coastal erosion to 45m.

All infrastructure development within 11km width of the coastal zone of Mauritius needs to undertake an **Environmental Impact Assessment (EIA)** in order to obtain a building permit, as stipulated in the Environmental Protection Act (EPA) (2008). The EPA thereby also applies to hotel developments and the EIA can be regarded as an effective tool to mitigate risk emanating from infrastructure development in the coastal zone, such as flooding due to unsustainable building practices. Against this perspective stands the observation that there are severe gaps in the enforcement of the EPA and the EIA approval process for tourism developments in the coastal zone in particular. Currently the review period for EIAs is limited to 21 days, which leaves local authorities with limited capacities only very little time to properly review EIAs, for instance for hotel development in the coastal zone. Furthermore, several instances have been reported in which an EIA has been approved for tourism infrastructure development despite articulated concerns of civil society groups regarding the effectiveness of the proposed mitigation measures.

Most recently however, increased risk of flooding due to infrastructure developments destroying the natural drainage system of the island for instance, is being recognized within the government. In the recent published guidance for Drainage Impact Assessments, it is stipulated that infrastructure development, the sealing of ground surfaces and a reduction in surface area for percolation and ground water infiltration has importantly contributed to the increased flood risk⁵³. As a large proportion of the infrastructure in the coastal zone can be traced back to the tourism industry, recent legislative changes, reflecting the institutional awareness for flood risk, have a direct implication for the tourism sector

and could potentially contribute to a reduction of flood risk amplified by the tourism sector.

The DIA guidance is unclear as to whether the newly introduced Drainage Impact Assessment under the EIA will be applied retroactively to all existing hotel infrastructure in the coastal zone and demand retrofitting measures as well as which unit will ensure the implementation of the mitigation measures.

KEY CHALLENGES

- Policy coherence between the objectives of rapid expansion to attract up to 2 million visitors and sustainable tourism development.
- Awareness and understanding of the inter-linked threats that multiple hazards pose to the tourism sector.
- Enforcement of legislation for infrastructure development in the coastal zone.

CAPACITY GAPS

- Within the Ministry of Tourism, there is limited capacity for long term risk sensitive policy & legislation making as well as analysis of exposure of the sector to multiple risks.
- In terms of EIA review for coastal zone development there is limited capacity within the local authorities to properly review the EIA requests within the 21-day period defined in the Environmental Protection Act (2008) in order to avoid unsustainable tourism infrastructure development and to include concerns expressed during the review period.
- Within the EIA/ Monitoring Committee there is limited capacity to follow up on the effective implementation of mitigation measures for infrastructure development in the tourism sector.

4.1.1.2 Recommendations



4.1.1.2.1 Develop a risk informed tourism legislation and policy guidelines.

4.1.1.2.1.1 Take the opportunity of the current revision of the Tourism Authority Act (2006) to develop a risk informed tourism legislation that reflects the increasing impact of climate change and increasing risk of natural hazards on the sector. Such a legislation could include provisions for the private sector to report loss and damage data and/or introduce provisions for an active private sector participation in mitigation measures. Similarly, the Ministry of Tourism should also take advantage of the formulation of legislation to regulate the tourism sector proposed in the Tourism Strategic Plan to further integrate DRR and CC.

4.1.1.2.1.2 Streamline projected sector growth and associated tourism infrastructure development and adopt a risk informed tourism strategy that takes into account the increasing pressure on the coastal zone under the current tourism infrastructure development.

4.1.1.2.1.3 For the Tourism Strategic Plan 2022-2025, insert Strategic Objectives for DRR and CAA and corresponding key performance indicators and provide budgetary space.

4.1.1.2.2 Strengthen enforcement of the Environmental Protection Act (2008).

4.1.1.2.2.1 Increase substantively human and technical capacities to review EIA for coastal zone development to avoid unsustainable tourism infrastructure.

4.1.1.2.2.2 Further strengthen capacities at the local level to enable an informed review of EIAs within local authorities by increasing staff as well as providing training opportunities to enable well informed EIA review.

4.1.1.2.2.3 Under the current DIA within the EIA, provide clear legislative guidance and consider applying DIA as a separate process for all private sector tourism entities in order to enable a comprehensive mapping of flood risk in the coastal zone, also to enable a clear assessment of the contribution of the tourism sector to flood risk in the coastal zone.

4.1.1.2.2.4 Strengthen capacities of the EIA/PER Monitoring Division within MoESC

to review proposed Environmental Management Plans regarding their effectiveness and to ensure follow up on their implementation.

4.1.1.2.2.5 Strengthen the current High-Water Mark (HWM) setback guidelines for construction in the coastal zone by increasing the setback distance in areas with increased beach erosion.

4.1.1.2.3 Strengthen the institutional capacity of the Ministry of Tourism/ the tourism authority to guide the sector in risk informed tourism.

4.1.1.2.3.1 Create a DRM unit within the Ministry of Tourism.

4.1.1.2.3.2 Provide regular training opportunities in collaboration with the NDRRMC to relevant staff of the Ministry of Tourism on DRR and CCA.

4.1.2 Access to information on disaster risk and climate change

4.1.2.1 Existing Capacities

All relevant risk information for the tourism sector are produced by other entities than the Ministry of Tourism. The Mauritius Meteorological Services (MMS) produce information for cyclones and torrential rains. Impact of climate change on this extreme weather events and climate change projections regarding the impact on the coastal zone are done by the Climate Change Division within the Ministry of Environment and the Minister of Blue Economy, Marine Resources, Fisheries and Shipping.

The data generated by the MMS are used by the private sector for early preparedness actions at hotels and resorts that follow strict Standard Operations Procedures (SOPs) in close collaboration with the Tourism Authority and NDRRMC. Risk information however are currently not used by the Ministry of Tourism for a risk sensitive policy making and there are currently no legal or policy provisions for risk analysis that would for instance require the private tourism sector to collect data regarding climate and disaster impact on its infrastructure.

The private sector hotel groups make active use of impact scenarios for the coastal zone to take

informed investment decisions on location of hotels, resorts etc. along the coast line. By using current climate change impact projections, the private sector is able to calculate if the construction of a new hotel complex at the coastline will be able to generate sufficient return that outweighs the projects costs until i.e. coastal zone erosion is threatening the hotel infrastructure and is thereby one of the few sectors that seems to be effectively using climate change projections.

Overall, there is a lack of comprehensive analysis and data that provide the public sector with an appropriate picture of the risk exposure to disasters and climate change, as well as analysis that provides data regarding the amplification of risks by the tourism sector.

Loss and damage data, the costs for beach restoration done by some of the large hotel groups as well as costs created due to destruction of assets caused by natural hazards are not available as there is currently no legislative obligation for the private tourism sector to collect these data and make them available to the public.

KEY CHALLENGES

- Limited analysis and data collection regarding climate change and disaster impact on the tourism sector.
- Current legislation provides only limited obligations for loss and damage data collection by private tourism sector.
- There is limited capacity within the Ministry of Tourism for risk informed policy making requiring the tourism sector to systematically collect and share data on current climate and disaster impact on their investments, especially within the coastal zone.

CAPACITY GAPS

- There is limited capacity within the Ministry of Tourism to collect and provide data on the current impact of climate change and disaster on the tourism sector.
- Within the Tourism Authority there limited capacity to undertake a comprehensive mapping of all tourism sites, including guesthouses and small hotels regarding their exposure to multiple risks.

4.1.2.2 Recommendations



4.1.2.2.1 Strengthen the capacity within the Ministry of Tourism for data collection on climate change and disaster impact on the tourism sector.

4.1.2.2.1.1 Train Ministry of Tourism to collect and record data on disaster and climate related losses and damages from public and private tourism actors.

4.1.2.2.1.2 Develop appropriate legislation obliging the private sector to share these data with the Ministry of Tourism, using the current revision of the Tourism Authority Act.

4.1.2.2.2 Strengthen the capacity of the Tourism Authority to undertake a mapping of all tourism accommodation sites and their exposure to disaster and climate risk.

4.1.2.2.2.1 Include regular mapping of tourism accommodation sites and assets in the revision of the Tourism Authority Act (2008).

4.1.2.2.2.2 Organize training courses for Staff of the Tourism Authority on GIS mapping to identify risk exposed tourism accommodation sites and identify practical preparedness and risk mitigation measures in collaboration with NDRRMC.

4.1.2.2.3. Include funding allocation for DRR in the Coastal Zone & Tourism chapter of the National Adaptation Plan.

4.1.3 Investment in Disaster Resilience

4.1.3.1 Existing Capacities

Public investment into resilient tourism through coastal zone rehabilitation projects are principally channeled through MoESC. Figures on private sector financing for disaster resilience investment are not available. There are numerous promising small scale disaster resilience building initiatives in the tourism sector which could be scaled up by the Ministry of Tourism.

In view of the special exposure of the tourism sector to disaster risk and climate change impact investment in coral reef restoration has proven to be an effective DRR measure to reduce impact of storm surges and resulting floods on the tourism infrastructure. Coral bleaching has increased over the past two decades from 10 percent in 1998 to 24 per cent in 2004 and more than 50 per cent in 2009⁵⁵. The current rate of coral bleaching has led to over 70% of the existing reef structure being affected by bleaching, which threatens the capacity of the reefs to function as natural wave breakers.

Mauritius disposes over 150km of coastal reefs that enclose around 243 km² of lagoon areas. So far, these coral reefs have been exemplarily for ecosystems-based disaster risk reduction since they function as natural wave breakers during storm surges and therefore protect the coastal zone from further erosion.

The DRR capacity of coral reefs has been recognized by the ICZM Committee as well as various NGOs and various small-scale initiatives aiming at restoring and protecting existing coral reefs as well as 'farming' new corals are being implemented, such as in Lagon Bleu, Albion, Pointe aux Sables and Trou aux Biches in Mauritius and at Graviers and Hermitage in Rodrigues.

Cultural heritage preservation is another important investment to consider in building tourism sector resilience. Historical heritage sites like the Apravasi Ghat and the Le Morne UNESCO world heritage site are critical to the social fabric and can potentially make a significant contribution to the tourism economy. Cultural heritage assets must therefore be considered as part of the overall DRR strategy of the tourism sector.

In 2018, MoESC, Land Drainage Authority (LDA), NDRRMC, Ministry of Tourism, and Mauritius Meteorological Services have launched the Adapt' Action Programme in partnership with Agence française de développement (AFD) i that will conduct climate change vulnerability assessments to inform action plans and policies for flood risk management and coastal management/tourism.

KEY CHALLENGES

- The current approach towards integrated coastal zone management remains project based, and there is no common project database in place that provides an overview of the different projects that are being implemented or were implemented that would allow for a clear picture of efforts currently being undertaken across sectors.
- Current efforts targeting the coastal zone, apart from coral restoration efforts are rather reactive and concentrated on repeated revetment of the beaches which reflects a short-term investment logic.
- Within the Ministry of Tourism, there is currently no financing that is directed towards investments for resilient tourism.
- Cultural heritage sites are currently not considered in DRR plans and strategies.

CAPACITY GAPS

- There is currently no cost-benefit analysis available that highlights the longer-term savings/benefits from investment into DRR measures such as coral restoration against the cost of reactive measures such as repeated beach revetment in order to incentivize prioritization of DRR investment at the national level.
- Within the Ministry of Tourism, there is no budget line for DRR and CCA that could enable a more systematized approach of investment into resilience of the tourism sector.

4.1.4 Preparedness for response & recovery

4.1.4.1 Existing Capacities

The tourism sector in Mauritius disposes over a strong preparedness infrastructure:

- The National Disaster Risk Management Act clearly defines the role of the Mauritius Tourism authority in case a warning for cyclones, tsunami, etc. is issued by the Mauritius Meteorological Services.
- Hotels carry out regular Simulation Exercises with the staff and guests and dispose over clearly defined Community of Practices (CP).
- There is a strong collaboration between AHRIM representing the hotel sector and the NDRRMC through the development and use of Standard Operation Procedures.
- There is a limited level of preparedness within the sector for large scale disasters. The existing preparedness mechanism and tools such evacuation plan is tailored to normal disasters. The sector is not prepared for big disaster such a tsunami which requires a massive evacuation.
- Weak in post-disaster assessment. Limited standard tools and systematic collection of damages and losses. These tasks are done in a more individual way, initiative and methodology. Therefore, it is difficult to the NDRRMC to consolidate information and data related to damages from tourism actors.

However, during discussions with the private sector, it became evident that the effectiveness of the CPs and the state of preparedness in general has not yet been tested in extreme events such as Very Intense Tropical Cyclones⁵⁴ or Tsunamis, simply due to the fact that Mauritius was spared from direct passage/ direct hits from extreme weather events in the last decades (last direct passage of a cyclone over Mauritius dates back to 1979: Intense Cyclone Claudette⁵⁵).

Furthermore, it needs to be considered that while the preparedness infrastructure for large hotels is very strong, there exists currently no data to what extend preparedness measures are implemented in small scale hotels and guesthouses.

KEY CHALLENGES

- In Mauritius, 60% of tourists are accommodated by hotels reporting to AHRIM. The remaining tourists either choose to stay in guesthouses or private houses. The situation of preparedness activities is unknown for the guesthouse and private house sites.
- There is limited capacity within the Tourism Authority to assess the preparedness activities at guesthouses and small hotels.
- Limited registration capacities to enable GoM and states of origin (or family, community, civil society, where practical and appropriate) to contact tourists in the event of a crisis and provide them with information on the extend of the disaster and available assistance.
- Within NDRRMC there are no contingency plans targeting the tourism sector that consider large scale disasters such as tsunamis.
- Under the National Disaster Scheme (2006) it is the Tourism Authority that is supposed to coordinate the preparedness measures for the Tourism Sector, but is not known to what extend this mandate is reflect in appropriate institutional capacity.

CAPACITY GAPS

4.1.4.2 Recommendations



4.1.4.2.1 Develop preparedness plans for massive evacuation of tourists.

4.1.4.2.1.1 Build the most probable scenario requiring a massive evacuation.

4.1.4.2.1.2 Identify the areas at risk related to this scenario.

4.1.4.2.1.3 Establish a user-friendly, online registration system for tourists and other foreign nationals in Mauritius.

4.1.4.2.1.4 Estimate the potential number of people to be evacuated.

4.1.4.2.1.5 Assess the existing capacities (equipment, human resources, coordination, etc) that can be mobilized for the evacuation, and complete the gaps.

4.1.4.2.1.6 Conduct a regular SI-MEX related to massive evacuation.

4.1.4.2.2 Develop/adopt standardized tools to record disaster losses and damages caused to the tourism sector with support from NDRRMC.

4.1.4.2.2.1 Establish a list of data requirement related to the nature of damages and losses.

4.1.4.2.2.2 Define methodology of data collection.

4.1.4.2.2.3 Identify capacities and means for data collection.

4.1.4.2.3 Increase capacities of the Tourism Authority to adequately coordinate disaster preparedness efforts at the hotel level.

4.1.4.2.3.1 Together with NDRRMC, assess current capacities and needs in view of increased tourist arrival and take into account future sector growth.

4.1.4.2.3.2 Provide adequate training in minimum preparedness actions to staff of the Tourism Authority.





Photo: United Nations Country Team Mauritius

4.2. AGRICULTURE.

When we assess DRM capacities in the agriculture sector, what are we considering?

- Awareness (government, private sector, population)
- Legal and policy framework assigning roles and responsibilities
- Organizational and institutional arrangements effectiveness
- Coordination (inter-ministerial, central-local, public-private, DRR-CC)
- Financing

Introduction:

While the contribution of the agriculture sector to the national economy is relatively small, reaching 4% in 2017, it represented 40% of export earnings on the same year. Main agriculture sub-sectors include the non-sugarcane and sugarcane crop production, livestock, fisheries, aquaculture and forestry⁵⁶. The sector is conditioned by geographical, climatic, economic and social factors. The geographical location of the island in the tropical cyclone belt of the South Western Indian Ocean, makes it highly exposed to tropical cyclones, torrential rains, and flash floods.

Moreover, changing climate patterns, a narrow domestic market, scarcity of arable land as well as high costs of production are the major constraints in expansion of agriculture production. Overall, the contribution of agriculture sector to the national economy is relatively small and reached 4% in 2017. The majority of the staple crops - rice and wheat - is imported. The national agricultural food sector currently meets 23% of the local food consumption requirements. Nevertheless, in the rural areas it continues to be the main source of livelihood and involves about 12,500 small-scale farmers⁵⁷.

Table I: Recent agriculture sectors' development indicators⁵⁸

Share of arable land used for agriculture	44%
• Share of land used for sugarcane production within the total arable land used for agriculture	90%
Share of agriculture in total employment	7.2%
Share of women employed in agriculture	13%
Share of agriculture contribution to GDP	4%
• Share of livestock and poultry within agriculture contribution to GDP	20%
• Share of fisheries within agriculture contribution to GDP	11%
• Share of sugarcane and tea within agriculture contribution to GDP	18%
• Share of food crops and fruits within agriculture contribution to GDP	40%
• Share of government services within agriculture contribution to GDP	11%

In the past decade, the agriculture sector has been undergoing significant transformation, mainly driven by the changes in the export prices for sugarcane in 2005 and the end of preferential access to markets of the European Union under

the Lomé Convention leading to the overall decrease in sugarcane production, which resulted in significant land-use changes of former arable land.

Impact of disasters to agriculture sector

The agriculture sector of Mauritius is regularly affected by disasters caused by natural hazards including hydro-meteorological (cyclones, torrential rains, flash floods, storm surges, water scarcity), biological (animal disease, crop pest and disease, invasive species), and geological (landslide, tsunami).

The sector is also affected by man-made disasters (fire), and financial crises (price volatility). Based on the data available, hydro-meteorological hazards such as cyclones and flash floods incur the highest economic losses across the sector (e.g. Cyclone Dina in 2002 caused ≈ 50 million EUR losses in sugarcane production⁵⁹).

Table 2: Impact of fire hazard to sugarcane industry

‘Uncontrolled fires resulting from the burning of sugar cane fields - as a common practice to ease manual harvesting for cane cutters – have been on the increase over the last decade and accounted for 2.3 percent of combined economic losses as well as 29.9 percent of nationally reported losses in terms of mortality between 1990 and 2014. This practice is now less and less common.’

Two types of burning of sugar cane fields exists in Mauritius:

- (i) Planned / controlled cane burning – which represents 17-19 % of the total area under cane cultivation; and
- (ii) Accidental / criminal cane burning – which represents 4 to 5 % of the total area under cane cultivation.

