



Preparing for extreme weather in the Eastern Caribbean

What role for forecast-based early action?

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Key messages

- The increasingly severe impacts of cyclones, floods and drought in the Eastern Caribbean necessitates a rethink in the way OECS member states prepare for disasters and build longer-term resilience.
- Preparedness plans are typically out of date and disaster risk management agencies have limited resources. As a result, actions taken when extreme weather is forecast are ad hoc and incomplete.
- Establishing a framework for forecast-based early action could help address these weaknesses in preparedness and reduce disaster impacts. Such a framework would link impact-based forecasts with early action plans, disaster risk finance and predefined channels for targeting assistance to vulnerable groups.
- There is huge potential to pool resources and strengthen coordination of preparedness at the regional level, as well as enhancing national preparedness systems. Options include creating a regional savings scheme to ensure reliable funding for early action and response, and developing a regional shock-responsive social protection system.



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Acronyms

AFD	Agence française de développement
CARICOM	Caribbean Community
CariCOF	Caribbean Climate Outlook Forum
Cat DDO	Catastrophe Deferred Drawdown Option
CCCCC	Caribbean Community Climate Change Centre
CCRIF	Caribbean Catastrophe Risk Insurance Facility
CDB	Caribbean Development Bank
CDEMA	Caribbean Disaster Emergency Management Agency
CDM	Comprehensive Disaster Management framework
CDRRF	Community Disaster Risk Reduction Trust Fund
CHARIM	Caribbean Handbook on Risk Management
CIMH	Caribbean Institute of Meteorology and Hydrology
CREWS	Climate Risk and Early Warning Systems
Crews	Coral Reef Early Warning System
DMCA	Disaster Management and Coordination Agency
DRM	disaster risk management
EAF	Emergency Assistance Fund (CDEMA)
ECLAC	Economic Commission for Latin America and the Caribbean
EOC	Emergency Operations Centre
EWS	early warning system
FbA	forecast-based early action
GDP	gross domestic product
GFCS	Global Framework for Climate Services
GFDRR	Global Facility for Disaster Reduction and Recovery
IbF	impact-based forecasting
IDB	Inter-American Development Bank
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
JICA	Japan International Cooperation Agency
LDCs	least-developed countries
NDCs	nationally determined contributions
NDRM	National Disaster Risk Management
NEMA	National Emergency Management Agency
NEMO	National Emergency Management Organisation

NHC	National Hurricane Center
NHMS	national hydro-meteorological services
NOAA	National Oceanic and Atmospheric Administration
NODS	National Office for Disaster Services
OECS	Organisation of Eastern Caribbean States
OFDA	Office of US Foreign Disaster Assistance
PAHO	Pan American Health Organization
PDNA	post-disaster needs assessment
PPRN	plan de protection des risques naturels
PRGT	Poverty Reduction and Growth Trust
RASOR	rapid analysis and spatialization of risk
RCF	rapid credit facility
RFI	rapid financing instrument
SIDS	small island developing states
SOP	standard operating procedure
SPEI	Standardised Precipitation-Evapotranspiration Index
SPI	Standardised Precipitation Index
SRSP	shock-responsive social protection
WFP	World Food Programme

Glossary

Anticipatory action. Anticipatory actions (AAs) ‘are aimed at reducing or mitigating the impact of disasters and enhancing post-disaster response, using forecasts or early warnings of imminent shock or stress’ (Weingärtner and Wilkinson, 2019). The term AA covers actions triggered both by forecasts of a shock (see FbA below), and actions triggered by predictions of a humanitarian crisis. Although the term ‘anticipatory action’ has mainly been used within the humanitarian sector, it has equal relevance for normal state services, development assistance and the private sector (for business continuity). It can also refer to actions taken by the people or communities likely to be affected by a crisis.

Early action. The term ‘early action’ is used to refer to anticipatory actions and to the rapid delivery of relief as soon as critical needs are felt, although the former is more common. Early action covers actions taken before crises develop, but can be triggered by forecasts of potential shocks or predictions that a crisis will develop after a shock has occurred. Early action is thus defined by its purpose (crisis prevention/mitigation) rather than by the trigger. The term ‘early action’ is used by the humanitarian community to mean action in relation to a crisis, as the crisis is the focus of attention for humanitarian action, while actions taken just before a crisis would not necessarily be considered ‘early’ for non-humanitarian actors.

