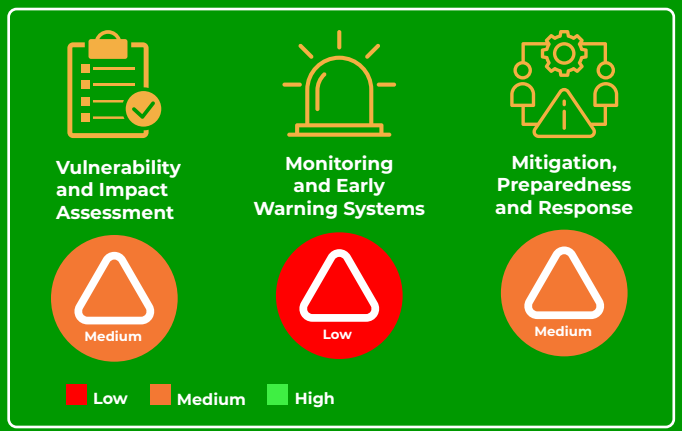
COUNTRY OVERVIEW

The Union of Comoros, made up of the three islands of Grand Comore, Anjouan and Moheli, faces a range of natural disasters including volcanic eruptions, cyclones, flash floods, torrential rains, landslides, drought, pest outbreaks, epidemics, tsunamis and tidal waves. In addition, it is very vulnerable to the impacts of climate change, due to an economy largely based on subsistence agriculture and fisheries. Agriculture, which engages about 55% of the population, is highly dependent on the rainfall regime and therefore sensitive to changes in temperatures and rainfall patterns, more frequent extreme events and sea level rise. Women in Comoros are particularly vulnerable to climate change as 67% of them are employed in the agricultural sector. Fisheries, which also play an important role in the country's food security is facing a modification and reduction of marine habitats, as well as the proliferation of toxic algae and the disappearance of nursery areas for marine wildlife, including corals and mangroves. While drought may not be a common occurrence in Comoros, water scarcity certainly is. Access to surface water on all three islands is a challenge. The main island of Grande Comore has no surface water, requiring coastal towns to exploit marginally fresh groundwater resources. The rural upland communities, making up 50% of the island's population, rely solely on rainwater harvesting. On the two more remote and poorer islands of Anjouan and Moheli, there are no proven groundwater resources and the people living there are completely reliant on seasonally variable streams. People in other parts of the island struggle to meet their domestic water supply needs and farmers do not have access to sufficient water for irrigation.



The Integrated Drought Risk Management Framework highlights a three-pillar approach centered around interconnected, multi-disciplinary, multi-institutional activities. These are 1) Vulnerability and impact assessment; 2) Monitoring and early warning systems; and 3) Mitigation, preparedness and response. This country Drought Resilience Profile contains drought information based on these three pillars.

This profile provides a background of Comoros's drought resilience capacity under the three pillars.

Comoros's vulnerability and impact assessment capacity can be regarded as medium as it possesses active institutions involved in conducting impact assessments but with variable levels of effective coordination.

In terms of monitoring and early warning systems capacity, some national institutions/government departments are tasked with the dissemination of climate and weather-related information and taking proper measures to reduce exposure. However, their operations are hindered by a lack of financial resources and the necessary equipment to operate efficiently. Its capacity under this pillar is therefore categorized as low.

Comoros has systems in place for mitigation, preparedness and response to natural hazards including drought. However, there is a lack of well-established institutions with strong coordination and this creates some functionality gaps. Mitigation, preparedness and response capacity of Comoros can therefore be classified as medium.

This document provides a brief overview of drought risk issues. The key resources at the end of the document provide more in-depth country and sectoral analyses. The contents of this report do not necessarily reflect the views of the World Bank, CIWA, NDMC or IWMI.