The Strategic Environmental Assessment of the Multi-Annual Adaptation Strategy Action Plan (2006-2015) highlighted cane burning as an important nuisance factor due to the coarse particulate matter and the fly ash rather than an air pollution. The native biodiversity is negatively impacted as well as the high temperature affects micro-organisms in the top layer of soil.

In the case of controlled cane burning, the impact of burning is mitigated by adopting of a code of practice for cane burning. This is further re-enforced by regulations made by the Minister under section 7 (3) and section 27 of the Mauritius Fire and Rescue Service Act 2013.

In the case of accidental/ criminal cane burning, the impact of cane burning is mitigated by preventive approaches and emergency response plans under the guidance and control of different authorities and institutions namely Police force , Fire Services , Ministry of Agro-Industry & Food Security, MCI, Sugar Insurance Fund Board, Irrigation Authority, Mauritius Sugar Producers Association, Sugar Corporate sector, planters and the collaboration of the general public. Furthermore, the legislation under section 346(3) of the Criminal Code Act provides that any person found guilty of this act is liable to an imprisonment up to 20 years.

Source: Mauritius Cane Industry Authority, 2019

4.2.1 Institutional & policy framework for DRM in agriculture

The management of the non-sugarcane crops, livestock and forestry is the core responsibility of the Ministry of Agro-Industry & Food Security, whereas the Minister of Blue Economy, Marine Resources, Fisheries and Shipping is responsible for management of fisheries and aquaculture (see Annex 1). Since 2012, as part of the agriculture sector reform, the sugarcane sub-sector management was delegated to the Mauritius Cane Industry Authority, which is one of the para-statal bodies⁶⁰ of the Ministry of Agro-Industry & Food Security⁶¹.

The agriculture sector policy and planning documents recognize the risks caused by changing climate and natural hazards. Even though not titled as adaptation, disaster risk reduction and

management, many relevant measures are mainstreamed in the national policy and planning documents (see Annex 2 and 3).

However, the lack of consolidated priorities for DRR within and across agriculture sub-sectors might create an obstacle in communication, reporting and resource mobilization for the sector, both at national and international levels. A clear definition of agriculture sector specific DRR priorities would strengthen the sector's presence within the National Disaster Risk Reduction platform and improve cooperation with the National Disaster Risk Reduction and Management Centre (NDRRMC)

4.2.1.1 Recommendations



4.2.1.1.1 Establish an approach for collecting recent research, measures, developments across sugarcane, other crops, livestock, fisheries and forestry sectors for internal awareness, information sharing and advocacy purposes. The four priority areas of SFDRR can be used as possible structure (1. Risk data and information 2. Risk governance and institutions 3. Investment in resilience 4. Emergency preparedness, recovery and rehabilitation).

4.2.1.1.2 Regularly conduct short semi-technical briefings with the National Disaster Risk Reduction and Management Centre to inform and update them on the recent DRR developments in sugarcane, other crops, livestock, fisheries and forestry.

4.2.1.1.3 Integrate the defined set/plan of priority adaptation and DRR measures into the Strategic plan for the food crop, livestock and forestry sectors, which expires in 2020 and other sub-sector plans for sugarcane, other crops, livestock, fisheries and forestry.

4.2.1.1.4 Integrate the defined set/plan of priority DRR measures for sugarcane, other crops, livestock, fisheries and forestry, in the National Determined Contribution, as well reporting mechanisms under the United Nations Convention to Combat Desertification, United Nations Framework Convention on Climate Change, Sendai Framework for Disaster Risk Reduction.

4.2.2. Access to information on disaster risk and climate change

The agriculture sector institutions are acting as both recipients and producers of risk information. Depending on the type of data, the collection, analysis, dissemination and storage is conducted by specific technical divisions. The agriculture sector acts as a recipient in case of hydro-meteorological and geological risk data, and as producer, in case of data related to biological and financial risks.

as well as monthly agro-climatic bulletins with information on past weather and other relevant parameters. The analysis of weather and climate data, and dissemination of climate services to farmers is done by the Food and Agricultural Research and Extension Institute (FAREI). The dissemination is a well-established practice, done by the extension officers (at least 2 in each agricultural region) as well as information technologies/media.

The Mauritius Meteorological services are the core provider of weather and climate services to agriculture sector. It includes 24 hours observed and forecasted weather agriculture-region wide⁶²,

Table 3: Dissemination of agro-climatic services for farmers through mobile

In 2019, the Ministry of Agro-Industry & Food Security, the Ministry of Technology, Communication and Innovation, in collaboration with the FAREI, launched the mobile application 'Mokaro' which serves as a tool for farmers and planters to better plan their agricultural activities, and manage resources, as well as minimize the losses⁶³.

'Mokaro' is an open source application, which advises farmers on future plantation, irrigation and other field activities following crop analysis and assessment. Farmers receive information related to climatic conditions of Mauritius, current agricultural news and alerts that may be useful for agricultural production and management. In the future, the application will inform planters on activities of wide range of agriculture sectors stakeholders where they may be invited to participate. The tool will also enable planters to locate and communicate directly to suppliers and service providers of fertilisers and pesticides as and when required.

The agriculture sector acts as a producer of risk information in case of biological and financial risk data. The surveillance systems are established for early detection of plant pest and diseases, animal diseases, toxic fishes, as well as alien and invasive species of animals and plants (see Table 4).

Major weaknesses regarding the production, analysis and timely dissemination of risk information became evident during the outbreak of Foot and Mouth Disease in Mauritius and Rodrigues Islands in 2016.

The significant extend of the outbreak was principally caused by delays in early diagnosis and adoption of control measures to stop the disease from spreading⁶⁴. Emergency support from the regional Indian Ocean Commission epidemiology experts was requested and received and in-depth investigation⁶⁵ carried out. Principal recommendations included strengthening the surveillance measures to minimise risks of entry of diseases in Mauritius and Rodrigues. In 2019, the government has endorsed the Nation-

al Biosecurity Plan which outlines prevention, preparedness and contingency measures for sugarcane, other crop and livestock sectors. Overall, the follow-up actions improved the overall preparedness to biological risks. The surveillance and early action capacities in Rodrigues, however, remain low due to lack of staffing and technical expertise, which makes the island particularly vulnerable to possible future calamities.

Table 4: Overview of surveillance systems in agriculture sector

Crop production – National Plant Protection Office (NPPO) provides services in Laboratory Analysis and Diagnostics for Pest and Disease identification. The service is equipped for detection and identification of diseases caused by pathogenic fungi, virus, bacteria, nematodes and non-parasitic diseases associated with mineral deficiencies. Control measures are recommended wherever applicable. NPPO also conducts onsite inspection and diagnosis service of plant health at location whenever required. For the moment, services provided by NPPO appear to be sufficient to avoid any major outbreaks in the crop production systems.

Livestock – Veterinary Services Division conducts Laboratory diagnosis of diseases at the Animal Health Laboratory. Breeders of cattle, pigs and poultry may bring material(s) or specimen(s) (e.g. sick or dead birds for investigation during office hours. The Division of Veterinary Services provides 24 hour-free service to all breeders of animals of economic importance. Consequently, all sick animals are treated with free veterinary drugs administered by Veterinary Officers of the Division.

Fisheries – Albion Research Centre conducts number of surveillance activities including screening of potentially toxic fishes and harmful microalgae/ ecological surveys to monitor and collect baseline data on coral reefs and water quality for the conservation of aquatic biodiversity and the marine environment/monitoring of existing fishing activities (including fishing vessels) and fish stock assessment (artisanal, banks and tuna).

Forestry - National Parks and Conservation Service, Forestry Service conducts surveillance activities to monitor/control the invasive/alien species of animal and plants and leads native forest conservation activities.

The data on damages and losses from disasters is regularly collected by the sub-sectoral institutions (e.g. in sugarcane subsector it is done by the Mauritius Cane Industry Authority, other crops – FAREI). The approaches for data collection differ from sub-sector to sub-sector, and

consequently, lead to different data storage. At the moment, there is no unified database for damages and losses in agriculture sector, hence, it is difficult to analyse and/or compare the frequency and impact of disaster over time periods.

4.2.2.1 Recommendations



4.2.2.1.1 Improve the technical capacities of epidemiology experts (particularly based in Rodrigues) through regional trainings, seminars, conferences on animal health and crop pest and diseases risk management.

4.2.2.1.2 Conduct (regular) sensitization campaign to inform and train farmers on responsibilities and risk management strategies of controlled sugarcane burning.

4.2.2.1.3 Build on the existing Agriculture Production and Market Information system to regularly provide an overview of targeted export markets.

4.2.2.1.4 Conduct a review of existing approaches to collection and analysis of data on damages and losses from natural disasters used for sugarcane, other crops, livestock, forestry and fisheries.

4.2.2.1.5 Develop a unified method for collection and analysis of data on damages and losses in agriculture sector.

4.2.3. Investment in disaster resilience

The agriculture sector benefits from well-established and functioning social protection mechanisms activated in case of crises and disaster. It includes the sugarcane insurance, crop insurance scheme, fishermen compensation schemes.

For example, a parastatal agency - the Mauritius Sugar Insurance Fund (MSIF) provides protection to the island's sugar farmers against losses from cyclones. This programme has gradually taken on the coverage of other risks. For example, fire and excessive rain were added in 1974, and losses from yellow spot disease (only in conditions of excessive rain) in 1984. The programme has also developed a sophisticated method for rewarding growers whose claims experience has been good for the insurer. All growers are placed, for each insurance/growing season, somewhere on a 100 point scale. Their position on this scale determines the level of premium to be paid, and the indemnity level they will receive in the event of

a claim for that insurance period.

The scale is dynamic, with movements up and down being dictated by claims experience⁶⁶.

The Fishermen Welfare Fund has developed and manages a sophisticated social protection package for fishermen, which well-integrated gender issue and creates environment where both, female and male fishers are protected from losing their livelihood in case of a crisis. Bad Weather Allowance is a form of social aid to assist fishers who have not been able to go fishing due to bad weather conditions (declared using wind speed and roughness of sea as criteria). The total amount paid for the last four years amounts to around Rs 260 million⁶⁷. Apart from that, the fund is introducing a special scheme which can be activated to compensate fishermen for damages caused by the natural disaster event.

4.2.3.1 Recommendations



4.2.3.1.1 Introduce the insurance scheme for the livestock sector to compensate farmers in case of biosecurity or other risks occur.

4.2.3.1.2 Pilot identified heat tolerant varieties and, based on the results, assess feasibility for upscaling.

4.2.4. Preparedness for response and recovery

The agriculture sector is well integrated into the national early warning system. It is receiving the early warning information for cyclones, storm surges, tsunamis, floods, extreme temperatures, from the Mauritius Meteorological Service. For instance, the early warning for tropical cyclones consist of four phases that are issues depending on the risk and time factor: Each agriculture sub-sector institutions are responsible for emergency preparedness planning in their respec-

tive sub-sector. Biosecurity contingency plans are developed for crop, sugarcane and livestock sub-sectors, and the contingency plan for extreme events is in place for the fisheries sector. At the national level, the simulation exercise for biosecurity emergency were conducted in 2005, and not repeated since. It might be useful to replicate this exercise in the nearest future for agriculture sectors, in order to test and proof the current emergency preparedness capacities.

4.2.4.1 Recommendations



4.2.4.1.1 Explore opportunities of using the existing mobile application 'Mokaro' for disseminating early warning information related to floods, cyclones, tsunamis.

4.2.4.1.2 Establish information system for monitoring and early warning of financial risks (e.g. commodity price change at the export markets).

4.2.4.1.3 Conduct inventory and monitoring of available emergency stocks for sugarcane, other crops, livestock, forestry and fisheries sub-sectors (e.g. seeds, vaccines, first aid kits).

4.2.4.1.4 Create a depository of available emergency preparedness/contingency plans for sugarcane, other crops, livestock, forestry and fisheries.

4.2.4.1.5 Conduct simulation exercise for biosecurity emergency, e.g. livestock disease outbreak, involving both, Mauritius and Rodrigues islands.





Photo: United Nations Country Team Mauritius

4.3. ENVIRONMENT.

When we assess DRM capacities in the environment sector, what are we considering?

- Awareness (government, private sector, population)
- Legal and policy framework assigning roles and responsibilities
- Effectiveness of organizational and institutional arrangements
- Coordination (inter-ministerial, central-local, public-private, DRR-CC)
- Financing

Overview:

It is not only the increasing impact of climate change which amplifies existing risks such as floods, but also changing consumption patterns affecting waste management systems, that put additional pressure on the environment of Mauritius and increase risk of biological hazards. Invasive species and land use changes negatively affect ecosystems in a way that reduces their capacity to provide important services to communities like food and protection from natural hazards. While laws and regulations are cognizant of some hazards such as floods, DRR is not specifically addressed or a comprehensive approach to multi-hazard analysis adopted. Most environment laws and policies are outdated and consequently do not reflect emerging threats posed by climate change. DRR related investments within the environment are very projected and mostly externally financed.

Introduction:

Understanding of ecosystem's coping mechanisms, responses and reactions to natural hazards will be critical for decision and policy makers aiming to plan for reducing the vulnerability of Mauritian resources and its people. As a tropical island, whose economy is intricately linked with the environment (agriculture, tourism, trade, etc) the role of the coastal eco-systems to the Mauritian productive sector and population wellbeing cannot be emphasized enough. According to IUCN, healthy ecosystems have important roles to play in reducing the risks of disasters through multiple ways. Healthy and resilient ecosystems such as wetlands, forests and coastal areas, including man

groves, cannot only reduce vulnerability to hazards by supporting livelihoods but also act as physical barriers that reduce physical exposure to hazards and support adaptation.

The biodiversity of flora and fauna in Mauritius is quite unique, with endemic species. But is also fragile, with some of these species extinct or near extinction. Mauritius is plagued by plant and animal invasive species that continue to threaten the existence of native species. Preservation of forests is vital for the protection of eco-system. At present, Mauritius has 14,918.0 hectares terrestrial protected areas and 13,953 hectares marine protected areas. Furthermore, Mauritius occupies 300km² of coral reefs, 243km² of lagoon area and 2.3 million km of Exclusive Economic Zone. The Island also has a total of 199,163m² of mangroves. In 2017, total forest area was 47,066 hectares (25% of total land area) and only 2% of these forests are in pristine condition. In comparison, sugar cane plantations occupy 39% (72,000 hectares), while built-up areas occupy another 25% (46,500 hectares). According to Statistics Mauritius, the land occupied by sugarcane, tea plantations and forestry continue to decrease while that of built-up areas, other agricultural activities, infrastructure, and inland water resource systems are going up. Fresh water supply of Mauritius consists of 92 rivers, 11 man-made lakes, two natural lakes, and ground water distributed into seven ground water basins. This ecosystem service provides water for domestic use, irrigation, as well hydropower.

There are many risks facing the water sector, driven largely by an increase in water requirements by industries and the tourism sector. Pollution of the aquifers by sewage, industrial waste water, refuse disposal and by poor agri-

Major Hazards and Vulnerability

The environment is being impacted by climate change. Sea level rise and elevated sea temperature cause increased coastal erosion as well as coral bleaching (it is noted that 75% of all coral colonies are partially or totally bleached). In addition, fires and biological hazards are substantive risks for the environment. According to a HazMat waste inventory study in 2011, 17,000-18,000 tons of hazmat is generated in Mauritius. Land-use changes where the natural environment is giving way to property development, tourism and agricultural production increase risk of flooding. Invasive species also weaken the capacity of forests to withstand cyclonic conditions

cultural practices is now widely acknowledged. In 2018, the Island generated over 540,000 tons of solid wastes, 95% of which are land-filled.

as the invasive species are not adapted to the Mauritian weather systems. Due to increasing population, economic growth and changing consumption patterns, waste management systems are coming under pressure, which are creating hazards and risks for the environment such as oil spills and hazardous waste. The impact of hazards on the terrestrial and marine environment combined with environmental degradation (largely from land use changes) reduces the capacity of these ecosystems to provide services to communities like food and protection from natural hazards. It creates high vulnerability of the people most dependent on the environment, particularly smallholder farmers and fisherfolk.

4.3.1 Institutional & policy framework for DRM in environment

4.3.1.1 Existing capacities

Regulatory and Policy Framework

Mauritius has ratified several global policy instruments that guide environmental management, DRR and climate change adaptation and mitigation. These include the Convention on Biological Diversity (CBD); the Kyoto Protocol; the UN Convention to Combat Desertification (UNCCD); Ramsar Convention on Wetlands; Paris Climate Agreement; and Sendai Framework for Disaster Risk Reduction, among others.

At the national level, Mauritius has a comprehensive regulatory and policy framework for the preservation of the environment and ecosystems, DRR and climate change. The Environment Protection (Amendment) Act 2008 is the overarching law in relation to natural resource management and the environment.

A further amendment of the Declaration of Environmental Laws was enacted in 2009. Environmental Protection Regulations were stipulated in 2013, and included the applications for Preliminary Environment Report (PER) Approval and Environment Impact Assessment (EIA) License. Mauritius developed its intended Nationally Determined Contribution (NDC) under the Paris Agreement in 2015, which highlight smart use of natural resources, waste management, and DRR as some of the measures to meet its adaptation and mitigation goals. The Climate Change Division within the Ministry of Environment plans to develop a Climate Change Bill and update the 2012 National Adaptation Plan (NAP), both of which present an opportune moment for an integrated approach to DRR, adaptation and environmental management.

It is clear that Mauritius has a comprehensive and robust policy framework on the environment, when compared to other countries in the region. However, while these laws and regulations are cognizant of some hazards such as floods, the Environment Protection Act, for example, does not specifically address DRR or adopt a comprehensive approach to multi-hazard analysis. Most environment laws and policies are outdated and consequently do not reflect emerging threats posed by climate change. Further to this, the integration of DRR and sustainable management of the environment into other sectoral policies is limited and, in some cases, almost in conflict with environmental protection objectives. For example, the current Mauritius Tourism Strategic Plan 2018-2021 makes passing mention of threats posed by disaster and climate change but does not propose any action to mitigate or consider of these threats. Furthermore, analysis of how the proposed plans to increase the number of tourists will impact on the environment and potential increase of vulnerability of the sector to disasters and climate change is also missing.