Early warning. Early warning systems (EWS) can serve two purposes: to collect information from or about a (potentially) affected area and communicate to those responsible for responding (e.g. governments, aid agencies) or who may need to act (e.g. businesses); and to collect information from outside the affected area (e.g. from meteorological agencies, governments) and communicate this to a potentially affected area, so that the affected population can take action. An EWS may be designed to look at weather forecasts in order to warn of an impending shock, or to analyse the predicted consequences of weather events that have already happened in order to warn of an impending crisis.

Forecast. A statement of expected meteorological and environmental conditions for a specified time or period, and for a specified area. In the case of FbF (see below), the forecast provides information about the possibility of an extreme event happening in the foreseeable future. Forecasts are often divided into short-term weather forecasts (less than 10 days), sub-seasonal forecasts (20–40 days) and seasonal forecasts (3–6 months).

Forecast-based early action (FbA). FbA is used to describe actions that are triggered by the forecast of the shock (Wilkinson et al., 2018). FbA has so far only been used in relation to forecasts of extreme weather events (droughts, floods, storms, heatwaves and cold shocks). FbA can be used to take action that is completed in its entirety before a shock occurs; in other cases, where implementation will take longer, it can be necessary to act on the shock forecast in order to complete implementation shortly after the shock. FbA may deliver livelihood protection, assistance to help reduce risks or to avoid or mitigate expected impacts once a shock or crisis is imminent, and preparedness to respond. Unlike early action, it is defined by its trigger and not by its purpose. FbA can contribute to managing part of this residual risk through early actions and preparedness for response when a disaster is forecast.

Forecast-based financing (FbF). FbF refers to specific funding modalities set up in response to the difficulties humanitarian actors have frequently faced in obtaining resources to act before a shock or crisis has occurred. These enable quicker release of funds based on a forecast. However, not all AA has to be funded by special FbF mechanisms – it can be funded from within state service budgets or

from development programmes, if flexible management is allowed. Normal humanitarian funding mechanisms can also be used for anticipatory action.

Extreme weather event. Weather that is unusual or severe for a specific location, based on the range that has been seen in the past. Impacts of extreme weather events are considered disasters when they produce widespread damage and cause severe alterations in the normal functioning of communities or societies.

Impact-based forecasting (IbF). A forecast of the potential consequences of a hydrometeorological event, in terms of its effects on people, infrastructure, etc. These types of forecasts and warnings are designed to provide detailed information on who or what is exposed and vulnerable to the particular hazard. While hazard forecasting tells you what the weather will be, IbF tells you what the weather will do.

Lead time. The time from when the forecast is issued until the occurrence of the forecasted event – for example, a forecast issued on Monday for a storm to make landfall on Friday has a four-day lead time.

Preparedness. Although preparedness simply means actions taken to be ready, the different mandates and responsibilities of different kinds of actor can lead to ambiguity or misunderstanding. Humanitarian agencies think of preparedness in relation to the ability to respond to a crisis (e.g. IASC, 2015). Governments, with a responsibility to protect their populations from crises, sometimes use the term in a similar way to disaster risk reduction, referring to measures that can reduce disaster impacts in periods when those events are expected to occur (for example, at the start of the hurricane season) as well as when a disaster is imminent, in order to mitigate the impacts and mount better responses.

Probability and forecast skill. No prediction is ever completely certain, whether it is of the likelihood of a shock or, after the shock, the exact way and timing in which a crisis will develop. Weather and seasonal climate forecasts usually indicate the probability that the event that they are describing will take place. This probability is calculated by the forecasting model or based on expert elicitation and consensus. It is also possible to test different forecasting models to see how well their predictions match what happened. This is the skill of the forecast, and it is a separate source of uncertainty from that calculated within the model.

Residual risk. The risk (potential impact) associated with hazards that remains after disaster risk reduction and adaptation measures are taken.