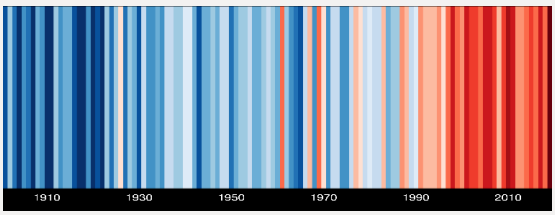
Drought: Historical and Future

Historical climate

- As illustrated in the #ShowYourStripes 'warming stripe' graphic in Fig. 1, the Comoros stripes turn from mainly blue to mainly light red in more recent years, illustrating the gradual rise in average temperature since 1901.
- Mean annual temperature is 25.6°C (1901-2016).
- Mean annual precipitation is 1676.21mm (1901-2016).
- Average annual temperature in Comoros has increased by 0.9°C. The largest increase in temperature is during the rainy season, particularly the months of March to May.
- The rainy season is increasingly irregular, but overall, it has shortened in duration from 6 months to around 3 months. During 1960-1975, Comoros experienced a decrease in precipitation, followed by a sharp increase in rainfall in 1976, then followed by increased irregularity between 1977-1989.
- A lengthening of the dry season has been observed, and the onset of the rainy season is delayed.

Prolonged water scarcity has been observed in the late 1990's and early 2000's.

Fig 1. Temperature change in Comoros, 1901-2019



Source: Berkley Earth/#ShowYourStripes

Future climate

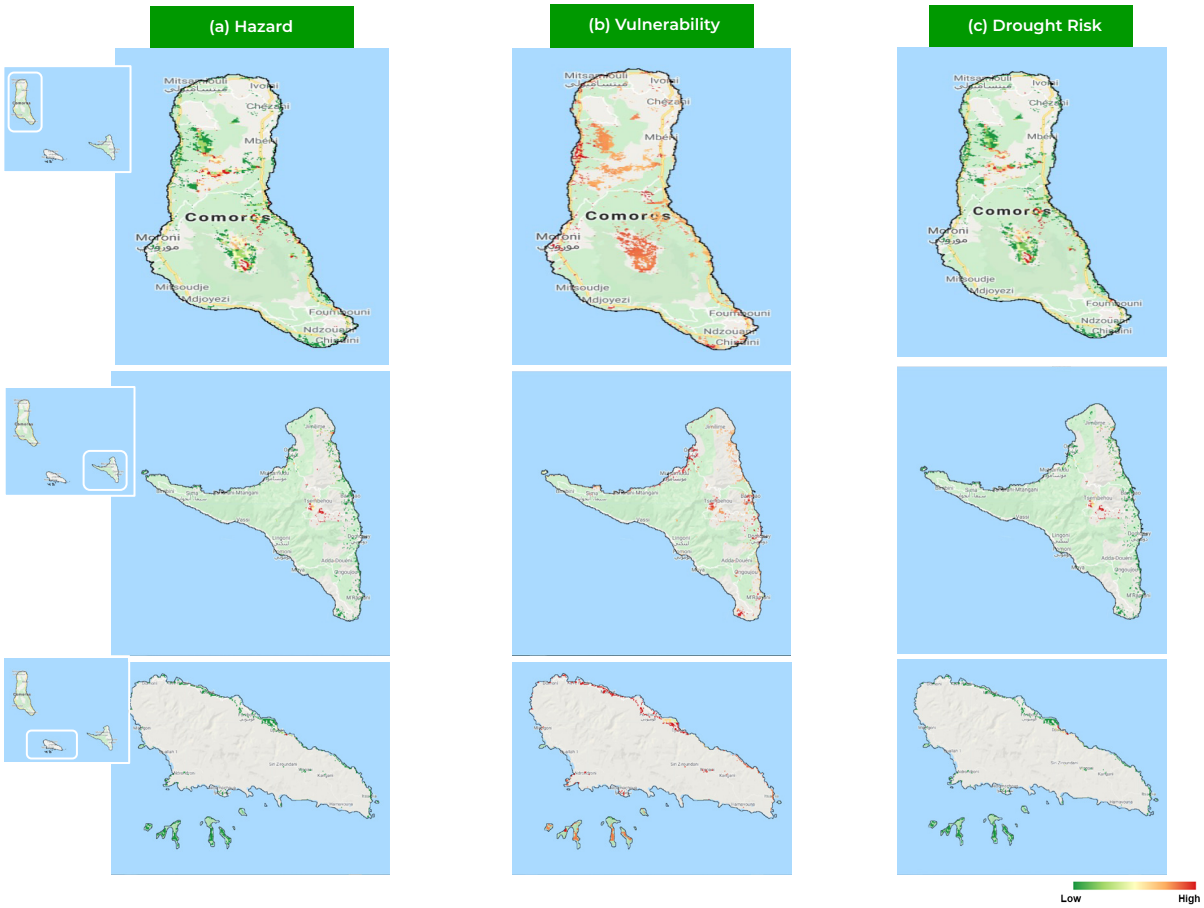
- Mean annual temperature is expected to rise by 1.35°C in 2040-2059.
- Mean annual temperature is projected to increase between 0.8-2.1°C by the 2060's and 1.2-3.6°C by the 2090's.
- Projections indicate all seasons will experience similar rates of increase in temperature.
- Annual precipitation could rise by over 9.5mm by 2040-2059.
- The predicted 20 cm rise in sea level by 2050 will likely result in the displacement of at least 10% of the population.