Enforcement of environment policies is observed as limited by the NGO community, private sector and to a lesser extent by the public sector. It was highlighted, for example, that the application of the EIA could be circumvented allowing property development in environmentally sensitive areas. The Minister of Environment, Solid Waste Management and Climate Change⁶⁸ is hopeful that the proposed climate change bill could address some of the challenges observed in the enforcement of DRR and adaptation objectives. Similarly, the enforcement of policies on environmentally sensitive areas (ESA) without governing laws is problematic. For example, terrestrial ESAs may be classified as on state or private land. The Ministry of Housing and Land Use Planning exercises authority over state lands but does not necessarily manage ESAs in order to protect them. It was also noted that information on zoned ESAs is not accessible by the public and private sector, which further creates tension with other sectors. In December 2019, the Assises de l'Environnement a multi-stakeholder platform to discuss current

and emerging challenges and develop a three-year masterplan that will feed into the National Environmental Strategy for 2020-2030⁶⁹. One of the major challenges identified included the implementation of the legislative framework and the enforcement of existing laws.

The migration policy highlights the importance that under the right circumstances, migration may be considered as an adaptation strategy to environment and climate change, allowing people moving to areas where they are less exposed to climate and environment related hazards. The root causes of migration related to environment and climate change need to be addressed to ensure a better quality of life and sustainable livelihoods of vulnerable communities, including migrants, in line with the objectives of the SDGs. An increased focus on addressing the root environmental and climate drivers of migration will ensure avoiding forced forms of migration and displacement, so people who are not willing to migrate can continue their lives in their communities of origin.

Laws:

- Environment Protection Act 2002
- Fisheries and Marine Resources Act
- Beach Authority Act 2002
- Marine Zone Act 2005
- Climate Change Bill (under proposal)
- Forests and Reserves Act (Amended) 2003

Policies and Strategies:

- National Environmental Policy 2006
- National Environment Strategy
- Mauritius Biodiversity Strategy and Action Plan 2017- 2025
- Guideline and reports for EIA
- National Forestry Policy
- National Maurice Ile Durable 2011 Green Paper. Towards a National Policy for a Sustainable Mauritius.
- Strategy and Action Plan for a New Solid Waste and Resources Recovery System for Mauritius and Project Preparation Support for the Implementation of the Strategy.

Institutional Capacities for DRR under the Environment Sector

The Department of Environment within the MoE leads the work on environmental legislation and standards, climate change, integrated coastal zone management, pollution prevention and control and environment statistics. It also hosts the NDRRMC as well as the Beach Authority, responsible for the control and management of public beaches in Mauritius and Rodrigues, and the Solid Waste Management Division (SWMD) responsible for the protection of the environment and public health through a proper management of solid and hazardous waste. SWMD is in a public private partnership with the company Polyeco. The operating of all these departments/ under one umbrella ministry, allows for easy coordination and integration of DRR. Institutions such as Albion Research Centre, under the Ministry of Blue Economy, Marine Resources, Fisheries and Shipping, manage the sustainable management of living marine resources, while the Forestry Services and National Parks and Conservation Services, under the Ministry of Agro-Industry & Food Security, support biodiversity conservation. The Water Resources Unit, under the Ministry of Energy and Public Utilities, is responsible for integrated water resources management. The NGO sector is highly engaged in environmental protection especially within marine resources. They work with communities to create awareness on the importance of protecting the environment. They are also key

partners in the propagation coral and mangrove seedlings to rehabilitate degraded areas. There is also a strong culture for advocacy and lobbying with the government especially in relation to property development in environmentally sensitive areas.

The MoE is the largest ministry in Mauritius, which brings its own challenges in terms of coordination, policy coherence and getting the attention of a sitting minister and principle secretaries to push for policy and regulatory adoption or enforcement of laws. It was also noted that while NGOs are involved in natural resource management at the community level, their engagement in the development and review of laws and policies related to the environment could be improved. Clarity of mandates of the above institutions to conduct risks assessment, integration of DRR, response and mitigation measures remains a challenge.

KEY CHALLENGES

- Laws and regulations do not specifically address DRR and climate change impacts or adopt a comprehensive approach to multi-hazard analysis.
- Enforcement of environment policies, such as EIAs as part of the EPA.
- Coordination and policy coherence across different divisions and departments within MoE.

4.3.1.2 Recommendations

Policy Frameworks

4.3.1.2.1 Support the explicit mainstreaming of DRR/CCA into sectoral policies to be developed in the coming years.

4.3.1.2.2 Utilise the development of the National Environment Strategy 2020-2030, CC bill and the update of the NAP to bring coherence to adaptation and DRR objectives and interventions at the national and sectoral level.



4.3.1.2.3 Strengthen data collection on migration and environmental impact, and assess the role of migration for adaptation.

4.3.1.2.4 Make public all environmentally sensitive areas with a presumption against any development in all ESA.

4.3.1.2.5 The long-awaited ESA bill should be tabled for approval which would cater for the lack of the actual laws to protect these fragile and valued ecosystems, in order to maintain their DRR functions.

Institutional

3.3.1.2.6 Increase awareness raising of the interlinkages between DRR/CCA/ environment management and different sectors. The CC Division and NDRRMC should jointly hold bi-annual training with different sectors for an in-depth sector understanding threats posed by disasters and climate change and measures for risk reduction.

3.3.1.2.7 Develop environment stakeholders' (forestry services, national parks and Conservation Services), skills for integrating DRR/adaptation in environment plans and programs.

3.3.1.2.8 Joint annual planning and progress review between the Environment Department and NDRRMC, with inputs from NGOs working in the environment sector to bring coherence to the integration of DRR/CC into development and risk analysis. This joint planning would also help clarify which government entities are responsible for what.

4.3.2 Access to information on disaster risk and climate change

4.3.2.1 Existing capacities

Some hazard maps have been generated over the past decade that have implication on the environment. These include beach erosion maps; flood maps being developed by the Land Drainage Authority; and landslides mapping by the Ministry of National Infrastructure and Community Development supported by the Government of Japan as well as tsunami risk maps on which early warning and response plan are based. The MoE is also responsible for the identification and zoning of environmentally sensitive areas, which can be key for creating physical barriers against hazards. The production of the yearly Digest of Environment Statistics by the Statistics Mauritius is a good practice that keeps track of the changes to the environment including precipitation, land-use changes, changes to flora and fauna populations, some of the major hazards such as cyclones, among other data.

Some element of risk analysis is conducted in relation to major development projects through

the environment impact assessments (EIA) mechanism as listed under the Fifth Schedule of the Environment Protection Act (EPA). Such assessments help to foresee and address potential adverse impact on the environment, enhance the positive impacts and promote sustainable development⁷⁰. While Mauritius faces some challenges in administering this mechanism effectively, the public can challenge the EIA Committee's recommendations, which have resulted in cancellation of some development projects.

As highlighted above, generation of risk maps is done by different entities within the government machinery without a coordinated approach. This results in fragmentation of data with no central reservoir to enable easy access to risk maps and information, promote a holistic analysis of risk and for risk-informed development. For example, the flood risk maps being developed by the Land Drainage Authority could also benefit the environment, agriculture, infrastructure, water and other sectors.

Discussions with the Mauritius Meteorological Services and the Department of Environment highlighted the capacity challenges they face in climate change modelling and scenario building, which limits the countries understanding of its vulnerability and could hinder preparedness for future climate change and variability as well as disasters. Contributing to the challenge above, is lack of technical skills, particularly GIS expertise, across key sectors to produce, use and apply risk information. It was also noted that where such risk analyses are done, these are under the domain of external/international specialists who leave without capacitating the local staff.

The EIA is a good mechanism for understanding the impact of large-scale projects on the environment. However, EIAs have, almost to some extent, replaced risk analysis. For example, when asked how DRR is integrated into the tourism sector, EIA was mentioned as the main vehicle for achieving this. Such response could also underlie a limited awareness of how DRR interfaces different sectors and the different between EIAs and sectoral risk analysis. The EIA is narrow in scope and limited to large-scale investments.

KEY CHALLENGES

- Fragmentation of data with no central reservoir to enable easy access to risk maps and information.
- Accurate climate change modelling and scenario building.
- EIA is currently seen as appropriate risk analysis.

CAPACITY GAPS

- Lack of technical skills, particularly GIS expertise, across key sectors to produce, use and apply risk information.
- Limited awareness of how DRR interfaces different sectors and the different between EIAs and sectoral risk analysis.

4.3.2.2 Recommendations



4.3.2.2.1 Strengthen capacity of MoE Climate Change Division on climate modelling for enhanced adaptation planning and public awareness raising activities on climate risks.

4.3.2.2.2 Strengthen GIS expertise across sector to allow for hazards profile, risk maps and analysis. The Ministry of Housing and Land Use Planning, which holds GIS expertise could provide in-house training for other relevant ministries.

4.3.2.2.3 Enhance understanding and monitoring of CC impacts on biodiversity and eco-systems, through the establishment of a proper eco-system-based information system, collecting information from government entities, NGOs, communities and academia.

4.3.2.2.4 Expand the scope of EIA, to include multi-hazards analysis beyond floods and coastal erosion.

4.3.3 Investment in disaster resilience

4.3.3.1 Existing Capacities

To meet its commitments under the NDCs, Mauritius needs an investment of \$4 billion for adaptation and \$1.5 billion for mitigation measures. Furthermore, Mauritius is a high-income country, which means it does not qualify to access some adaptation vertical global funds and ODA in general. However, a 2011-2018 analysis done by a UN Partnership for Action on Green Economy⁷¹ in partnership with the Ministry of Finance and Economic Planning and Development, shows encouraging results⁷². For the period 2017-2018, the total Environment Expenditure was Rs10.33 billion, equivalent to 7.02 % of the Total Government Expenditure (TGE) of Rs147.2 billion, and 2.16 % of GDP, (up from 2.1% in 2014) amounting to Rs 478.7 billion. Of this, total Climate Expenditure was Rs10.28 billion, representing 6.99 % of TGE and 2.15 % of GDP. While it is hard to ascertain how much of the climate expenditure can be attributed to DRR, it is noted that the lion's share of the climate expenditure went towards adaptation Rs7.7 billion representing 77%. Additionally, in 2013 adaptation expenditure peaked at 79% due to increase in expenditure on drainage systems as part of disaster risk mitigation.

The Government of Mauritius manages a National Environment Fund (NEF), which seems to be an amalgamation of national and external

environment and climate change funds⁷³. The primary focus of the NEF speaks largely to DRR. The proposed activities include the construction and maintenance of drainage infrastructure, development of flood risk maps, finalization of land drainage master plan, rehabilitation and protection of beaches, lagoons and coral reefs and improved capacity for fire response. Several development partners have also invested substantially in DRR, mostly through adaptation and biodiversity projects, namely Japan, Indian Ocean Commission, UNDP, EU and others.

While Mauritius is among the leading countries in investing in environment, an analysis at the sector level indicates a project-based approach, where most investments are made through adaptation and biodiversity projects funded by development partners mentioned above, rather than dedicated sectoral public financing. With the exception of the Department of Environment, particularly the ICZM and Beach Authority, most ministries mentioned NGO or UN projects as their sector investment in DRR. This investment paucity at the sectoral level could be explained by the skewed allocation of 65% of public adaptation resources to two ministries only; the Ministry of Energy and Public Utilities (51%) and Ministry of Agro-Industry & Food Security⁷⁴.

4.3.3.2 Recommendations

4.3.3.2.1 Increase the coverage of climate public investment and expenditure beyond the land and drainage authority and energy sectors to other sectors, through annual budget allocation and annual budget tagging of DRR/CCA to each sector.



4.3.3.2.2 Use the NAP as an entry point for integrated DRR/CCA/environment financing and the Climate Change Bill for mandatory DRR/CCA budget allocation.

4.3.4 Preparedness for response and recovery

4.3.4.1 Existing Capacities

In line with its strategy of economic diversification, Mauritius has developed its textile manufacturing, its medical and pharmaceutical services and ICT services, and it has become a major trade hub. The increasing use of complex chemicals in various sectors results in the production of complex hazardous waste that make the country vulnerable to environmental contamination accidents, and fires. Additionally being in the vicinity of one of the world's busiest shipping routes, the country is at a high risk of oil spills. Forest fires caused in the sugar cane plantations are another significant environmental hazard but tend to decrease in occurrence in recent years.

In response to this, Mauritius has quite a robust preparedness system for some environmental emergencies. Mauritius was one of the first African countries to finalize in 1990 an oil spill contingency plan, which was revised in 2003, however not updated since then. Upgrading the oil spill contingency plan would need to consider increasing capacity in containment equipment, increasing capacity in maritime surveillance, and improving regional protocols in maritime cooperation/environmental emergencies management.

Hazardous waste management in Mauritius is constrained due to limited options for their treatment locally and data gaps. Despite progress in formulation of the hazardous waste regulations, their enforcement has been hampered owing to capacity constraints. Regarding management of hazardous materials, this function is contracted out as well to a Polyeco which is well equipped and upholds international standards for hazardous waste management as well as adhering to protocols for preparedness for emergencies.

Regarding forest fires, it was noted by the Forestry Services that forestry fire breaks are in place and maintained although this undertaking is quite expensive and not always done across all forests. In accordance with the Mauritius Forestry Policy, the Forestry Services conducts periodic monitoring of pathogens and insects responsible for large-scale damage to forests. There are also some efforts to restore indigenous forests with native tree species, which are more resistant to cyclonic conditions, but progress on this is quite slow.

There are no national contingency plans for environmental emergencies. The national oil spill contingency plan is outdated, there is no contingency planning for marine resources such as coral reefs, forest fires, forests diseases, etc. Furthermore, an analysis of frequency and extent of damage caused by recurring disasters to the environment is not systematically recorded across all key resources. Similarly, there is no policy guidance and tools for long-term impact of hazardous waste discharge on the environment. E.g. impact of leachate on water resources and other aquatic species. And as observed in other sectors, there are no harmonized tools and limited national expertise for assessing the impact that disasters have on the environment and communities dependent on them

KEY CHALLENGES

- Lack of contingency plans for environmental emergencies.
- No systematic recording of disasters as well as associated loss and damage accounting.

CAPACITY GAPS

- Lack of policy guidance and tools for long-term impact of hazardous waste discharge on the environment as well as affected communities.
- HazMat Wastes is not yet collected at the household level. Sorting at source of hazmat at household level is proposed by the SWMD for the FY 2019/2020.
- La Chaumiere Storage Facility for HazMat Waste does not accept radio-active, explosive, infectious healthcare and e-waste.

4.3.4.2 Recommendations



4.3.4.2.1 Through trainings, enhance capacity to conduct disaster impact assessments to enhance national understanding of disaster impacts on the environment to guide preparedness for environmental emergencies.

4.3.4.2.2 Linked to above, adopt harmonized tools for impact assessments such the PDNA tools.

4.3.4.2.3 Pursue Partnership with international services and networks for best practices (UNEP, EU Civil Protection, etc) in preparedness for environmental disasters.

4.3.4.2.4 Increase SWMD capacity in terms of organisation and management of sorting hazmat wastes at household level as well as with the transportation to and storage of hazmat wastes in the Polyeco Hazmat Storage Facility.





Photo: GEF SGP UNDP Mauritius

4.4. WATER & SANITATION.

When we assess DRM capacities in the WASH sector, what are we considering?

- Awareness (government, private sector, population)
- Legal and policy framework assigning roles and responsibilities
- Organizational and institutional arrangements effectiveness
- Coordination (inter-ministerial, central-local, public-private, DRR-CC)
- Financing mechanisms
- Operation and Maintenance of the facilities
- Type and condition of the drinking water and sanitation facilities
- Monitoring of the drinking water and waste water treatment utilities
- Type and condition of drainage system as drainage and waste water system are combined

Overview:

The Water, Sanitation and Hygiene sector is vulnerable to hydrometeorological hazards such as drought and floods, biological hazards such as water borne and gastro-intestinal diseases, as well as technological hazards such as industrial accidents causing risk of water contamination. The obsolescence of part of the waterpipe network together with the open sewage system increases the risk of drinking water contamination at times of floods or torrential rains. Due to Climate Change, the need for sufficient drinking water becomes more acute as droughts are projected to increase⁷⁵.

The Ministry of Energy and Public Utilities and the two main agencies, the Central Water Authority and the Wastewater Management Authority have competent skilled personnel for the management of the water supply and wastewater infrastructure. The policy framework for sewage, wastewater and solid waste is relatively strong. Enforcement and control of the existing regulations remains a challenge. National capacities need to be strengthened in relation to control of industrial wastewater/ Sustainable waste water treatment plants must be considered.

Introduction:

Mauritius is faced with a steadily growing demand for water, while the impact of climate change on water resources is being felt and expected to increase in the future. The Master

Plan for Water Resources identified the need to ensure an additional 224 Mm³ of water mobilization capacity by 2050 to be able to increase the present water use from 500 Mm³/year to 724 Mm³/year⁷⁶.

In Mauritius, water contamination risk has the potential to negatively influence the public health status of communities due to a combination of factors and serious deficiencies within the infrastructure network for drinking water distribution, discharge of waste water and drainage systems.

About 99.7% of the population has access to piped water supply. However, as the waterpipes were constructed in the 1960s almost 50% of the water is lost due to leakage and at times of flooding waste water and toxic liquids can seep in, contaminating the drinking water and causing serious health problems for the inhabitants. Challenges in this area concern primarily the need for network refurbishment and maintenance to reduce the currently very high rate of leakage.

Only 29% of the total population is connected to the sewerage network mainly situated in the Urban Corridor. The rural and coastal areas rely on septic tanks, which need to be pumped out by private contractors. With each flood, the septic tanks tend to overflow, causing contamination of the living environment and infiltrating the damaged drinking water pipelines.

Tariffs for drinking water and waste water facilities are far below the international standards and the Ministry of Energy and Public Utilities, the Central Water Authority as well as the Waste Water Management Authority do not dispose over sufficient financial means to repair the drinking water infrastructure and to connect all households to waste water pipelines.

Natural hazards with impact on health include cyclones, tsunamis, floods and dry spells as well as biological hazards such as water borne and gastro-intestinal diseases: Flood waters or lack of water create a conducive environment for vector breeding hence vector borne diseases.

Additionally, shortages of water during dry spells results in disruption of health services in case water supply planning does not include and prioritize health care institutions.

4.4.1 Institutional & policy framework for DRM in water & sanitation

4.4.1.1 Existing Capacities

The Ministry of Energy and Public Utilities (MPU) oversees drinking and wastewater management. The two main agencies, the Central Water Authority (CWA) and the Wastewater Management Authority (WMA) have competent skilled personnel for the management of the water supply and wastewater infrastructure.