Major droughts in Comoros:
Comoros has not often experienced drought, and apart from the drought recorded in 1981, there have been none since then as per the EM-DAT database.

The country does however experience the impacts of climate change evident by a reduction of water sources due to erratic rainfall and increased temperatures.

Vulnerability and Impact Assessment

Fig 2a-c. Hazard, vulnerability and risk maps for Comoros



The above maps (Fig 2a-c) depict drought hazard areas (a), areas of vulnerability (b) and drought risk (c). Drought risk is defined by characterizing hazard and exposure to vulnerability and the lack of adaptive capacity, using multisource information from satellite-derived drought indices and socio-economic conditions. In terms of components, hazard is defined through meteorological and agricultural drought i.e. Integrated Drought Severity Index (IDSI); and exposure and vulnerability expressed through population density, human modification index, water risk, and irrigated systems.

Agricultural production (agricultural practices i.e. irrigated area, food production as provided on HarvestChoice) was used to define levels of vulnerability which were finally combined with all three components to define levels of drought risk at the country level, referred to as the National Drought Risk Index (NDRI). The drought risk profile is therefore based on the probabilistic estimation of hazard and vulnerability to assess the drought risk in the exposed areas.

The NDRI shows that the central and northern parts of Grand Comore Island are more vulnerable and have high drought risk as compared to other areas, and this is depicted by the change of green colour to red (maps generated by IWMI). However, the impacts of drought are not similar across all regions. While most regions receive consistent rainfall, some are becoming drier affecting water availability for irrigation and human consumption.

Droughts have adverse effects on water resources

Water resources are already stressed on Comoros and water supply is insufficient to meet the needs of the population. In the future, the predicted increases in temperature and evapotranspiration, and the decline in rainfall, are expected to lead to reductions in surface water flows and groundwater recharge. The demand for water is growing steadily, placing further stress on water supply systems. In 2003, the demand for water was 28 600m³ /day, and it is predicted that water demand in 2025 will almost double to 46 498 m³ /day and 79 200 m³ /day in 2050 (Union des Comores, 2002).

Most of the rural population in Comoros relies on rainwater harvesting, so is vulnerable to water scarcity during droughts. The country has very small watersheds and aquifers with little natural water storage capacity, so is vulnerable to increased rainfall variability. Grand Comore Island relies heavily on groundwater resources, although the steep topography limits exploitation to locations within 3km of the coast, where saline intrusion is problematic. The inland population (50% of the island) is solely reliant on rainwater harvesting. Anjouan and Moheli Islands rely on stream flows from small, steep, highly erodible volcanic watersheds and these streams are variable to seasons.

While the sources of water vary between the islands, all are vulnerable to drought and variability in rainfall, and already, water dries up during dry seasons.