The sewerage system as well as construction of on-site disposal systems such as septic tanks are governed by the Planning Policy Guidance 2004. About 6 mm³ of industrial wastewater is produced annually from sugar production, textile, breweries, food processing, leather tanning and galvanizing, only part of which is directed to sewerage treatment plants. Hotels in the coastal and rural areas are required by law to develop their own wastewater treatment plants. Three of the four hospitals are connected to the sewerage network.

The sewage Master Plan provides a clear framework for network expansion and is being implemented under the auspices of the WMA. Ongoing financial constraints however pose a substantive threat to a timely implementation of the envisaged measures aiming at a substantive network expansion.

The National Water Policy includes DRR & climate adaptation targets to address the challenges of climate change impact on water availability (reduction in average annual rainfall, sea level rise leading to groundwater quality deterioration in coastal areas) and technological hazards such as effluent discharge potentially resulting from industrial development. The policy also includes provisions to mitigate the effects of extreme weather events as well as preparedness and contingency plans, including:

- provision and continuation of services during and after emergencies;
- plans for rehabilitation and repair of water systems;
- protection of water bodies and water systems from pollution and depletion

In addition, different legal instruments govern how drinking water resources and wastewater disposal sites are managed and controlled: Central Water Authority Act (1971), Environment Protection Act (2002), Ground Water Act (1970), Irrigation Authority Act (1978), Planning and Development Act (2004), Public Health Act (1925), Rivers and Canals Act (1863), Waste Water Management Authority Act (2000), The Local Government Act (2011), Forest and Reserves Act (1983), Fisheries and Marine Resources Act (2007), National Disaster Risk Reduction and Management Act (2016).

Wastewater

The Environmental Protection Act (2002) under the auspices of Ministry of Environment, Solid Waste Management and Climate Change (MoESC) is the most relevant legislation regulating wastewater and pollution:

Table 5.1: Legislation and Regulations relevant to Wastewater and Pollution in the EPA (2002)

The Environment Protection Act 2002 (amended 2008)

Environmental Guidelines

- Guidelines for Coastal Water Quality
- Guidelines for Inland Surface Water Quality
- Guidelines for Irrigation Water Quality

Environmental Standards

- Drinking Water Standards
- Standards for Hazardous Wastes Regulations
- Standards for effluent discharge Regulations

Standards for effluent discharge (Amendment) Regulations 2004

This standard falls under

- Effluent Discharge Permit Regulations
- Effluent Discharge Permit (Amendment) Regulations

Standards for effluent discharge into the Ocean Regulations

This standard falls under

- Effluent Discharge Permit Regulations
- Effluent Discharge Permit (Amendment) Regulations

Standards of effluent for use in Irrigation Regulations

This standard falls under

- Effluent Discharge Permit Regulations
- Effluent Discharge Permit (Amendment) Regulations

Solid waste management

Solid and hazardous waste is managed by the Solid Waste Management Division (SWMD) within MoESC. SWMD is also tasked with the cleaning of public beaches and toilets, operation of the waste transfer stations, operation and maintenance of the landfill, collection and carting away of post cyclonic disaster waste.

In 2019, the Strategy and Action Plan for a New Solid Waste Management and Resource Recovery System as well as project preparation support for the implementation strategy with short

to long-term goals was developed. These include (i) new regulations for waste minimization (composting, recycling, reuse, etc.) since the current level of waste minimization and recycling is very low; and (ii) setting up of a decentralized pollution control agency, for control and monitoring at local level.

The new solid waste strategy and action plan aims to maximize resource recovery and recycling in the short and medium term while recognizing the potential use of waste for energy production in the long term.

In this new action plan a waste oil bank is set up at La Laura transfer station, a storage site for construction and demolition wastes will be set up at La Chaumiere transfer station, a feasibility study for scrapyards facility will be done, a national solid waste characterization study will be implemented and the collection of hazardous wastes at household level is proposed for the FY 2019/2020.

At paragraph C.8 of the 'Annex to Budget Speech' 2020-2021, it was announced that the Environment Protection Act will be amended to set up an Extended Producer Responsibility on

management of E-wastes, end of life vehicles and waste batteries, in close partnership with the private sector. Draft Regulations to encourage the setting up of "Extended Producer Responsibility on management of E-Wastes" is currently being drafted by the Solid Waste Management Division of the Ministry of Environment, Solid Waste Management and Climate Change, for promulgation within Financial Year 2020/21.

KEY CHALLENGES

- Enforcement and control of the existing legislation and regulations remains a challenge. For instance, existing legislation prescribes to separate wastewater drains from sewage, which in practice is not implemented, as rainwater regularly infiltrates into sewage pipes.
- Non-government stakeholder participation in decision-making remains limited and ad hoc (e.g. through the Water Resources Monitoring Committee). The fact that the water management plans are based on a Central Water Authority supply zone system and not on hydrologically defined Water Management Areas, is not conducive to local stakeholders' participation.
- In major industrial plants, owing to lack of effluent control and monitoring, little or no pre-treatment of commercial waste is occurring. With industrialization development, there is an increased risk of pollution of the aquifers, surface water sources and the lagoon. There is a need to prepare a comprehensive set of regulations to prevent wastewater pollution.

CAPACITY GAPS

- The Wastewater Management Authority (WWA) and the Solid Waste Management Division (SWMD) within the Ministry of Environment have a shared responsibility regarding the management of wastewater. The SWMD plans, implements and manages the waste disposal sites. The WWA is responsible for the management and transportation of leachate from these disposal sites to wastewater treatment plants and the final discharge. There is no formal communication system established between these two institutions and communication should be improved.
- Although the Central Water Authority (CWA) and the Wastewater Management Authority (WMA) have qualified staff, these institutions do rely on foreign donor's assistance to conduct required research, assessments and develop policies and measures.
- WMA Pollution Control Unit has insufficient capacities to properly oversee industries in terms of appropriate waste and wastewater treatment.

4.4.1.2 Recommendations



4.4.1.2.1.1 Increase and regulate participation of non-government stakeholders / water users in management of water resources.

4.4.1.2.1.2 Develop water management plans based on hydrologically defined Water Management Areas, to promote local stakeholder structures' participation.

4.4.1.2.1.3 Clarify division of labour and communication between the Waste-water Management Authority and the

Solid Waste Management Division with respect to the management of wastewater.

4.4.1.2.1.4 Liaise with universities to develop BA and MA courses tailor made for the requirements for both institutions and to provide training for the staff of the CWA and the WWA.

4.4.1.2.1.5 Strengthen WMA Pollution Control Unit to reinforce control on industries discharging effluent.

4.4.2 Access to information on disaster risk and climate change

4.4.2.1 Existing Capacities

The quality of the water resources, both ground- and surface water are being monitored daily: more than 200 samples are being collected and vulnerability studies of existing dams of water reservoirs have been carried out by the CWA.

The CWA has established a water table to monitor daily the quality and quantity of water in the reservoir system. WMA monitors the industrial disposal into the rivers. MPU conducts SIMEX for dam breaks and has established modelling and scenario building for DRR.

The National Land Management Authority has identified 250 flood prone sites, with 60 sites identified as high-risk areas.

KEY CHALLENGES

- Sampling of water quality is carried out by the private and industrial sector stakeholders before the samples are tested by the National Environmental Laboratory. This risks non- objective sampling and obscures the testing methodology.

CAPACITY GAPS

- Although flood prone areas are identified with accurate geographical coordinates, the corresponding data are only available in excel sheets and are not used to be displayed in GI-systems.

4.4.2.2 Recommendations



4.4.2.2.1 Strengthen sharing of WASH related risk information (such as flood prone sites and dam safety) and ensure access for all relevant stakeholders.

4.4.2.2.2 Wastewater Management Authority (WWA) to introduce and conduct objective random sampling and testing of industry wastewater.

4.4.3 Investment in disaster resilience

4.4.3.1 Existing Capacities

The quality of the water resources, both ground- and surface water are being monitored daily: Mauritius hosts a dense network of river systems consisting of 25 major catchment areas and 21 minor river basins. These include 350 river-run off takes, three major river abstractions and six major impounding reservoirs. The water quality of these rivers is being automatically recorded. When a problem such as contamination of the water during distribution occurs, the NDRRMC is informed and the water supply system closed.

There are five main aquifers that are harnessed to cater for water demand through 520 boreholes. The potential for further groundwater exploitation is however limited, as most of the sources are mapped by now.

The reservoirs connected to the river systems can provide water supply when there is shortage of water in the dry season. Dam heights are being increased and reservoir capacity enlarged in order to increase the water capacity for the dry season. There is close collaboration between the CWA and the Meteorological Services.

At present, the operating expenses of the CWA and WMA are financed through consumer tariffs, with the bulk of revenue generated from industrial clients (despite their minor share in overall service usage) due to the higher industrial tariffs. The current tariffs do not cover expenditure for the network maintenance (water supply) and expansion (wastewater). Projects are funded by the Government through grants, and more recently loans from the Public-Sector Investment Programme.

	'Input'	'Output'		
	Rainfall	Surface runoff	Net recharge to groundwater	Evapo-transpiration
Island of Mauritius	3,536	2,122	353	1,061
Water Balance	100%	60%	10%	30%

Wastewater

Three centralised wastewater treatment plants recently started operations, illustrating the government's heavy investment to improve sanitation in the country.

The rudimentary treatment plant of St Martin was revamped at a cost of about USD 35 million into an activated sludge plant. It now has a design capacity of 69,000 m³ d⁻¹ and provides tertiary treatment using ultraviolet (UV) disinfection for the effluent which is re-used for irrigation purposes. The biogas installation of this plant creates methane for household electricity purposes. The sludge can be used as fertilizer in the sugar cane industry after heavy metals are distracted. The Grand Bay treatment plant (costing about USD 12 million), with a design capacity of 3,000 m³ d⁻¹, also uses an activated sludge process, and provides tertiary treatment using chlorine for disinfection of the effluent. The Montagne Jacquot WWTP, built at a cost of about USD 21.5 million was commissioned in 2018 and provides primary treatment to the industrial zones of Coromandel and La Tour Koenig and to part of the Port Louis effluent sent by pumping station.

As of 2019, about 29% of the population are connected to the sewerage network of the country. Current investments related to network extension will enable connection of 16 000 additional premises by 2020, thus bringing network coverage to around 30%.

Solid Waste Management

In 2018, 543.000 tons (1487 ton/day and 1.17 kg per person per day) were collected by SWMD. Solid Waste is collected by the local council at household level and transported to one of the six transfer stations from where it is transferred to the Mare Chicose landfill and a pilot for sorting waste at household level has been recently initiated. In addition, there exists an intermediate storage facility for hazardous materials at La Chaumiere.

In two pilot projects construction and demolition wastes are sorted and disposed of in a civil amenity centre, recyclables as glass, paper, plastics and metals will be sorted and collected by recyclers, and a composting plant will be constructed for food and yard wastes.

KEY CHALLENGES

Over half of Mauritius' potable water supply is from abstracted groundwater. The sustainable management and protection of groundwater aquifers is therefore important to ensuring safe and sustainable water supply for the country. While aquifers are actively managed by the WRU and CWA, currently aquifers are not managed based on tailored aquifer management plans and this is viewed as a gap in the management framework.

Waste and rainwater drainage systems are currently not separated. In addition, the wastewater drainage is an open system alongside the roads and rainwater can infiltrate and overload the system.

CAPACITY GAPS

- The current water tariffs do not cover expenditure for the network maintenance (water supply) and expansion (wastewater).
- The adoption of water saving technology (water saving equipment) in businesses and households is underdeveloped.
- The only landfill on the island (Mare Chicose) needs to be increased due to rising waste quantities (about 2.4 % per annum). However due to rising costs and unsustainable consumption of land for landfilling combined with restricted development in the surrounding lands and growing resistance of the surrounding population this is a challenge.

- Sorting waste at household level needs to be increased in order to improve recycling and re-use of waste and to mitigate hazardous wastes to end up in the Mare Chicose landfill. As this landfill is open toxic liquids from electronic waste and hazardous materials like paints and solvents will trickle down and infiltrate the leachate. This leachate is pumped to the Baie du Tombeau Wastewater Treatment Plant and disposed of in deep sea.
- Except from the St Martin and Grand Bay Wastewater Treatment Plant (WWTP), the treatment plants in the island discharge essentially untreated sewage through short marine outfalls into the sea. The pollution of the lagoons and groundwater resources by human excreta, industrial effluent and agricultural chemical run-off causes severe environmental damages and health problems.
- The use of sludge as fertilizer is however not widely accepted, therefore the majority is sent to the Mare Chicose landfill, where it is eventually disposed of in the deep sea.

4.4.3.2 Recommendations



4.4.3.2.1 Develop Sustainable Wastewater Treatment Plants.

4.4.3.2.1.1 The 10 Wastewater Treatment Plants on the island should be upgraded to tertiary treatment plants in order to re-use the wastewater and faecal sludge for agricultural purposes and for the creation of energy. It is recommended to develop a number of low-cost and low-energy wastewater treatment systems in the rural areas on the island. Appropriate technologies for any particular region can be oxidation ditches, aerated lagoons, upflow anaerobic sludge blanket, waste stabilisation ponds and constructed wetlands. A variety of processes, such as an activated sludge system, rotating biological contactor, upflow anaerobic sludge blanket, waste stabilisation ponds, constructed wetlands and physico-chemical treatment can be used.

4.4.3.2.2 Increase Water and Wastewater Tariffs.

4.4.3.2.2.1 A review and potential upward adjustment of tariffs (while considering social concerns) would have the dual effect of improving the CWA's and WMA's revenue stream (thus allowing further investments in infrastructure) and a potential of providing an incentive to curbing the high per capita household demand in the country.

4.4.3.2.3 Increase investment in resilient water infrastructure in the face of disaster risk.

4.4.3.2.3.1 Close off the sewerage system and refurbish the leaking drinking water pipelines in order to prevent water contamination by sewage at time of floods.

4.4.3.2.4 Regulate hazardous waste management at Mare Chicose landfill.

4.4.3.2.3.4.1 Implement waste sorting at household level to mitigate the risk of hazardous wastes (electronic, solvents) to end up in the Mare Chicose landfill. Household hazardous waste should be sorted and disposed of at La

Chaumiere Intermediate Storage Facility.

4.4.3.2.4.2 Implement storage of toxic leachate from the Mare Chicose Landfill at La Chaumiere Intermediate Storage Facility for Hazardous Wastes.

4.4.3.2.5 Develop tailored aquifer management plans.

4.4.4 Preparedness for response and recovery

4.4.4.1 Existing Capacities

The level of preparedness for WASH related emergencies is currently low. Due to the absence of WASH relevant preparedness protocols, related emergency response is rather reactive. There is lack of adequate information management and sharing systems which poses a significant challenge towards cross-sectoral coordination at national level. Furthermore, enforcement capacities and local level need to be strengthened.

KEY CHALLENGES

- Within NDRRMC, the capacity for WASH related emergencies needs to be systematically strengthened.
- Limited sector coordination at national level.
- There are no preparedness protocols for WASH related emergencies.
- During cyclones and flash floods, water filters at the main potable water treatment plants get blocked with mud, and water distribution service is usually interrupted for 2-3 days before the filters are cleaned.

4.4.4.2 Recommendations



4.4.4.2.1 Establish preparedness protocols for drinking and wastewater, including maintenance of WWTPs.

4.4.4.2.2 Initiate awareness raising campaigns in cooperation with the Ministry of Health and Wellness and non-governmental stakeholders at community level regarding health risks related to floods

in combination with overflowing septic tanks and drainage systems and the contamination of drinking water and living environment.

4.4.4.2.3 Develop procedures and formal structures for sectoral coordination of preparedness measures in the WASH sector at national level.

4.4.4.2.4 Establish penalties for violating the rules in order to increase the enforcement capacity of local governments.

Best Practice:

St Martin Wastewater Treatment Plant

The WWTP at St. Martin, operational since 2005, treats wastewater received under gravity from the Plaines Wilhems area through the trunk main sewer network, and supplies the treated water for irrigation purposes. It has a design capacity of 69,000 m³ per day and an average of 40,000 m³ is being treated daily.

Treatment of Wastewater

The primary treatment comprises of a set of coarse and fine screens for the removal of screenings, detritator units for the grit removal and primary settling tanks for the removal of primary sludge. The secondary treatment comprises of a biological aeration system (Photo 5.1) based on an activated sludge process), final settling tanks (Photo 5.2). Return Activated Sludge pumping system and Surplus Activated Sludge pumping systems. The tertiary treatment system comprises of balancing tanks for flow equalization, Rapid Gravity Filters for filtration followed by UV (Ultra Violet) disinfection system.

Treatment of Sludge

The primary sludge from the Primary Settling Tanks is thickened in the Picket Fence Thickeners, and the secondary sludge from the Final Settling Tanks is thickened in the Belt Filters using polyelectrolyte chemical. The thickened primary and secondary sludge are mixed in the buffer tanks and pumped to the anaerobic digesters (see Photo 5.2). The digested sludge is dewatered in the centrifuge machines using polyelectrolyte chemical, and the sludge cake is disposed at the Mare Chicose landfill. This sludge can be used as fertilisers in agriculture.

5.1 Aeration basin



5.2 Final Settlement Tank





Photo: GEF SGP UNDP Mauritius

4.5. HEALTH.

When we assess DRM capacities in the health sector, what are we considering?

- Awareness (government, private sector, population)
- Legal and policy framework assigning roles and responsibilities
- Organizational and institutional arrangements effectiveness
- Coordination (inter-ministerial, central-local, public-private, DRR-CC)
- Financing

Overview

Mauritius, as a SIDS, has several strong advantages to face epidemics risk including a highly educated population and strong community preparedness networks. In view of its significant trade exchanges and with more than a million tourists visiting every year, Mauritius is however highly exposed to the risk of a pandemic outbreak. The ageing of the population also increases the vulnerability of the country to communicable and non-communicable diseases.

In 2020, the early imposition of confinement measures, the setting up of quarantine centers together with large communication and community engagement campaigns, were effective in managing the spread of COVID-19. Similarly, the government managed to mitigate the measles outbreak of 2018, and the risk of an outbreak of pneumonic plague coming from Madagascar on the same year. The country demonstrated its capacity to respond efficiently to these threats. Mauritius needs to further develop its preparedness capacity to adapt to changing epidemics patterns that are expected to evolve with the impact of climate change and the increased incidence of extreme weather events. It needs to significantly invest in strengthening its surveillance systems and its overall preparedness and response capacities to be able to face major pandemic that could affect the whole archipelago.