Droughts drag agricultural growth production

Reduced rainfall and extended periods of water scarcity have an impact on agricultural production and yield.

Fig 3 shows the current and future (2030 and 2050) climate suitability for banana, cassava and tomato crops showing a gradual decrease in suitability in the coastal areas (western coastal areas of Grand Comoros and the coast of Mohéli) under projected climate change (Bourgoin, et al, 2016).

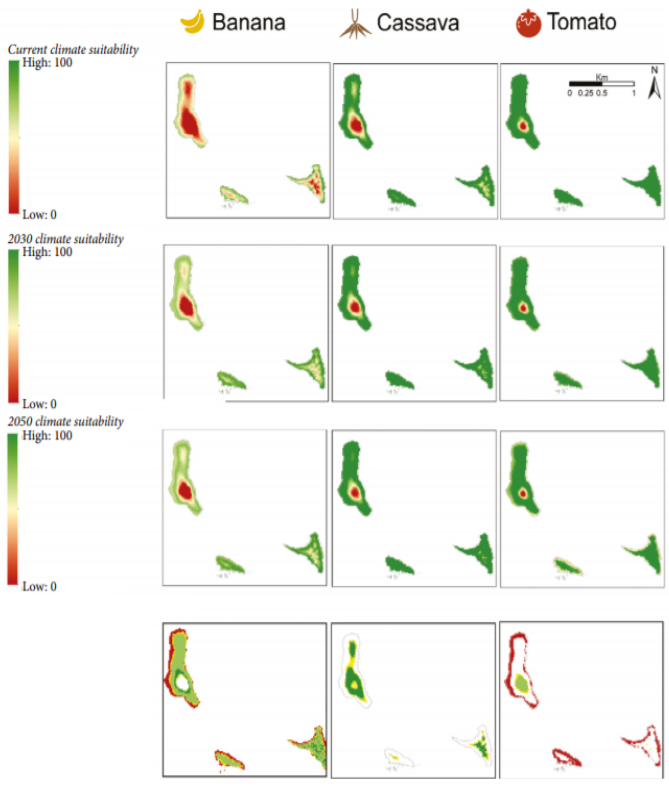
Cassava is more resilient to climate change with the maps showing little loss in suitability predicted for the future (2030 and 2050).

Climate change will require adaptation in cropping and agricultural practices to limit any negative impacts and to build resilience in disaster risk management (ibid).

Change in climate suitability up to 2050

- Loss of suitability
- No change of suitability
- Marginal increase of suitability
- Increase of suitability
- Major increase of suitability

Fig 3. Climate modelling of banana, cassava and tomato



Source: Bourgoin, Louis, Martínez Valle, Mwongera & Läderach **2016**

Vulnerability and Impact Assessment

Vulnerability and impact assessment capacity

The Initial National Communication to the UNFCCC (2002) highlighted Comoros' vulnerability to climate change with the most at-risk sectors identified as agriculture, health, infrastructure, drinking water and coastal ecosystems. In response, several initiatives were developed and implemented contributing to improved knowledge and capacity on climate change impacts and identifying adaptation measures on the ground (UNDP, 2014).

However, to date there has been little discussion of drought vulnerability and impact assessments and planning, arguably because drought is not one of the biggest natural hazard threats in the country.

The country has developed a policy framework for climate change adaptation.

This includes a range of policies and action plans including: the National Environmental Policy (NEP), the Strategic Document for Rapid Growth and Poverty Reduction (DSCRP), the National Adaptation Program of Action (NAPA), the 2011-2016 Strategic Planning Framework on Natural Environment, Climate Change and Disaster Risk Reduction, and the Accelerated Growth and Sustainable Development Strategy (SCA2D).

In addition, the Minister of Environment launched the National Adaptation Plan (NAP) process in Comoros, on behalf of the Government in September 2014.

According to UNDP (2014), in an early stocktaking report, the priorities identified in the NAP lacked alignment to

national priorities and the options proposed were limited, without taking into consideration the long-term impact of climate change. Further, international partners have highlighted the need to strengthen sensitization and ownership, especially through better identification of economic and social benefits (UNDP, 2014).