Introduction:

Mauritius disposes over a well-structured public health system that guarantees free public health care to all its citizens. The network of public

health institutions is adequate in urban as well as rural areas. Since 1973, the country is malaria free with few imported cases only and there is no local transmission of the disease (1.6 per 100,000 in 2014). The country has demonstrated

its capacity in eliminating other vector-borne and communicable diseases such as whooping cough, diphtheria, leprosy, schistosomiasis, poliomyelitis and other communicable diseases. Tuberculosis is already low (10 per 100,000 in 2014). In 2005-2006, an outbreak of Chikungunya was reported with more than 272 000 people infected. There are recurrent dengue outbreaks on the main island (300 cases in 2016). Over the past two years, the country was affected by a measles outbreak (2018) and a dengue fever outbreak (2019).

It is anticipated that the incidence of vector borne diseases like dengue and chikungunya fever will increase parallel to an overall increase in temperature due to increasing impact of climate change on the archipelago creating a conducive environment for vector breeding. The Government of Mauritius developed an ambitious strategy to adapt to climate change impacts on the health sector. Environmental and climate change resulting in extreme drought and acute water shortages, often followed by unusually heavy rains tend leading to a high risk of vector-borne and communicable disease outbreaks. In addition, the health sector is strongly interlinked with sectors such as WASH and agriculture, that are being increasingly affected by the incidence of disasters and climate change.

Currently, 29% of the population in the country is connected to the sewerage network, while 71% of the households dispose over septic tanks. These septic tanks tend to overflow during floods provoked by torrential rains and storm surge and cause waste water to enter the surrounding environment.

At the same time, the drinking water pipes of the island are in a critical condition, leak and the drinking water is prone to pollution at time of disasters in case waste water from septic tanks enter the leaking pipes. Consequently, there exists a significant health risk for the population caused by consumption of polluted water and direct contact with waste water during floods.

Mauritius is also a net importer of food and staple crops and the national agricultural food sector currently meets 23% of the local food consumption requirements which generates a double vulnerability: In case imports are being hampered due to disaster impact on the infrastructure or external shocks, food insecurity is likely to arise.

Despite the high volume of tourists and migrant workers that travel in and out of the country, which may create a “conducive environments for pandemics”⁷⁷, the preparedness systems for a pandemic outbreak are currently underdeveloped. The government is keenly aware of these challenges and recently underwent a Joint External Evaluation together with WHO to strengthen its health sector. Relevant findings have been used to complement the present analysis.

4.5.1. Regulatory and Policy framework

The **Ministry of Health and Wellness (MoHW)** draws its mandate for disaster risk management from several pieces of legislation: the National Disaster Risk Reduction and Management Act (2016), the National Disaster Scheme (2015) as well as the Public Health Act of 1925 and the Quarantine Act of 1954.

The Public Health Act (1925) regulates practices for the prevention of morbidity and mortality due to communicable diseases, ensures an environment free of health hazards and enacts the list of Notifiable Diseases in Mauritius. This list has been updated in June 2017 for the Integrated Disease Surveillance and Response (IDSR) programme⁷⁸.

The Quarantine Act (1954) provides for measures to prevent spread of infection and other dangers to public health from ships or aircraft or persons or things on board arriving in Mauritius. Port and Airport Health Officers enact the law to preventing the spread of communicable diseases in the country.

Further, the ministry is at the core of and/or contributes to disaster risk management through additional legislation such as:

- a) The Food Act (1998) which provides for the modernization and consolidation of the law relating to the quality of food;
- b) The Pharmacy Act (1983) regulating the manufacture, import and sale of pharmaceutical products;
- c) The Dangerous Chemicals and Control Act (2004) providing for the prevention of damage to health and to the environment caused by dangerous chemicals;
- d) Mental Health Care Act (1988) regulating the management of mental health care services

Furthermore, the country has developed a national health sector strategy (2017-2021) which amongst other, recommends to:

- Strengthen and sustain the implementation of the National Programme for the Prevention and Control of Communicable Diseases including emerging and re-emerging communicable diseases such as Zika and the vector borne diseases including the setting up of a negative pressure facility.
- Put in place an IDSR strategy in line with WHO recommendations.
- Consolidating health sector response to climate change within the framework of sustainable development.

The **National Disaster Risk Reduction and Management Act** (2016) recognizes the roles of Ministry of Health and Wellness and the Public Health Emergency services in disaster risk management and prescribes that the National Disaster Risk Management Council as well as the local sub-committees shall consist of a supervising officer or a representative of the ministry responsible for the subject of health.

4.5.2. Institutional set up

The **Ministry of Health and Wellness** is the principal government body charged with public health in Mauritius and is the enforcing agency for safe drinking water, noise and odour pollution under the Environment Protection (Amendment 2008) Act “Other stakeholders include local government authorities, other ministries, the local community, the private sector, non-governmental organisations and other partners.”⁷⁹

MoHW is divided in two principal divisions, the curative, as well as the preventive where the public health division hosting the **Communicable Diseases Control Unit (CDCU)** sits.

The CDCU is the principal government agency responsible for control and prevention of communicable diseases “through surveillance and response [and] assists in data collection, man-

The **National Disaster Scheme** (2015) defines the specific responsibilities of the Ministry of Health and Wellness as well as the Public Health Services for different hazards before during and after the event of a disaster. For instance, MoHW is responsible to carry out sensitisation campaigns on public health issues ahead of the cyclone season and to ensure that respective emergency plans are up to date.

The **National Health Sector Strategy** (2017-2021) indicates that an effective Communicable Disease Surveillance and Response System is in place to avoid the spread of these diseases in Mauritius and outlines that an Emergency Preparedness and Response Framework targeting individual cases and mass casualties at times of epidemics or other infectious diseases has been developed.

agement and analysis”⁸⁰ and is supported by an epidemiologist who “enabled the establishment of an early warning and response system.”⁸¹

The CDCU also serves as the **Public Health Emergency Operations Centre (PHEOC)** and is charged with aspects of disaster risk management, including natural hazards such as cyclones and floods. The head of the communicable diseases’ unit is also liaison with the meteorological department and ensures the ministry receives early warning information for the purpose of decision making whenever there is a potential event.

In order to effectively provide public health services, MoHW disposes over sub-offices at the regional and local level as well as strategic entry points such as the airport and the port, where surveillance of passengers coming from high risk areas is carried out in order to prevent the introduction of communicable diseases that are considered of major public health importance. The public health officers are “are responsible for the surveillance of communicable diseases, for reducing risks from vector-borne, food, and water-borne diseases and for the prevention and control of communicable diseases.”⁸²

“Mauritius has established an intersectoral collaboration mechanism for IHR (2005), comprising the MOHQL, MOAIFS, Home Affairs (Police), Environment, Labour and Education; the Customs and Port Authorities; the business sector; and community participants (Force Vives). The Intersectoral Committee for IHR (2005) is chaired by the Minister of Health. The country has designated the office of the Director of Health Services as the NFP and there are designated focal points in each of the various relevant ministries. TORs are in place for the NFP and the specific focal points in each of the relevant sectors of government. The Committee normally meets whenever there is a national or international health event of significance.”⁸³

The government aims at establishing Mauritius as a medical center excellence and attracting more visitors for medical tourism. Since 2017, medical visa are granted for foreigners upon arrival for treatments that do not exceed six months. It is important to continue ensuring access to health services in the same way as nationals and that that immigrants meet the requisites of national health standards as a precondition for their admission into the country.

At the international level, MoHW, more specifically the Vector Biology and Control Division initiated a collaboration with International Atomic Energy Agency as part of its Integrated Vector Management Strategy after the increased occurrence of the Chikungunya virus in 2005-06. The objective was to jointly fight against insect pests and vector-borne diseases by exploring the opportunity to make use of the Sterile Inset Technique⁸⁴.

In terms of funding, emergency management funding is currently being curved out of the health sector budget.

KEY CHALLENGES

- While the various structures and legislation provide a clear mandate for MoHW in disaster risk management, the efforts of the ministry in implementing DRM are not documented.
- Mauritius did not adopt the second edition of the ISDR technical guidelines, an evidence-based strategy for strengthening national public health surveillance and response systems at the community, health facility, 'district' and national level which makes explicit the skills, activities and resources needed at each level of the health system to operate all functions of surveillance”
- MoHW collaborates with environment, water management and meteorology in vector management, water quality monitoring and early warning for climate related hazards, however there is need for further integration with other sectors such as education sector in health promotion as well as awareness creation in relation to epidemics and pandemics.
- The regular budget for MoHW is used for disaster risk management even though this is not traced.

- Today, Mauritian medical personnel emigrate on their own initiative to Australia, Canada or New Zealand. Germany has lately expressed the intention to start recruiting nurses from Mauritius, which has prompted the establishment of a new nursing school that will recruit trainees on a regular basis.

Primary Health Care Network

As of “2015, the Primary Health Care (PHC) network in the country consisted of 18 Area Health Centres, 116 Community Health Centres, 5 Medi-clinics, 2 Community Hospitals and other satellite PHC institutions. Secondary and specialized health care services in the public sector are delivered through two hospitals at the district level, five Regional Hospitals, one ophthalmology hospital, one ear/nose/throat hospital, one mental health care institution, one chest hospital and a cardiac centre.”⁸⁵

“The laboratory system of the MoHW in Mauritius consists of one Central Health Laboratory (CHL) at Victoria Hospital (Candos), four regional hospital laboratories, four “branch laboratories” in district or specialized hospitals, and several mediclinic laboratories”. Public health laboratories typically provide all essential services including disease and outbreak detection, environmental monitoring and disease surveillance. The CHL is tasked with the auditing of private laboratories “while external bodies such as WHO, SADC, etc. undertake audits of government laboratories. It has been reported however, that for instance vector management in private premises remains a challenge. “Laboratory personnel are generally well-trained in basic biosafety, and training is provided to all new staff. However, not all staff at facilities that handle dangerous pathogens and toxins have been fully trained.”⁸⁶

A Biosafety Level 3 (BSL-3) laboratory capable of handling priority events such as disease outbreaks is reported to be established, but at the time of the diagnosis, it has not been finalized yet.

Other health services that are provided to Mauritian citizens include amongst other the Service d’Aide Médicale d’Urgence (SAMU), the Mauritius Blood Service and Rehabilitative Services. SAMU was created 1997 with support of IOC and the French Government and consists today of units at each of the five regional hospitals and a fleet of 15 fully equipped ambulances. In 2015, 10,998 cases were attended by one of the SAMU teams. SAMU units are systematically included in preparedness activities of NDRRMC and participate regularly in the national Simulation Exercises.

KEY CHALLENGES

- Biosafety Level 3 (BSL-3) laboratory not operational yet.
- Vector management within private premises remains a challenge.
- Not all laboratory staff are fully trained on proper handling of dangerous pathogens and toxins.

4.5.3. Access to information on disaster risk and climate change

In order to facilitate the exchange of information on public health emergencies, Mauritius has signed several cross-border agreements, protocols and MOUs with neighbouring countries. As a member of the Indian Ocean Commission, the country shares data on epidemic-prone diseases “within the Indian Ocean islands of the Comoros, Madagascar, Mauritius, Reunion and Seychelles. The country is also required to share data with the Africa Centres for Disease Control and Prevention (Africa CDC)”⁸⁷.

At national level a surveillance system for both human and animal diseases, including zoonotic diseases has been established. The MoHW conducts both active (search) surveillance on all visitors arriving in the country as well as passive surveillance for diseases. Public health services make use of GIS-based disease-mapping technology and GIS-shape files are used for analysis and reporting for outbreak and spread of diseases.

However, there is a lack of a real-time reporting/surveillance system with interoperability between the human and animal health sectors to manage human/animal epidemics risk. Currently the case-based form used for notification of priority diseases are sent from the local health centres to the central level via fax or email⁸⁸. Furthermore, the laboratory investigation capacity of the public health system does currently not make use of a laboratory information management system (LIMS), which would facilitate the exchange of findings at the national and regional level. On the other hand, appropriate risk communication systems remain to be established.

In 2017 MOH /WHO undertook a rapid assessment and gap analysis of the surveillance system, with 21 sites surveyed. The report highlighted the need to further strengthen surveillance and early detection systems to address the lack of effective multisectoral coordination and information sharing as well as to facilitate the implementation of integrated disease and event-based surveillance. Currently there is limited documented

clarification with regards to coordination and division of responsibilities between the Ministry of Health and Wellness and the NDRRMC in case of a public health emergency. At the same time both MoHW and NDRMMC agree that in case of a health emergency, they have a clear division of roles requiring MoHW to take lead unless the emergency requires capacity beyond the ministry’s level. This agreement still remains to be documented.

Existing facilities of the PHC network that may be located in disaster prone areas have been mapped by the NDRMMC, however there is currently no record of damages and losses that occur to the PHC network as a result of disasters within MoHW. In addition, a vulnerability, risk assessment and mapping has not been conducted and risk prioritization is yet to be constituted.

The current and future impact of climate change on public health in Mauritius is well documented. According to Mauritius’ Third National Contribution to the UNFCCC, the increased occurrence of vector borne diseases like dengue and chikungunya viral fevers shows a correlation with a rise in temperature.

‘An increase in vector-borne diseases was observed for the first time in 2006 with an epidemic of some 9 000 cases of chikungunya fevers. This was followed by epidemics of dengue observed for the first time in 2009 recording some 300 cases island-wide with successive outbreaks in the years 2011, 2014 and 2015 [...]. These outbreaks coincided with the gradual increase in temperature from 1950 to 2005 as observed by the Mauritius Meteorological Services (Ministry of Health, health statistics report for 2015). This circumstantial evidence taken against the globally projected dengue rise (Fock, 1995) argues for climate change as a possible cause of vector-borne diseases in Mauritius.’⁸⁹

In addition, annual occurrence of episodes of conjunctivitis and gastroenteritis, as well as respiratory diseases are linked to increased climate change impact. It is concluded that climate change may lead to an increase of communicable diseases and exacerbate the effects of the already high prevalence of non-communicable diseases.'

Potential long-term challenges of climate change on the health sector with an increase in associated health costs and impaired socio-economic development shall be met with a three-fold adaptation strategy:

- **Strengthen climate-resilient health systems.**

Anticipated strategies will include expansion and strengthening of new public health infrastructure, development of public policy as well as institutional and professional capacity development.

- **Strengthen preparedness measures to avert disease burden attributable to climate change.**

A series of actions could include (a) contingency planning, (b) identification of risks and vulnerable exposed communities for monitoring, forecasting and predicting possible adverse health effects from natural and man-made hazards, and (c) the adoption of healthy life-style and nutrition habits by promoting health promotion strategies.

- **Target response for triggering effective and timely response.**

In order to reduce the incidence of morbidity and mortality from disease burden associated with climatic changes, action could include (a) dedication of trained health care workers (b) procurement of essential medicines, emergency supplies kits, and (c) expansion of possible range of currently available vaccines⁹⁰. Further, coordination with other ministries such as gender, education and local authorities could provide the Ministry of Health and Wellness opportunities in awareness raising; facilities for organizing health service provision during emergencies

and strengthen implementation of various legislation such as regards water and sanitation and vector control and environmental management before a disaster occurs.

However, there is no evidence as to what extend these recommendations have resulted in deliverables, key performance indicators as well as a clear designation of tasks between MoHW and other relevant ministries such as Ministry of Environment. Furthermore, there currently exists no specific climate information products for the health sector to be developed by Mauritius Meteorological Services.

KEY CHALLENGES

- Lack of real time reporting/surveillance system.
- Laboratory investigation capacity does not make use of laboratory information management system.
- Lack of effective multisectoral coordination and information sharing.
- Loss and damages to PHC network during disasters not recorded.
- Implementation status of recommendations for climate change adaptation of the health sector is unknown.
- No specific climate information products for health sector available.

Best Practice:

Mauritius efficient response to the 2018 measles outbreak

In 2018 the outbreak of measles triggered a positive response from the healthcare system. The measles outbreak, which occurred as a result of low vaccination coverage in many sectors of the population, was rapidly contained through efficient public health actions. Health officials have reported about 1324 confirmed cases of measles, including four deaths. The most affected districts were Port Louis and Black River. Children less than one year of age were the most affected age group, accounting for over 70% of all cases, followed by 1-4 years and 25-29 years. Just over one-third (33%) of cases had unknown vaccination status, 49% were not vaccinated. A total of 10 rapid response teams made up of a medical health officer and a healthcare assistant have been set up to conduct active case search (screening for fever and rash) and ascertain vaccination status in pre-primary, primary and secondary schools. Supplementary vaccination activities were carried out in high risk areas, targeting children and people between 15 and 45 years of age. The MMR vaccines were also administered to company workforces in the public and private sectors, as well as those working in the transport sector and health workers in both the public and private sectors. Several communiques have been issued advising people in the 15-45 age groups to be immunized, in addition to younger children. Community leaders in high risk areas, and the general population were sensitized on measles symptoms and vaccination by radio, press and television, as well as flyers. The MMR vaccination schedule has also been revised to two years of age, from five years and the first dose given at less than one year.

4.5.4. Preparedness for response

The Public Health Emergency Operations Centre (PHEOC) is activated in times of need to address public health emergencies through an incident management system with defined command and control functions. In the case of an emergency, the Director General of Health Services is the designated focal person for activation of the PHEOC, in consultation with technical and administrative staff.

Rapid Response Teams (RRTs) are available at national and regional levels. National-level RRTs can be rapidly deployed countrywide within a reasonably short time, given the relatively small size of the country.

There also exist “disease specific operational plans for H1N1 pandemic influenza, chikungunya, dengue fever, Ebola virus disease, MERS-CoV and Zika virus fever”⁹¹. Furthermore, stockpiles of personal protective equipment are available. In addition, the Ministry of Health and Wellness

has Standard Operation Procedures for surveillance available, which includes case definitions for all nationally important diseases and syndromes.

In May 2017, an upsurge in influenza-like illnesses was noted rising from 6,010 cases weekly and peaking to 25,463 cases, causing eight deaths attributable to influenza H1N1 and one death attributable to H3N2. In response, the MOHQL scaled up the influenza vaccination campaign which initially targeted senior citizens to include the public at large.

In response to an outbreak of pneumonic plague in Madagascar, MOH formulated a National Preparedness Plan to mitigate the threats including local capacity building to detect and respond efficiently in the event of an imported case of pneumonic plague and strengthening of active surveillance at all points of entry and in the community, as well as preposition of equipment.