Moreover, the NAP process relies on existing studies and capacity in identifying vulnerability, using the data collection and analysis from information systems already in place.

The process also requires the strengthening of existing coordination structures and implementing capacity building programs (UNDP, 2014). As part of the NAP development, drought risk, impact and vulnerability will need to be assessed.

The NAP process has the potential to support institutional and technical capacity strengthening, to consolidate overall adaptation activities and embark on a coherent and strategic adaptation approach with drought an important component given the links to agricultural and water resource risk.

If implemented well, it could also improve the coordination, monitoring and evaluation of development initiatives and provide an opportunity to mobilize funding and build synergies amongst donors in drought management.

Monitoring and Early Warning Systems

Monitoring and early warning systems capacity

Table 1 represents a summarized traffic light checklist to illustrate the state of monitoring and EWS capacity in Comoros. It summarizes key aspects needed for a strong monitoring and early warning systems framework, most notably, whether there is an official definition of drought used in country; whether drought indicators are used, and if so, which ones; whether there is a drought early warning system (DEWS) in place; and if so how functional it is; and whether the country makes use of seasonal forecasting.

In terms of institutional arrangements coordinating climate information, the Technical Directorate of Meteorology (DTM) and the National Agency for Civil Aviation and Meteorology (ANACM) were established to manage natural hazards through dissemination of climate and weather-related information and taking proper measures to reduce exposure. However, their operations are hindered by a lack of financial resources and the necessary equipment to operate efficiently.

Table 1. Summarized checklist of monitoring and EWS capacity

Official definition of drought	No
Drought indicators used	Limited
Existence of a DEWS	No
Capacity to tailor EWS messages to end-user needs	No
Effective communication of early warnings with built-in feedback mechanisms	No
Use of most salient communication channels to reach women/youth/disenfranchised communities	Yes
Use of community relays, extensions services, local media to communicate EWS and reach at risk communities promptly	Yes
Seasonal forecasting	Limited

Yes No Limited

Monitoring and Early Warning Systems

While there is no clear definition of drought articulated in policy, as part of the process of developing the NAP, the Government has established various national and island steering committees to help coordinate efforts, and this has included moves to enhance climate risk monitoring and evaluation. However, there is lack of specific focus on drought resilience and there is a need for technical capacity to identify and develop solutions for the resultant risks.

There is also a need to create an enabling environment for drought monitoring and forecasting. The DTM lacks financial resources, necessary equipment, expertise and professional skills in many areas of climate information services (UNISDR, 2015). The directorate keeps few data records for hydro-meteorological hazards. Its surveillance system is primarily based on information generated outside the country. Thus, in practice, the role of the DTM is highly constrained in monitoring of extreme weather events responsible for disasters and risks such as drought (UNISDR, 2015).