However, while “the country has demonstrated, to some extent, effective multisectoral coordination and communication during public health emergencies, this collaboration has not yet been fully systematized and adequately incorporated into preparedness planning and response to public health emergencies of international concern (PHEIC).”⁹²

KEY CHALLENGES

- The MoHW conducts/participates in simulation exercises, these are however not well documented or executed. The Joint External Evaluation (JEE) for instance notes that there is need to conduct varying kinds of exercises to ensure that preparedness and response capacities are tested effectively.

- Attendant to this is the need to have updated guidelines and training for Emergency Operation Center Management.
- With regards to disaster risk management, the NDRRMC is charged with overall management of national disasters and there is a need to clearly document the roles between NDRRMC and MoHW whenever there is a health event of national concern.
- Communication during Public Health Emergencies is not fully systematized.
- Core requirement for RRTs to ensure Pandemic Influenza Preparedness including laboratory, epidemiology and data management components remain to be identified.

4.5.5 Recommendations



Regulatory & Policy Framework, Institutional set up

4.5.1.1 Adapt and fully implement third edition of AFRO IDSR.

Primary Health Care Network

4.5.1.2 Establish Biosafety Level 3 (BSL-3) laboratory.

4.5.1.3 Increase capacities for vector management within MoHW to cover private premises.

4.5.1.4 Extend training on proper handling of dangerous pathogens and toxins to all laboratory staff.

Access to information on disaster risk and climate change

4.5.1.5 Establish a real-time reporting/surveillance system with interoperability between the human and animal health sectors to manage human/animal epidemics risk across all levels in the context of One Health (agriculture, environment, water and health sectors).

4.5.1.6 Establish a laboratory information management system for the laboratory investigation capacity.

4.5.1.7 Strengthen surveillance and early detection system and address the lack of effective multisectoral coordination and information sharing to facilitate the implementation of integrated disease and event-based surveillance.

4.5.1.8 Establish an integrated information system for biological risk.

4.5.1.9 Integrate data on damages to PHC network caused by disasters into the loss and damage database that is currently being established.

4.5.1.10 Track progress of climate change adaptation policies in the health sector, by establishing specific deliverables and KPIs, as well as responsibilities of participating stakeholders.

4.5.1.11 Mauritius Meteorological Services to develop specific climate information products for health sector to enable a more detailed analysis of current and future impact on occurrence of diseases, mortality rates, etc.

Preparedness for response

4.5.1.12 Document challenges and progress made during simulation exercises within MoHW and apply varying kind of scenarios on various disease and non-disease hazards to ensure that preparedness and response capacities are tested effectively.

4.5.1.12.1 Develop updated guidelines and training for Emergency Operation Center Management.

4.5.1.12.2 In line with national priorities for the health sector build capacity of the Rapid Response Teams (RRT) in terms of event-based surveillance and promote an integrated diseases surveillance response.

4.5.1.12.3 Develop Standard Operating Procedures for implementation of events-based surveillance.

4.5.1.13 Clarify roles and responsibilities between NDRRMC and MoHW during for health event of national concern.

4.5.1.14 Formalize and align all communications and coordination protocols and standard operating procedures (SOPs) formulated in the draft Multihazard Plan.

4.5.1.15 Build national capacity to undertake better detection, assessment and response to major epidemic and pandemic-prone diseases.

4.5.1.15.1 Develop, implement and test the national preparedness plan, incorporating the medical and non-medical response.

4.5.1.15.2 Carry out a Hospital Safety Index (HIS) assessment for the PHC network in order to gauge the probability that hospitals and health facilities will continue to function in emergency situations.

4.5.1.15.3 MoHW to develop a plan promoting epidemic and pandemic preparedness including sectors such as tourism and education through the school programme.

4.5.1.15.4 Promote GIS capacity building for prevention, preparation, detection and rapid response to and recover from outbreaks and emergencies.

4.5.1.16 MOHW to lead a multi-sectoral all hazard risk assessment and mapping of the health sector.

4.5.1.17 Encourage the short-term return of health professionals from the diaspora (on a voluntary basis or through incentives) to participate in new initiatives and provide training in the public health sector.



Verbe être au Présent
 Je suis
 Tu es
 Il/Elle/On est
 Nous sommes
 Vous êtes
 Ils/Elles sont

Verbe jouer au Présent
 Je joue
 Tu joues
 Il/Elle/On joue
 Nous jouons
 Vous jouez
 Ils/Elles jouent

Verbe lancer au Présent
 Je lance
 Tu lances
 Il/Elle/On lance
 Nous lançons
 Vous lancez
 Ils/Elles lancent

Mr Pierre is in a boat near the reefs.
 Every morning he is there. At 7 o'clock he goes in his boat. When he starts catching fish.
 At one o'clock he stops fishing and goes home.
 There he sells the fish to the market.
 Finally, he returns home.

Photo: United Nations Country Team Mauritius

4.6. EDUCATION.

When we assess DRM capacities in the education sector, what are we considering?

- Awareness (government, private sector, population)
- Legal and policy framework assigning roles and responsibilities
- Organizational and institutional arrangements effectiveness
- Coordination (inter-ministerial, central-local, public-private, DRR-CC)
- Financing

Introduction:

A diagnosis of capacities for disaster risk reduction and climate change adaptation within the education sector typically entails two different analytical perspectives. Firstly, the extent to which the education sector caters for the need to create capacities and expertise for DRR and CCA in the country including creating and sustaining an offer of distinct high quality tertiary education; to raise awareness amongst school directors, teachers and pupils as well as parents

on how to be prepared for the event of a hazard turning into a disaster; as well as the measures needed to actively reduce disaster risk in the very own educational institution. Secondly, the education sector typically disposes over a large amount infrastructure that needs to hazard proof, such as schools and universities. Therefore, it is important to also consider the capacities of the sector to actively reduce disaster risk, for instance by relocation of schools that are located in the hazard prone areas.

4.6.1. Institutional & policy framework for DRM in education

4.6.1.1 Existing capacities

The Ministry of Education, Tertiary Education, Science and Technology (hereinafter referred to as Ministry of Education, MoE) is responsible for education and skills development systems to construct a cohesive, inclusive and productive society in Mauritius.

The education system is divided into four different geographic zones, in which education institutions are distinguished according to school type: pre-primary, primary, secondary and tertiary.

The MoE sees the integration of DRM in the education sector as crucial in order to increase awareness of disaster causes and effects amongst children, parents and teachers. The objective is to create a safe school culture and empower communities to take preventive as well as preparedness actions.

In order to create national expertise and capacities for DRR and CCA in Mauritius, the education system offers a diploma certificate, a bachelor and master's degree in Disaster management at the University of Technology, that includes courses in DRR, Climate Change, Local and Global Health Disaster Management as well as Humanitarian Logistic and Social Resilience. Courses in Civil Engineering and the Building Environment in local Universities offer modules regarding resilient infrastructural development, especially given the context of cyclonic conditions prevailing in the country.

However, at the primary and secondary school level, curricula do not formally include DRR related content.

Several bodies have a role in DRR in the education sector:

The **Mauritius Institute of Education (MIE)**, the country's curriculum development body, has been requested to include elements of DRR on a cross-curricular basis in school materials and teacher training.

The **MoET Occupational Health and Safety Unit** oversees the safety and security of students, including risks such as, but not limited to, fire hazards. The Ministry implemented an internal reporting mechanism to NDRMC regarding incidents related to hazards in schools.

The Ministry started conducting school risk assessments. Under the DRR Strategic Framework and Action Plan (2012), the Ministry of Environment conducted an assessment of schools in terms of their location in hazard prone areas. The assessment showed that 46 schools in the country were located in areas with a high risk of flooding, inundation and landslides. Consequent to this assessment, MoET relocated the pupils of the Chitrakoot Government School, after the site had been identified to be in a landslide prone area.

The mapping of schools was part of the JICA supported project carried out by the former Ministry of Public Infrastructure and Land Transport (MPI) on landslide management⁹⁶. Additional measures such as surveys and constant monitoring have been carried out by the Technical Staff of MPI for upgrading works and ancillary works in the school compound.

With respect to DRR financing, the government makes a significant budgetary allocation to the education sector (10,8 % of total government expenditure in 2018-19), but there is no separate budget line for DRR, and it is therefore not possible to estimate how much is being allocated on education related to DRR.



KEY CHALLENGES

- DRR is not integrated into the primary and secondary school curricula despite significant impact of hydrometeorological hazards and the potential risks of epidemics and pandemics.
- Lack of established system for loss and damage accounting to record and consolidate disaster damage to control infrastructure and number of days of school closure.
- There is no comprehensive school safety framework that would include regulation to conduct regular and country-wide school safety/disaster risk assessments.
- Although tertiary education institutions offer courses and degrees related to DRR, there is a lack of engineering diploma for resilient infrastructure development.
- Despite investment in DRR, there is no separate budget line for DRR.

4.6.1.2 Recommendations



4.6.1.2.1 Define the DRR budget out of the general MOE budget in order to prepare the schools training program, conduct regular mapping and assessment of school safety and other risk reduction and preparedness activities.

4.6.1.2.2 Track education investment in DRR.

4.6.1.2.3 Develop DRR modules for primary and secondary education curricula in close collaboration with NDRMC and provide teachers with a training on new DRR modules in curriculum.

4.6.1.2.4 Establish a loss and damage database for the education sector.

4.6.1.2.5 Implement a comprehensive school safety framework.

4.6.1.2.5.1 Conduct nationwide school safety risk assessment, at first prioritizing the educational institutions that are located in disaster prone areas and implement preventive measures including possible relocation.

4.6.1.2.5.2 Establish an emergency preparedness plan for the education sector and develop SIMEX modules at school level.

4.6.1.2.6 Expand offer of tertiary education curriculum in civil engineering applied to resilient infrastructure and expand student exchange programmes in civil engineering (potentially with India).

4.6.2. Preparedness for response and recovery

4.6.2.1 Existing capacities

The MoE has a well-established “School Emergency Response Plan” which has been updated in 2018 and which is currently reviewed by all schools. The plan defines roles and responsibilities of the School Disaster Management Committee, the School Emergency Crises Cell and the School Emergency Response Team. Furthermore, principals have the authority to close schools or suspend classes for 24-48 hours following the destruction of school facilities.

In order to increase the awareness of students and education personnel for different hazards and their likelihood of occurrence in the distinct area, the School Emergency Response Plan clearly defines procedures for command and communication, different levels of alertness, alarm detecting systems, firefighting equipment and provides the schools with distinct site maps. It also includes the assembly point, evacuation and

escape routes during and in case of a disaster. Scenarios principally focus on severe weather events such as flash floods, torrential rain, thunder storms, landslides, heavy swells, bush fire, spills, tsunami as well as earthquakes. Simulation and evacuation exercises related to the hazards mentioned above are carried out periodically.

There is good interaction of MoE with Communities, National Disaster Risk Reduction and Management Center (NDRRMC), the Mauritius Police Force (MPF) and other schools.

In order to assess the level or preparedness of the schools in Mauritius MoE has sent a questionnaire to all school directors in order to receive feedback on the emergency preparedness activities.

4.6.2.2 Recommendations



4.6.2.2.1 Develop and integrate epidemic and pandemic preparedness into teacher training curriculum and school’s programs. Standards precautionary measures as well as major disease agents should be part of the curriculum.

4.6.2.2.2 Monitor implementation of School Emergency Response Plan.

4.6.2.2.3 Establish a joint bilateral agreement between National EWS NDRRMC and MoE for the set-up of quarterly awareness sessions, including simulation exercises in all schools.

“The steady growth of disaster risk, including the increase of people and assets exposure, combined with the lessons learned from past disasters, indicates the need to further strengthen disaster preparedness for response, take action in anticipation of events, integrate disaster risk reduction in response preparedness and that ensure capacities are in place for effective response and recovery at all levels. Empowering women and persons with disabilities to publicly lead and promote gender equitable and universally accessible response, recovery rehabilitation and reconstruction approaches are key. Disasters have demonstrated that the recovery, rehabilitation and reconstruction phase, which needs to be prepared ahead of the disaster, is a critical opportunity to build back better, including through integrating disaster risk reduction into development measures, making nations and communities resilient to disasters.”

Sendai Framework Priority for Action IV.



5. P R E P A R E D N E S S .

When we assess disaster preparedness capacities, what are we considering?

- Risk analysis and its application to early warning and surveillance
- Institutional and policy framework for preparedness and response
- Resource allocation for response, preparedness and recovery
- Contingency and response plans
- Training and exercises
- Emergency services, standby arrangements, prepositioning

Overview:

The Republic of Mauritius has a strong legal and institutional framework for disaster preparedness and response at national and local level, and the DRM structure is decentralized. Mauritius is well known for its community preparedness, especially with respect to cyclones. Funding mechanisms for preparedness and response efforts are in place. There is a functioning early warning system for hazards such as cyclones, tsunamis and epidemics and, to a lesser extent, floods and landslides. To further strengthen the prepared

ness and response system, a significant effort is required to improve risk identification and information management system, and in particular flood early warning. A number of guidelines and arrangements need to be further enhanced ranging from the design of simulation exercises to the pre-positioning of emergency stocks. Finally, existing capacities are tailored to manage average magnitude of disasters and the country must review its system to manage more complex emergencies such as industrial accident or whole-of-island pandemic.

5.1 Hazard/ Risk analysis and early warning

5.1.1 Existing capacities

The Republic of Mauritius produces a wealth of disaster risk data. There are surveillance systems in place to monitor various dimensions of risk (water quality and water availability; extreme weather events through a network of observation stations; epidemics; crop and livestock diseases). There is a good understanding of tropical cyclones risk and there have been some progress in mapping flood and landslide hazards. The availability and access to risk information is described in detail in Chapter 1 of this report.

Building on the information produced and the various surveillance systems, the country has a relatively strong Early Warning System (EWS) in place. The National Disaster Risk Reduction and Management Act (2016) includes legal provisions

for the establishment of a multi-hazard early warning system and assigns clear responsibility to the Mauritius Meteorological Services to “develop and improve warnings and advisories systems for all-natural hazards affecting Mauritius and implement a national multi-hazard emergency alert system to provide accurate and timely advice to the public and key stakeholders”.

The Mauritius Meteorological Services is the institution responsible for issuing warning, including for non-meteorological events, for cyclones, torrential rains, tsunamis, high waves, strong winds. It relies of a network of 30 automatic station and 200 rainfall stations (the later not providing real time data). It also monitors tide gauges for the risk of storm surges.

The Mauritius Meteorological Services produces various climate services products based on the analysis of meteorological data, including: a 24-hour weather forecast issued three times a day, a 7-day weather forecast issued daily, observations of temperature, humidity and wind speed at 21 locations, the past 24 hour figures for rainfall (also past 3 hours), a monthly agro-climatic bulletin and seasonal forecast for farmers; precipitations for the national water authority/ water monitoring committee; daily bulletins for fishermen in the whole archipelago, national coast guards, the national Port Authority and the aviation. The EWS appears to function well with timely warnings. An alert system exists based on agriculture zone and community involvement (volunteers, etc.). The dissemination of early warning messages makes use of sms messaging and is secured through a back-up mechanism through the VHF in case the network breaks-down.

The EWS is well-integrated into the regional and international systems. Mauritius is a member of the RA I Tropical Cyclone Committee for the South-West Indian Ocean, for which Mauritius is a sub-regional centre, and the South West Indian Ocean Climate Outlook Forum (SWIOCOF). Mauritius contributes to the Monitoring of Environment and Security in Africa (MESA) programme of SADC which uses satellite Earth Observation data and land-based monitoring technology to monitor drought, wild fire and flood risk.

One best practice is the involvement of communities in the alert system in place for torrential rains - which can also be used for the risk of flash floods. It is based on river basin and capitalizes on community involvement (local government, police and community volunteers). After the meteorological station issues a torrential rains warning, it is followed by a communiqué from the Ministry of Education ordering the temporary closure of all educational institutions. Public sector employees and, to some extent private sector employees, are instructed to return back home due to risk of flooding of major road networks.

Furthermore, the Ministry of Health and Wellness manages the surveillance and EWS system for pandemic and epidemics, which is efficient and allows for timely implementation of preventive measures. This EWS has been successfully tested during the plague outbreak that affected Madagascar in 2017. The epidemic surveillance is closely linked with the RSIE (Réseau de surveillance et d'investigation épidémiologique) initiated by the Indian Ocean Commission. The analysis of the surveillance system is described in detail under the health Chapter.

For other type of biological threats, the Ministry of Agro-Industry & Food Security has a surveillance system in place to monitor the risk of animal / plant diseases that is described in detail in the agriculture chapter. The National Plant Protection Office provides services in Laboratory Analysis and Diagnostics for Pest and Disease identification which covers a wide spectrum of diseases. The Veterinary Services Division provides 24 hour-free service to all breeders of animals at the Animal Health Laboratory. The Albion Research Centre conducts screening of potentially toxic fishes and harmful microalgae/ ecological surveys and monitor water quality for the conservation of aquatic biodiversity and the marine environment. The National Parks and Conservation Service & Forestry Service monitor/control the invasive/alien species of animal and plants.

Finally, the Ministry of Energy and Public Utilities monitors dam security and has established modelling and scenario building for disaster risk management including early warning/early action. The Central Water Authority maintains a water table to monitor daily the quality and quantity of water in the reservoir system. The Waste Water Management Authority monitors the industrial disposal into the rivers.

KEY CHALLENGES

- Impact monitoring of early warning is lacking to assess the efficiency of the system.
- The EWS is relatively weak for flood risk and forest fire, pest and epizooties.
- Meteorological data from Rodrigues and the Outer Islands is currently being sent to the main Island for analysis before being reissued in the form of forecasts. This necessarily involves a time lag. While cost effectiveness is undoubtedly a major consideration, it may be worthwhile to examine whether weather forecasting facilities can be established on Rodrigues Island at least.

CAPACITY GAPS

- There is no established alert mechanism for fire forest, pests and epizooties. Such threats are communicated on an ad hoc manner.
- The network of observation stations is insufficient. The number of automatic weather stations and the number of river gauges to monitor river levels need to be increased to improve flood, including flash flood forecasting. Similarly, the network of sea level monitoring stations could be increased to monitor wave heights and provide timely information to fishermen of main island and Rodrigues.
- There is no mechanism in place to ensure that alerts are well received by the communities at risk, and that adequate measures (early action) are being implemented. For example, when NDRMMC shares an alert with the “association des hoteliers”, there is no feed-back mechanism allowing the NDRMMC to follow-up if the alert is well received by the clients and whether adequate measures are undertaken.

5.1.2 Recommendations



5.1.2.1 Increase the number of automatic weather stations, river gauges and sea level monitoring stations as well as budget allocation for maintenance and monitoring.