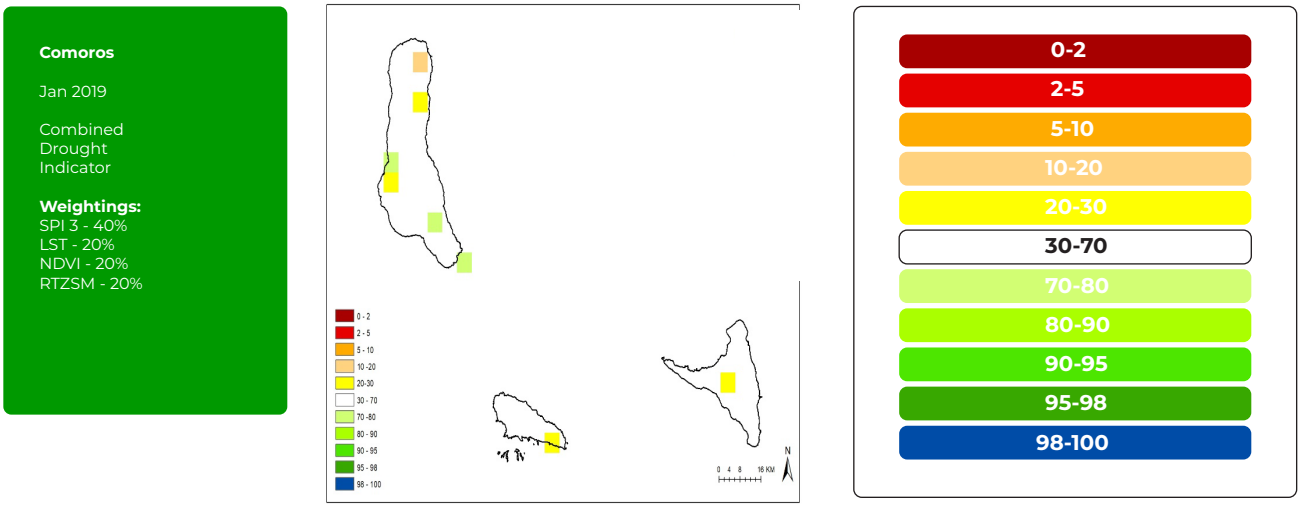
January, being the peak of the rainy season when more rain is expected, provides an assessment of a drought's magnitude (duration and intensity), spatial extent, probability of occurrence, and impacts. The January 2019 CDI map shows that all three islands were impacted by low rainfall.

Without an effective drought monitoring and EWS to deliver timely information for early action, such as the CDI, effective impact assessment procedures, proactive risk management measures, preparedness plans aimed at increasing the coping capacity and effective emergency response programs directed at reducing the impacts of drought, the country will continue to respond to drought in a reactive, crisis management mode.

Combined Drought Indicator (CDI)

Using a combined drought indicator (CDI) approach, the National Drought Mitigation Center (NDMC) at the University of Nebraska-Lincoln, in partnership with the World Bank, has developed a Drought Monitor that represents a consolidation of indices and indicators into one comprehensive drought map. The CDI map for Comoros was created using a weighted combination of four indicators of drought: precipitation, vegetation stress, land-surface temperature and soil moisture. January 2019 was selected.

Fig 4. Combined Drought Indicator (CDI) for Comoros, January 2019



Source: NDMC, **2020**

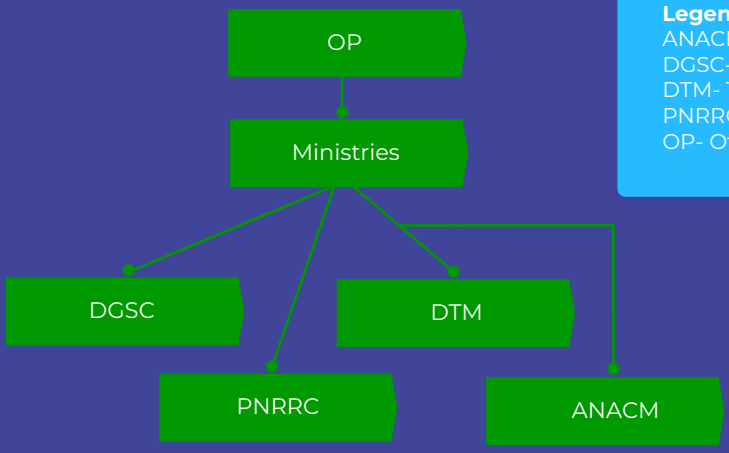
Mitigation, Preparedness and Response

Drought policy framework

The government of Comoros has been actively involved in natural disaster management and has a well-articulated policy and institutional framework, although drought is not always explicit. Key and related policies include the Environmental Law Decree No. 94-100 / PR on Article 70; National Sustainable Development Strategy 2015-19; Hyogo Framework for Action, 2005 –2015; International Strategy for Disaster Reduction (ISDR); Response Plan for Karthala Volcano Eruptions; National Contingency Plan; Specialized Cyclone Relief Plan; Contingency Plan for Cyclones / Floods in the Health Sector; Specialized Tsunami Emergency Plan and Plan for Marine Pollution (MARPOL). In addition, Comoros also complies with several regional policy frameworks that include the Arab Strategy for Disaster Risk Reduction and African Strategy for Disaster Risk Reduction.