5.1.2.2 Explore the cost efficiency of establishing a weather forecasting capacity in Rodrigues Island to decrease warning time. This would include determining the capacity needs; developing a Standard of

Procedure describing the complementarity with the National Weather forecast and providing the required training.

5.1.2.3 Establish a feed-back mechanism for priority hazards such as cyclones and floods to be tested during the SIMEX.

5.1.2.4 Develop early warning messages for specific vulnerable groups such as migrants.

5.2 Information management and communication

5.2.1 Existing capacities

Neither the National Disasters Scheme (2015) nor the National Disaster Risk Reduction and Management Act (2016) make provisions for an information management system. The National Emergency Operations Command (NEOC) relies on the communication and intelligence system of the Mauritius Police Force. NDRRMC collects data on historical events for the last 30 years including location, deaths and damage. This data is not geo-coded. With respect to vulnerability analysis, NDRRMC relies on the Social Register of Mauritius for updated data on household vulnerabilities. It also maintains data on squatters living in hazard prone areas to plan the process of evacuation and relocation.

NDRRMC organigram (2019) includes an information management and early warning unit falling under the Response Directorate. It is composed of three officers: ICT specialist; Information & Communication Manager and a Disaster Monitoring Officer (DMO).

The NDRRMC DMO TOR includes information management related tasks such as “liaising with the Mauritius Meteorological Services in the monitoring of climatic concerns and weather patterns; provide timely advice on disaster threats both before and during a response; evaluate activities relating to the monitoring and forecasting and disasters”. The TOR does not require specific competencies neither in information management nor in GIS. NDRRMC also has an emergency communication position.

KEY CHALLENGES

- Absence of central information system.
- Limited capacity in data collection and analysis to inform response and preparedness efforts.

CAPACITY GAPS

- There is no centralized data / information system and therefore limited awareness of what data is available from whom at time of response.
- Lack of baseline. Pre-disaster baseline information does not exist and not archived at the NDRRMC, while this kind of data is critical for post-disaster analysis. Furthermore, eventual baselines available at the ministry level are not centralized at the NDRRMC.
- Response Assessment tools and methodologies must be revised and harmonized. The existing forms and mechanism of data collection and reporting are tailored for minor disasters. They differ from one sector to another and from one year to another.
- NDRRMC positions for information management and disaster monitoring are yet to be recruited. Information & Communication focal points are also needed at local level. TOR for information officer go beyond producing reports during an emergency phase.
- ITC equipment is required including cloud GIS as well satellite phones as back-up if telecoms infrastructure is damaged during disasters.

5.2.2 Recommendations



5.2.2.1 Establish an Information Management Unit at NDRRMC directly reporting to the Director General with the responsibility to perform information management and communication functions in support of preparedness, response and prevention activities.

5.2.2.1.1 Develop the ToRs of the Unit.

5.2.2.1.2 Review the job description to meet the ToRs.

5.2.2.1.3 The Information Management Unit must be allocated a budget line for regular training in both information management and communication for junior technical staff at NDRRMC.

5.2.2.1.4 Procure necessary ICT equipment and software including GIS and satellite phones for central and local level.

5.2.2.2 Recruit NDRRMC positions for information management and communication and allocate budget for their continuous training over several years. Information and communication focal points at the local level must also benefit from the continuous training.

5.2.2.3 Harmonize the multisector needs assessment process.

All humanitarian stakeholders must be trained on the concept of post-disaster assessment process which includes the types of assessment, the timeline, the adequate tools and methodology and the reporting process. The concept of MIRA (Multi-Initial Rapid Assessment) can be also introduced in order to complete the cycle.

5.2.2.3.1 Provide training on the concept of assessment to all the involved actors.

5.2.2.3.2 Develop the methodology and tools (Annexes. Example of baseline/ key indicators to be centralized – model of assessment tools).

5.2.2.3.3 Ensure that rapid needs assessment teams are multi-sectoral and cover different levels (national and local, including Rodrigues).

5.2.2.3.4 Develop SOPs for the data collection and analysis process.

5.3 Legal and policy framework for DRM

5.3.1 Existing capacities

The legislative framework for disaster preparedness is strong. Roles and responsibilities are clear and understood down to the local level.

The **National Disasters Scheme** (revised 2015) is a key regulation for disaster management as it details agencies' roles and responsibilities in the management of various hazards: cyclone, tsunami, landslide, torrential rains and floods, high waves, earthquake and water crisis.

The **National Disaster Risk Reduction and Management Act** (2016) is a good piece of legislation when it comes to disaster preparedness and response. It provides great clarity on the structures to be activated in crisis situations such as the national crisis committee, the national emergency operations command (NEOC), the disaster response unit (within the Special Mobile Force, SMF), the local DRR/M committees, and the local emergency operation command (LEOC). It also clarifies the institutional set up for Rodrigues. The legislation covers both the issues of policy making processes in normal times as well as the command and control chain and functions during disasters. Key elements of preparedness and response

are legislated such as the declaration of state of emergency, the request to international assistance and facilitation on its entrance in the country, provisions for evacuation of population, etc.

CAPACITY GAPS

- Lack of clarity on NDRRMC function during certain disasters such as epidemic, epizooties, pests, oil spill, fire-forest and social unrest. This limits NDRRMC coordination & information management & reporting role during emergency period.
- Budget for recovery and reconstruction is not stated in the existing Act.
- The legislative framework does not provide detail about the facilitation of international assistance in case of a major disaster. Even the probability of such event is not high, massive international assistance need to be anticipated.
- Lack of legal and policy frameworks targeting Internally Displaced People.

5.3.2 Recommendations



5.3.2.1 Improve legislation and tools to anticipate facilitation of the entrance of international aid.

5.3.2.1.1 Consider adapting IFRC international disaster response law (IDRL) to the local context and constrains.

5.3.2.1.3 Adapt and domesticate AU Kampala convention.

5.4 Institutional framework and coordination mechanisms

5.4.1 Existing capacities

The **National Disaster Risk Reduction & Management Centre (NDRRMC)** has been administratively set up since 23rd October 2013. It now operates under the Ministry of Local Government and Disaster Risk Management⁹³. It acts as the focal institution for the planning, organizing, coordinating and monitoring of disaster risk reduction and management activities at all levels. It has a regular annual budget allocation for running costs. At time of crisis it hosts the National Emergency Operations Command (NEOC) which is the command authority. NDRRMC previous anchoring under the Ministry of Environment created a number of hindrances in the fulfillment of its functions. The recent change in the institutional anchoring of NDRRMC from the Ministry in charge of Environment to the newly established Ministry of Local Government and Disaster Risk Management is expected to improve its convening power and coordination function between the different sector ministries.

NDRRMC organizational structure is still under development. Its current organizational structure was designed for Preparedness, Response and Recovery. Out of the ten professional staff budgeted for, six were still under recruitment in 2019. An ad hoc arrangement has been in place with ten staff seconded from the Mauritius Police Force (MPF) who perform, de facto, some of NDRRMC functions. The team seconded from the Mauritius Police Force, under the leadership of the Deputy Commissioner of Police, has allowed the newly established NDRRMC to perform core functions of coordination of preparedness for response efforts (including through the organization of regular SIMEX, community education and awareness raising).

There is a funding mechanism available for immediate emergency response and relief activities, mainly the Prime Minister's Relief Fund. This fund can be supplemented by the National Social Inclusion Foundation and the National Empowerment Foundation under the control of the Ministry of Social Integration, Social Security and National Solidarity (MoS). Over 12 500 people affected by disasters have benefited from social protection schemes for disaster victims by MoS. Allowances were paid out to: 4,000 households affected by floods, and 147 households victim of fire.

With respect to coordination of response efforts, the National Emergency Operations Command (NEOC) is activated when a disaster/major crisis is imminent, and coordinates activities using the Police command, control, coordination and communication system. It is a multi-agency entity, and includes representatives from other Ministries/Departments, emergency services, NGOs, and the private sector.

At the local level, **Local Disaster Risk Reduction & Management Committees (LDRRMC)** have been established within all Municipal and District Councils along with the appointment of Local Disaster Management Coordinators. In the localities visited, there is evidence that the committees have been meeting regularly under the leadership of the mayors and the Chairperson. Overall, there is a good level of integration between the central and local / municipal level.

KEY CHALLENGES

- Predictable funding for response, preparedness and recovery.
- Limited engagement in international humanitarian assistance networks.
- Limited engagement and coordination mechanisms aiming to ensure inclusion of foreign nationals, migrants and tourists in the relevant DRM plans.

CAPACITY GAPS

- Funding allocation mechanism for Response, Preparedness and Recovery is unclear. Additionally, it is difficult to track preparedness expenditures made by many ministries on community awareness, shelter equipment, exercises etc. A system by which such spending is separately accounted for should be devised.
- Insufficient Engagement with International Disaster Response Networks. For the Republic of Mauritius, participation and integration into the international institutional mechanisms that deal with disaster preparedness and response are very limited. There is limited awareness on the existence and added value of being connected with international networks.
- Lack of procedures for facilitation of incoming international assistance in the event of a major disaster. In the event of Mauritius being subjected to a major disaster, it is quite likely that the international community would be quick to offer assistance to the country and the Government may decide to accept it according to the NDRRM Act 2016. In such an eventuality, international assistance would

arrive quite rapidly by air and sea. For this to be assimilated smoothly into the ongoing national response, it is necessary that Governmental procedures for accepting incoming international assistance be in place already. The NDRRM Act 2016 refers to the Customs Act which generally is a classic facilitation and not systematically adequate to respond to a disaster. The procedures would need to cover issues such as Customs exemptions for incoming relief supplies including medicines, recognition of foreign medical qualifications of incoming medical teams, import of communications equipment by incoming relief teams and clarification of financial liabilities. In addition, these procedures should cover the establishment of institutional structures required to coordinate incoming international assistance and amalgamate it with ongoing national response such as Reception Centres, On Site Operations Coordination Centres etc

- Insufficient institutional interaction with Rodrigues Island. Rodrigues Island is the second most populated island and it is more prone to cyclones than the main island. There is no representation from Rodrigues Island in the NDRRM Act in Mauritius and very little training or cross fertilization interaction between the Fire and Rescue Services of Mauritius and Rodrigues Island.

5.4.2 Recommendations



5.4.2.1 Establish NDRRMC organizational structure with a full-fledged team of DRR/M professionals.

5.4.2.2 Establish more predictable mechanisms for response, preparedness and recovery.

5.4.2.3 Put in place a mechanism to monitor funds spent by Ministries and Government bodies on disaster preparedness activities.

5.4.2.4 Enhance interaction with international disaster response networks.

5.4.2.5 Enhance interaction with consular officials, labour attachés and other personnel of institutions mandated to serve and assist nationals abroad.

The United Nations Office for the Coordination of Humanitarian Affairs (OCHA) manages most of these response networks such as the International Search and Rescue Network (INSARAG), the UN Disaster Assessment and Coordination Team (UNDAC), Humanitarian Military Coordination, Environment Emergencies Partnership, etc. These networks set mutually acceptable international standards, hold regular training exercises and are mostly organized in geographic Regional Groupings. Mauritius being a relatively small country, it would gain significantly by becoming a member of, and engaging in these networks. Participation is also cost effective as a Member State has only to pay of the costs of the participation of its own personnel.

5.4.2.6 Enhance regulation and mechanism to facilitate the entrance of international aid.

- Step 1: Domestication of the International Disaster Response Law (IDRL). This is an International Federation Red Cross initiative at the global level and supported by OCHA. IDRL is a global framework and can be tailored based on the context and constraints at the country level.
- Step 2: Integration of the ASYREC (Automated System for Relief Consignment) software into the Customs mechanism. ASYREC is an additional module that can be integrated into the SYDONIA++ and can be activated only during emergencies to facilitate and accelerate the entrance of international aid. ASYREC is a joint initiative of CNUCED and UNOCHA.

5.4.2.7 Establishment of a Rodrigues liaison section within the organizational structure of NDRRMC.

5.5 Contingency planning

5.5.1 Existing capacities

The concept of contingency planning is well appropriated and implemented in Mauritius. Under NDRRMC coordination, almost every sector, depending of the potential hazards, has developed its own contingency plan. The following hazards are covered: cyclones, flash floods, tsunamis, torrential rain, high waves, earthquakes, landslides, water crisis, oil spill, epidemic, epizooties and pests.

The establishment of NDRRMC appears to have been a catalyst in the contingency planning process. At NDRRMC level, there are detailed emergency schemes promulgated by NDRRMC for these different hazards. The contingency plans and emergency schemes cover both national and local Government actions and there seems to be good collaboration and synergy between these two levels of Government. The Contingency Plan of the Ministry of Education is worth mentioning for being practical and thorough.

Furthermore, there are a minimum of Preparedness Actions at national and local government levels. After perusing the status of preparedness actions for disasters at both national and local level, it is felt that these are well synchronized and adequate for the types of potential hazards. Activities such as the designation and manning of Emergency shelters as well as the Ministry of Education's vulnerability analysis of all schools show a good collaboration between both levels of Government.

KEY CHALLENGES

- Limited integration of NGOs, Private Sector and Consular Officials in Disaster Preparedness, including the contingency plan.
- Uneven quality of contingency plans

CAPACITY GAPS

- NGOs are well connected to communities and have significant capacities to execute disaster preparedness functions. There was a noticeable absence of NGO participation in contingency planning or other disaster preparedness activities. Even during the national SIMEX, it was observed that there was no involvement of national or international NGOs in the exercise. Besides not utilizing an existing capability, this also detracts from the realism as NGOs will certainly be present in an actual disaster. The only commendable involvement of the private sector in government DRR activities was the contractual utilization of POLYECO in hazardous waste management.
- Contingency plans do not systematically include all the key elements such as the potential scenario, the threshold/triggers to activate the plans, the post-disaster assessment process, and the existing capacities and potential financial gaps. This means that all the existing contingency plans are not budgeted and are not scenario-oriented. The absence of these key elements is an important gap as actors and Government don't know ahead of any disaster the magnitude of any potential emergency situation in order to allow them to be prepared financially and logistically.
- The national oil spill contingency plan was done 25 years ago. For tier 2 and 3 emergencies the government does not have the required capacity and contracted out the response to South Africa experts to pump out the oil.
- The hazardous material national plan is still not approved
- Limited contingency planning arrangements targeting foreign nationals (migrants and tourists).

5.5.2 Recommendations



5.5.2.1 ERP Training - Reinforce understanding of emergency response and preparedness (ERP) through training on ERP.

5.5.2.2 Joint Planning - Conduct annual preparedness planning including NGOs, Red Cross and private sector to develop emergency scenario for priority risk and update mapping of actors and pre-positioned stocks.

5.5.2.2.1 Identification of potential risks and scenario based on annual basis.

5.5.2.2.2 Mapping of actors, including NGOs and private sector: who does what where, mapping of capacities.

5.5.2.2.3 Distribution of tasks depending on agencies' mandates.

5.5.2.3 Oil spill contingency plan.

5.5.2.4 Hazardous material national plan must be approved as a matter of emergency.

5.5.2.5 Develop a Mass Evacuation in Natural Disasters Contingency Plan targeting local population as well as foreign nationals (migrants and tourists) using the based MEND Guide.

5.5.2.6 Early Warning - Establish a feedback mechanism for priority hazards such as cyclones and floods and refine threshold/triggers to activate contingency plans.

5.6 Training & Exercises

5.6.1. Existing capacities

Conducting regular simulation exercises (SIMEX) is a common practice in the Republic of Mauritius. At least one SIMEX is conducted every year by the NDRRMC. At national level, SIMEX are conducted bi-annually. Some sectors such as tourism, fisheries, environment (oil spill) also conduct SIMEX. Mauritius also participates in inter-islands exercises with the Indian Commission, such as the Tsunami Warning Indian Ocean Exercise. Regular training involving communities (training of Community Disaster Response Teams) is quite satisfactory and considered a good practice.

While the establishment of the evacuation plan is mandatory, this is not the case for the organisation of SIMEX. In addition, each SIMEX is hazard specific or focused on a specific thematic, such as accident, evacuation, etc. There is no SIMEX covering simultaneously divers thematic and cascading risks.

KEY CHALLENGES

- Awareness training for children. The Government may like to examine the feasibility of introducing children quite early to disaster response drills in the form of games and other child friendly activities.

- **Realism in conduct of simulation exercises (SIMEX).** National level SIMEX is conducted bi-yearly to test national response to a disaster event. The CADRI team participated as observer in a simulated a passenger aircraft crash away from the airfield. The SIMEX saw the comprehensive involvement of emergency responders such as SAMU, the Mauritius Fire and Rescue Services, Police, SMF etc as well as volunteer services such as psychologists to interact with relatives. Their actions were prompt and commendable. However, it was observed that all participants in the SIMEX had prior knowledge of the location of the disaster site, number of victims, timing of the event and other details of the exercise. This prior knowledge reduces the effectiveness of the exercise as it eliminates the ability to gauge the effectiveness of the response of various Agencies and entities to a sudden disaster event which occurs without warning. It is suggested that future SIMEX be conducted on a 'no warning' basis to derive full benefit from the exercises.

CAPACITY GAPS

- **Lack of facilitators team.** Facilitators team who is trained specifically to facilitate SIMEX does not exist both within the NDRRMC and the Ministries. The roles of facilitators are to prepare the ToRs of the SIMEX, establish the scenario, the injects and the master plan of the SIMEX, facilitate the SIMEX itself and organise the debriefing session. SIMEX guideline exists which is produced by the Inter-Agency Emergency Simulation (IAES), a joint United Nations Agencies initiative (OCHA, UNICEF and WFP).
- **Lack of information management products during the SIMEX.** Information management products are key when there is an emergency and must be developed and tested during a SIMEX. Lack of visuals and infographic at the NEOC was observed during the SIMEX; this is mainly due to the absence of the IM Unit at the NDRRMC.

5.6.2 Recommendations



5.6.2.1 Simulation Exercises: Improve the practice of simulation exercises (SIMEX)

5.6.2.1.1 Carry out realistic SIMEX on a 'no warning' basis to derive full benefit from the exercises.

5.6.2.1.2 Establish and train a pool of SIMEX Facilitators among NDRRMC and ministries staff.

5.6.2.1.3 Conduct SIMEX for most likely hazards including for epidemics.

5.6.2.2.4 Develop SIMEX modules for schools

5.6.2.1.5 Adjustment of the IASC SIMEX standard guideline to be applicable to the Mauritius context.

5.6.2.1.6 Consider a SIMEX for mass evacuation of population targeting both national population and foreign nationals (migrants and tourists).