Of importance is the National Strategy for the Reduction of Risk and Disasters (SNRRC). This strategy plays a crucial role in providing guidance on disaster risk reduction (DRR) and management. Floods are identified as the most destructive natural hazard in the country and are well covered and addressed in policy. Drought, on the other hand, receives little attention because of its limited impact in the past.

Fig 5. Comoros's drought institutional framework



Legend
ANACM- National Agency for Civil Aviation and Meteorology
DGSC- Direction Générale de la Sécurité Civile
DTM- Technical Directorate of Meteorology
PNRRC- Permanent Secretariat of the National Platform for DRR
OP- Office of the President

Institutions and coordination

Comoros has institutional arrangements to coordinate and manage responses to natural disasters but none with a specific focus on drought management.

In terms of disaster management, Comoros still has a reactive approach, such as rebuilding after extreme events rather than trying to reduce risks or build resistant structures.

However, in more recent years, Comoros has begun to establish institutional entities mandated to manage risk.

The DGSC (Direction Générale de la Sécurité Civile) which operates under the Ministry of Interior (MI) is the main institution responsible for disaster management responses.

It was created in 2012 by an official presidential decree – Decree No. 12-054 / PR – and is mandated to protect the population, property and the environment and to coordinate the development of a national DRM strategy and ensure its implementation.

The DGSC is also responsible for preparation, coordination, prevention and response of emergency crises in Comoros. In the management of disasters, the DGSC serves as the focal point of the Hyogo Framework for Action (HFA).

In addition, one function of the DGSC is to oversee the effective functioning of the Permanent Secretariat of the National Platform for DRR (PNRRC).

This platform was created in 2010 and is coordinated by the ministerial committee and executive body as well as the DGSC.

It is through this platform that the country is trying to articulate appropriate measures to reduce disaster risk. Several of these institutions are constrained by limited capacity in disaster management in multiple domains.

Mitigation, preparedness and response capacity

The Government of the Comoros (GoC) has expressed a commitment to adopt a more proactive approach to disaster management. Various post-disaster capacity development assessments have taken place over the past decade. The government has also developed essential policies and institutions as an effort to increase its climate resilience effort, such as the DGSC to manage natural disasters. This entity helps in the preparation, coordination, prevention and response of emergency through different disaster strategies.

The operational section of the DGSC is the Centre des Operations de Secours et de la Protection Civile (COSEP). COSEP is the main organ of early warning and coordination of operations during a disaster response. In case of emergencies, COSEP coordinates the response by Civil Protection, UN, the Red Cross, or Comoros Red Crescent and NGOs meets in the DGSC base. The GoC also works with the international humanitarian community to assist vulnerable and affected communities during disasters.

For example, in 2000, the French Red Cross, through the PIROI (Regional Intervention Platform for the Indian Ocean) established a regional structure of interventions during disasters including pre-stored relief and emergency stocks such as buckets, jerry cans, mosquito nets, lanterns, stoves, treatment units for water, family tents, rescue stations, warehouse tents and sleeping mats.

There has been a sound partnership between donors, international non-governmental organizations (INGOs) and the GoC since cooperation started in 2009 through Therapeutic Feeding Programs. Presidential Decree No. 09-062/PR of 23 May 2009 provides for the setting up of a strategic committee to coordinate development aid coming from these partners. The committee is operational and functions under the responsibility of the General Commissariat for Planning.

Nevertheless, collaboration among the donors operating in the country has not been institutionalized through a formal agreement, and the UNDP informally coordinate the development partners' activities (UNDP, UNICEF, WHO, World Bank etc) in an effort to harmonize the various interventions in the country. The Comoros Red Crescent also remains active during disasters through training and coordinating volunteers who are willing to assist.