5.7 Emergency services and prepositioning

5.7.1 Existing capacities

The emergency response in Mauritius is based on the Police network which is present at all levels of the administrative boundaries and supported by other emergency services such as the Mauritius Fire and Rescue Services and SAMU which are long standing, professional and well-established services manned by staff with experience. This coupled with the small size of Mauritius ensures that in the event of a disaster, search and rescue interventions is likely to be timely and efficient.

Disaster Response Unit. The recent decision to raise a Disaster Response Unit (DRU) with a multi hazard response capability within the Mauritius Police Special Mobile Force is a sound and positive step. Currently, this DRU is of Platoon strength and is to be enhanced to Company strength. This DRU, once fully raised, will give the Government a central reserve response capacity to deploy to augment the local capacity if needed. This final DRU Company strength capacity should be enhanced by at least one more Platoon which could be located in rotation in Rodrigues Island thereby enhancing the response capacity in that vulnerable location.

Emergency Levels in Government. There are three emergency response levels in NEOC. The NEOC is activated solely for the purpose of coordinating all activities during a disaster and makes use of the well-established command, control, coordination and communication system of the Police so as to avoid unnecessary duplication of resources. Depending upon the magnitude and severity or potential magnitude or severity of a crisis/disaster situation, the NEOC may be activated at three levels:

Level I: Monitoring of situation by NDRRMC
Level II: Monitoring by NDRRMC staff assisted by representatives from main first responders
Level III: Full scale activation with designated NEOC Members

There are only two Government Administrative levels in Mauritius i.e. the Local Government and National Government unlike in larger countries where there is an intermediate level such as a State between the Local and National levels. Therefore, the emergency response levels are mismatched with the Administrative levels in Mauritius. If there is a disaster, either it would be localized and within the response capabilities of the Local Government or the National Government would need to step in resulting in the NEOC being activated.

Fire and Rescue Services. The Fire and Rescue Services, both in Mauritius Main Island and Rodrigues, require to be upgraded and given more international exposure. Their equipment held by them is old and needs replacement. There is only one modern Fire Engine in Rodrigues Island and no rescue vehicle capable of being used in a cyclone level wind speeds. Similarly, in Mauritius Main Island, the Fire and Rescue Services equipment needs to be modernized.

As regards training, being an island, the Fire and Rescue Services personnel have the disadvantage of limited contact with other services from different countries to enhance their skills and training facilities and techniques. This needs attention and joining the UN's INSARAG network as recommended in para 11 (c) above or signing MOUs with other countries for exchange visits by Fire and Rescue Services personnel and attending training courses in other countries are actions that should be considered by Government.

Rodrigues Disaster Centre. The Rodrigues Disaster Centre is understaffed with two officers. This is inadequate to fulfil DRR functions. At least one additional technical staff with information management & communication capacity

CAPACITY GAPS

- **Limited pre-positioning.** There is no clear strategy and systematic prioritization on pre-positioned stocks prior to disasters. There was no evidence of a pre-stocked reserve of disaster relief supplies such as tents, blankets, water purification equipment, MREs etc in any location except Rodrigues Island where the Mauritius Red Cross Society had stocked items for 100 people, which is also quite inadequate for a population of 40,000.
- In addition, information and mapping of the pre-positioned stocks is not available at the NDRRMC level, again this would be due to the absence of the Information Management Unit at the NDRRMC organigram. Finally, within the annual NDRRMC and ministries budgets, there are no clear indication concerning the emergency stocks for different potential risks.

5.7.2 Recommendations



5.7.2.1 Alignment of the emergency levels used for planning by NDRRMC with the actual Administrative levels of the Government (Local and National). Have only two emergency levels instead of three as at present i.e. Level 1 for monitoring and Level 2 for activation of NEOC. Level 1 when the disaster situation is within control of the Local Government and NDRRMC is only monitoring it and Level 2 when the disaster situation cannot be handled by the local Government and the NEOC needs to be activated.

5.7.2.2 Upgrade the equipment, training and international exposure of the Fire and Rescue Services both in Mauritius and Rodrigues Island.

5.7.2.2.1 Position one Platoon of the newly created Disaster Response Unit (DRU) in Rodrigues Island in order to enhance the disaster response capacity in this isolated and vulnerable location.

5.7.2.2.2 Join INSARAG as well as enter into MOUs with friendly countries for this purpose.

5.7.2.3 Creating a centrally-held reserve stock of relief supplies.

5.7.2.3.1 This could be for half of the population of Mauritius and 1% of the population of Rodrigues Island in view of its isolated location. The recent experience of the Bahamas and Cyclone Dorian is illustrative of the necessity for such centrally held reserve relief stocks.

5.7.2.3.2 Pre-positioned stocks must be mapped and information from actors must be updated regularly prior to the disaster.

5.7.2.3.3. Allocate specific budget line for disaster emergency stock prepositioning.

5.7.2.3.4. Include local Red Cross, NGOs and regional mechanisms such as PIROI in SIMEX and planning of preparedness/logistics/prepositioning.



Photo: Avinash Ramessur

6. FOCUS ON RODRIGUES ISLAND.

Rodrigues population is proportionally more vulnerable to disasters and less able to manage disaster risks. Rodrigues experiences the same hazards as the main island, however, threats from tsunamis, droughts, and cyclones are more elevated. Most recently cyclone Gelena in February 2019 led to flash floods and population displacement. Rodrigues is also more exposed to episodes of water scarcity. Being a small island with no natural springs, Rodrigues is also facing gradual salt water intrusion into its ground water system which is being aggravated by frequent droughts and intensive irrigated agricultural production from the three valleys that produce vegetables.

Rodrigues Island is characterised by an economy largely dependent upon subsistence agriculture and fisheries, supported by a large public sector, with limited opportunities for private sector development. It has not fully benefited from the rapid economic development experienced on the main island. Rodrigues has a higher number of female-headed households who form a large proportion of the poorest quantile. The housing sector (homes with pitched iron roofs) often sustain more damages than concrete dwellings. This often results in displacement of poor female headed households; forcing them to live in evacuation camps. It is worth noting that there is inter-island internal migration from Rodrigues to Mauritius main island, which are partially driven by climate change and disasters⁹⁴.

The infrastructure sector is affected by cyclones, floods, torrential rains, tsunamis but also dry spells and drought, all of which affect roads, schools, the port, as well as access to water. The airport itself is located in a tsunami prone area. The capacity of the Commission of Public Infrastructure, Housing, Transport and Water Resources to access and apply risk information to development is limited. The housing sector is also quite vulnerable to floods and cyclones. This is the sector where there is noticeable differential impact of disaster based on gender and socio-economic status.

The establishment of the Rodrigues Disaster Risk Reduction & Management Centre is progressing with the support of the NDRRMC. Disaster Management Coordinators have been introduced for the outer islands of St Brandon and Agalega, and are working closely with the NDRRMC. For Rodrigues and the outer islands, appropriate schemes relating to the disasters to which they are vulnerable should be put into place by the office of the Chief Commissioner and Outer Islands Development Corporation (OIDC) respectively.

As far as Rodrigues is concerned, there shall be a Rodrigues Disaster Risk Reduction and Management Council which shall liaise and coordinate with the National Centre on disaster risk reduction and management activities in Rodrigues, and the Rodrigues Disaster Risk Reduction and Management Centre shall be responsible for coordinating and monitoring the implementation of disaster risk reduction and management activities as per the Strategic Framework and Plan for Rodrigues.

In the event of a disaster in Rodrigues, there shall be a Rodrigues Crisis Committee which shall supervise the conduct of disaster response operations and take such other measures as may be appropriate in the circumstances.

Moreover, the Rodrigues Emergency Operations Command, which is headed by the Divisional Commander, Rodrigues Police Division shall, in the event of a disaster, lead disaster response operations with the assistance of the Rodrigues Centre. There shall be a Rodrigues Disaster Risk Reduction and Management Council.

The Rodrigues Council shall consist of :

- the Chief Commissioner, who shall be the chairperson
- the Deputy Chief Commissioner, who shall be the vicechairperson;
- every Commissioner who is assigned responsibility for a Department of the Rodrigues Regional Assembly
- the Island Chief Executive
- the Departmental Head of every Commission
- the Divisional Commander
- the Director, Health Services, Rodrigues
- the Officer in Charge, Meteorological Services, Rodrigues
- the Officer in Charge, Fire Services, Rodrigues
- the Officer in Charge, Water Unit, Rodrigues

- the Manager, Central Electricity Board, Rodrigues
- the Chairperson, Rodrigues Council for Social Services
- a representative from the private sector
- a representative of the Mauritius Red Cross Society.

The Rodrigues Council may, where it considers necessary, co-opt any other person with relevant expertise not already available so as to assist it in relation to any matter before it. The Rodrigues Council shall meet as often as its chairperson may determine but at least once every 3 months.

6.1 Managing disaster risk in the agricultural sector

The local government and farmers are dependent on:

- the National Meteorological Service for weather/climate observations, forecasts and longer-term climate change related analysis.
- the national and regional expertise (e.g. Indian Ocean Commission) for biosecurity surveillance and disease outbreak response.

There are limited local capacities to analyse and transform the meteorological information into advisory for farmers. The land suitability map developed for the island is expected to be the main tool for planning the natural resource management. The map is based on detailed soil content survey/analysis and additional research/resources are needed in order to use it for mapping landslide/flood risk prone areas. The damage and loss assessment is conducted by agriculture sub-sectors using different approaches.

The local epidemiology service at the Commission of Agriculture have very low capacities to conduct early detection and response in case of animal disease/pest outbreak. The biosecurity plan for the island is however developed. The crop calendars are not updated and climate proofed. The livestock shelters are very fragile and do not protect the animals in case of a cyclone. No insurance scheme for agriculture sector is available.

There is no formal information exchange modality between the Rodrigues Disaster Risk Reduction and Management Centre (RDRRMC) and the Commission for Agriculture. Cases of false/untimely warning are occurring. There is no inventory of agriculture emergency stocks is available. No SIMEX was conducted for biosecurity risk.

6.1.1 Recommendations



6.1.1.1 Explore the possibilities of building on the Land Suitability Database and Map for hazard risk mapping.

6.1.1.2 Provide opportunities for the local epidemiology experts to participate in the regional trainings, workshops, conferences related to biosecurity, animal health, plant pest and disease control.

6.1.1.3 Capacitate the local epidemiology unit, provide additional laboratory equipment for early detection and control.

6.1.1.4 Capacitate National Meteorological Service to deliver localized forecast, including agro-meteorological advisory for Rodrigues.

6.1.1.5 Review the cropping calendars considering the changing climate patterns.

6.1.1.6 Institutionalize exchange of information on disaster risk reduction between the Commission for Agriculture and the RDRRMC.

6.1.1.7 Introduce the scheme for building animal shelters.

6.1.1.8 Explore the option for introducing crop and livestock insurance.

6.1.1.9 Conduct inventory and regularly update the agriculture emergency stocks.

6.1.1.10 Conduct SIMEX exercise focused on the outbreak of animal disease.

6.2 Managing disaster risks in the environment sector

The Rodrigues Commission of Environment seems best positioned to support disaster risk reduction and climate change adaptation. It has the largest portfolio, which includes agriculture, environment, fisheries, forestry, marine parks, coastal zone management, solid waste management among other thematic areas. The main hazards threatening the natural environment include cyclones, torrential rains causing extensive soil erosion, coastal erosion due to high sea-level rising, high sea temperature rising causing extensive coral bleaching.

Generation and analysis of risk information to inform development decision making processes in Rodrigues is very limited. It was noted that several studies on Rodrigues have been conducted by the former Ministry of Social Security, National Solidarity, and Environment and Sustainable Development, however, such information has often not been shared with Rodrigues. It was also noted that the Commission has very limited capacity on GIS and risk analysis in general making it difficult for the Commission of Environment to provide guidance to other sectors. Much like Mauritius, some element of risk analysis is conducted in relation to major development projects through the Environment Impact Assessments (EIA) mechanism as listed under the Fifth Schedule of the Environment Protection Act (EPA). However, the effectiveness of the EIA in disaster risk mitigation is unclear. For start, the Rodrigues Commission of Environment does not have a seat on the EIA Committee, which makes it difficult for the Commission to provide technical advice to the sectors.

Furthermore, some public infrastructure investments are exempt from EIA, which makes it challenging to ascertain the long-term implications of such investments on the environment. For example, the desalination plant, which is alleviating the water scarcity chal-

lenges that Rodrigues faces, dumps high concentrations of salt directly into a lagoon.

Waste management is an issue that requires some attention. While generation of toxic waste is not at the same level as Mauritius, its management is even more rudimentary. For example, there is a long-standing chlorine spill in Mourouk that has never been resolved. Rodrigues does not have a proper waste disposal facility and instead has a waste dumping site, which causes regular toxic fires often resulting in the closure of a nearby school.

Rodrigues is taking some measures to reduce the risk of disasters and climate change. For example, replantation of coral and mangroves is already showing the differences these resources can make in reducing disaster risks. It was noted, for example, that boats and roads fringed by mangroves were not affected by Cyclone Gelena. The main constraint affecting these efforts is the lack of seedlings for replantation. With regard to understanding the impact of disasters on the natural environment, some support is provided by the Marine Academic and Research Centre, which assesses damage to marine resources after hazardous events.

Community infrastructure plays a key role in the aftermath of disasters by providing shelter to displaced households. Rodrigues has 39 Cyclone evacuation centres, some of which are schools but are largely composed of community buildings. However, most of these are old and in derelict condition, which creates a challenge when communities are displaced because of cyclones. There is lack of clarity on which authorities in Rodrigues are responsible for the maintenance of the evacuation centres.

KEY CHALLENGES

Absence of data collection, analysis and management, which limits the community and government's understanding of risks and their ability to make informed decisions. General Capacity for Risk Analysis in Rodrigues

In general Rodrigues does not generate and analyse disaster and climate risk information for informed development. The FAO on-going study is expected to not only support land use planning in relation to agriculture but also inform development investments and patterns on the islands.

While this is a good start, more is needed to capacitate the relevant authorities in understanding the consequences of disasters to different sectors for informed decision-making processes. Where data is collected, e.g. damage and losses, analysis and management of this data is an issue where data is kept in individual computers and files but not saved on a server and hence limiting institutional memory. Some damage and loss data are collected for compensation purpose and there is no systematic analysis or harmonised approach to how this data is collected.

- Staff capacity in terms of staff number and capabilities on DRM was noted across all the sectors. For example, the Meteorological Office has two staff, similarly RDRRMC has two technical staff both of whom come from civil protection background rather than DRM.
- Joint data collection, analysis and Information sharing between Mauritius Minister of Environment, Solid Waste Management and Climate Change and its Rodrigues counterpart Commission is needed.
- While the EIA is good mechanism for limiting the negative impact of large-scale investments on the environment, its effectiveness is weakened by not having the Rodrigues Commission of Environment to sit on its Committee.

6.2.1 Recommendations



6.2.1.1 Increase Rodrigues capacity for DRM through increasing number of staff in critical commissions particularly the Commission of Environment, the Meteorological Office and RDRRMC.

6.2.1.2 The above should be further strengthened through provision of training of staff on DRM and other technical areas such as GIS, and data analysis. In addition to this, relevant technical staff from Rodrigues should be invited trainings organized by NDRRMC and other relevant ministries on DRM. Studies conducted on Rodrigues by Mauritius should be jointly undertaken with relevant authorities in Rodrigues to ensure follow-up and facilitate institutional memory.

6.2.1.3 Commission of Environment should sit on the EIA Committee and have a greater say on the recommendations of the Committee.

6.2.1.4 Joint data collection, analysis and Information sharing between Mauritius Minister of Environment, Solid Waste Management and Climate Change and its Rodrigues counterpart Commission.

6.2.1.5 Biosecurity training and laboratory equipment for Commission of Agriculture.

6.2.1.6 Capacitate Meteorological Service to deliver localized forecast, including agro-meteorological advisory.

6.2.1.7 Have monthly interaction between NDRRMC and the RDRRMC.

6.2.1.8 Receive regular updates from NDRRMC, particularly on hazard profiling, risk assessment and mapping activities.

6.2.1.9 Ensure that RDRRMC and relevant Commissions are part of national level DRRM project as well as EIA formulation.

6.2.1.10 Introduce scheme for building animal shelters, evacuation path.

6.2.1.11 Train RDRRMC staff on major aspect of DRRM across sectors.

6.2.1.12 Upgrade Fire and Rescue Services equipment, training and exposure outside.

6.2.1.13 Pre-stock Emergency Supplies for more than 1% of population.

6.2.1.14 Shift Fire and Rescue Services from Commission of Health To Chief Executive's Office.

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6. Mauritius Cane Industry Authority
7. Mauritius Fire and Rescue Service
8. Mauritius Meteorological Services
9. Mauritius Police Force
10. Mauritius Port Authority
11. Ministry of Agro Industry and Food Security
12. Ministry of Defence, Home Affairs and External Communications; Ministry for Rodrigues, Outer Islands and Territorial Integrity
13. Ministry of Education, Tertiary Education, Science and Technology
14. Ministry of Energy & Public Utilities
15. Ministry of Finance, Economic Planning and Development
16. Ministry of Gender Equality and Family Welfare
17. Ministry of Health and Wellness
18. Ministry of Housing and Land Use Planning
19. Ministry of Local Government and Disaster Risk Management
20. Ministry of Blue Economy, Marine Resources, Fisheries and Shipping
21. Ministry of Land Transport and Light Rail
22. Ministry of Social Integration, Social Security and National Solidarity
23. Ministry of Environment, Solid Waste Management and Climate Change

DEVELOPMENT

24. Ministry of Information Technology, Communication and Innovation
25. Ministry of Tourism
26. National Development Unit
27. National Disaster Risk Reduction and Management Centre
28. National Housing Development Corporation
29. Outer Islands Development Corporation
30. Prime Minister's Office
31. Road Development Authority
32. Statistics Mauritius
33. Waste Water Management Authority

LOCAL LEVEL

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35. Bel Ombre Police Station
36. Community Disaster Response Team (CDRT) Riviere des Galets
37. City Council of Port Louis
38. District Council of Savanne
39. Rodrigues Commission for Agriculture
40. Rodrigues Commission for Environment
41. Rodrigues Commission for Health and Others
42. Rodrigues Disaster Risk Reduction and Management Centre (RDRRMC)
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PRIVATE SECTOR

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