Citizens and the private sector in the country are also active in disaster response, mostly observed during the floods in May 2012 and Hurricane Kenneth in 2019. The country also has contingency funds created after the flood disaster in 2012 and approved by the Council of Ministers. This fund has continued to provide relief in times of disasters, and is managed through different levels including a special commission established in the President's Office and the Ministry of Finance. Contributions by the State and the private sector also feed into this fund.

In terms of sectoral responses, energy supply is a longstanding challenge for Comoros, particularly in times of post-disaster economic recovery.

The GoC has taken necessary actions to stabilize energy production and to provide consumers with a regular energy supply.

The government also developed the Poverty Reduction and Growth Strategy aiming at increasing the energy supply at competitive prices so that the sector can operate sustainably and to allow growth sectors to develop.

In the water and sanitation sector, the government has also taken steps to prioritize access to high-quality drinking water.

This relates to the provision of safe water for people and their animals to meet daily minimum water requirements of 15 liters per day; promotion of community led total sanitation and prevention of water borne diseases initiated by the government with the support of UNICEF; promotion of public and personal hygiene practices to prevent the spread of diarrheal disease such as cholera, dysentery, ameobiasis and others mainly for children under five years; and strengthening synergies between provincial directorates in order to improve efficiency of national or provincial programs.

In conclusion, drought is not a major threat in the Comoros, and as such, receives less priority in policy frameworks and institutional responses. While it may not be necessary for Comoros to have dedicated drought policies and institutions, a clear articulation of drought in its disaster management policy framework is important given how prone the country is to chronic water scarcity.

The government of Comoros may consider strengthening government-private sector partnerships as there is still limited effort achieved so far.

The government may also consider reviewing its recovery plan for boosting agriculture during crises such as having a strategy for irrigation, water harvesting and improved agriculture inputs that are drought resistant.

Recent drought resilience efforts by the international community

Table 2. Selected projects focused on drought, or some aspect of it, in Comoros

World Bank	GEF	Multiple
Comoros Solar Energy Integration Platform Budget (USD): 42.6M Time Period: 2020–	Adapting water resource management in the Comoros to expected climate change Budget (USD): 13M Time Period: 2011-2017	Ensuring climate resilient water supplies in the Comoros Island Budget (USD): 60M Time Period: 2020-2030

References and data sources

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2. Government of the Comoros, Plan d'Action pour la Réduction des Risques de Catastrophes (RRC) en Union des Comores (mars 2014).
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4. Government of the Comoros, Stratégie de Croissance Accélérée de Développement Durable (SCA2D) 2018-2021.
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6. UNDP (2014). Stocktaking Report for the NAP process in the COMOROS. National Adaptation Plan Global Support Programme (NAS-GS).
7. UNEP/GEF, Gouvernement des Comores, « Programme d'Action National d'Adaptation aux changements climatiques (PANA) », mars 2006. Bourgoin, C., Louis, P., Martínez Valle, A. I., Mwongera, C., & Läderach, P. (2016). A spatially explicit assessment of climate change vulnerability in the agricultural sector of the Union of the Comoros.
8. Union des Comores (2002). Initial National Communication On Climate Change under the United Nations Framework Convention on Climate Change (UNFCC). Comores Ministry of Development, Infrastructures, Post and Telecommunications and International Transports.
9. UNISDR, (2015). UNISDR Working Papers on Public Investment Planning and Financing Strategy for Disaster Risk Reduction: Review of Comoros. Geneva.

Data Sources:
Climate Data: CHIRPS
Drought Risk : International Water Management Institute (IWMI)
CDI: National Drought Mitigation Center at the University of Nebraska-Lincoln
Population Data: WorldPop
Livestock, GDP: FAO, World Bank

About the Southern Africa Drought Resilience Initiative (SADRI)

SADRI is a World Bank initiative supported by the Cooperation in International Waters in Africa Program (CIWA) that integrates across the energy-water-food-environment nexus to help lay the foundations for making southern African countries more resilient to the multi-sectoral impacts of drought. Its main objectives are to generate tools and dialogue for enhancing partnerships and capacity across Member States and to inform future national and regional investments in drought-related activities.