Executive summary

Countries in the Eastern Caribbean are highly vulnerable to, and severely impacted by, extreme weather events. The probability of the region being affected by severe storms, flooding and drought is high, and the costs are enormous. According to estimates by the international disasters database EM-DAT¹ and International Monetary Fund (IMF) calculations, the probability of at least one disaster occurring each year in Antigua and Barbuda, Dominica, Saint Kitts and Nevis, Saint Lucia and/or Saint Vincent and the Grenadines is 25%. While average losses from hurricanes in these countries range from 9% to 43% of gross domestic product (GDP), for individual events (such as Hurricane Maria in Dominica in 2017), they may exceed 200% of GDP.

In some countries, the risks are spelled out in national budgets, policies and planning documents. Climate risks are a national priority (although not as high up the agenda as strengthening financial systems, limiting fiscal and financial sector risks and enhancing productivity), alongside a growing awareness that impacts are likely to increase with climate change. There is a recognition of the urgent need to build resilience to these threats.

The devastation caused by Hurricane Dorian in the Bahamas in 2019, and the high vulnerability of its migrant populations, is a clear sign that, despite the known risks and improvements in preparedness planning and forecasting, not enough is being done in advance to protect people and their livelihoods. In particular, there is a lack of prospective risk management to avoid the accumulation of new risks.

There are numerous mechanisms and initiatives aimed at helping national disaster management organisations and other agencies

in the Eastern Caribbean to reduce the risks associated with extreme weather events and prepare for and respond to crises. With so much already happening, the question is not so much whether the region needs a new mechanism for early action and financing, but, rather, how existing preparedness plans can be improved, implementation incentivised, and coordination enhanced before disasters occur. Similarly, it is important to look at how existing national and regional emergency coordination mechanisms could be triggered earlier.

Establishing a framework for forecast-based early action (FbA) in the Eastern Caribbean could enhance existing early warning and preparedness mechanisms by improving decision-making – so stakeholders know when and where to act, and who/what is more likely to be impacted – and through the identification of early actions that can address specific risks. Such actions are part of broader disaster risk reduction (DRR) and climate change adaptation (CCA) planning but, critically, are implemented in the window of time between a forecast and a shock, helping to mitigate impacts and/or prepare for a more effective response. Discussions are now under way about setting up a regional contingency financing mechanism that could release funds to support early action. The detailed design of such a mechanism will need to be undertaken through extensive consultation and technical development with key stakeholders. There is no blueprint, as no other regional approach to early action exists, but the results of this scoping study suggest that any next steps to promote early action would need to have certain core qualities to be appropriate and socially and politically acceptable in the Eastern Caribbean, including building on existing initiatives and coordination mechanisms.

1 www.emdat.be

1 Introduction

Following the Paris Climate Agreement (UNFCCC, 2015), Agence française de développement (AFD) launched Adapt'Action to support countries in the implementation of their commitments to adapt to climate change. Adapt'Action is supporting 15 countries and regional organisations with an estimated €30 million over four years, focusing on africa, least developed countries (LDCS) and small island developing states (SIDS), which are among the most vulnerable to climate change.

Under Adapt'Action, AFD is supporting the Organisation of Eastern Caribbean States (OECS) Commission to explore options for taking forward FbA, including potentially through a regional financing mechanism. The aim is to improve the resilience of OECS member states facing increasing risks associated with extreme climate events. This scoping study is a pivotal deliverable under this programme of work.

The process to create new FbA mechanisms is lengthy and requires the engagement and support of a large set of national and regional stakeholders. An FbA financing mechanism will require coordination between regional agencies, national governments and civil society organisations such as the Red Cross, which are familiar with the communities most vulnerable to hurricanes, flooding and drought. During the scoping phase of this project, a team of experts in forecasting, disaster risk governance, risk financing and stakeholder facilitation and engagement has taken important steps to foster the regional dialogue and cooperation necessary for these institutional changes to take place. That said, the team has been careful not to try to convince stakeholders that they need new financing mechanisms, but rather to listen to their concerns and identify gaps or constraints in current arrangements that a broader FbA framework could help address.

Alongside this analysis, the project team has engaged in a process of sensitisation to key FbA concepts, through in-depth discussions of the benefits and challenges of planning, implementing and financing early action. The consultants organised:

1. A virtual consultative workshop on FbA (22 July 2019).
2. Bilateral meetings with key informants at national and regional levels to explore existing arrangements for forecasting, action-planning, delivery and financing of anticipatory action (June–September 2019).
3. Focus group discussions with stakeholders at the national level, to reflect on the timing and effectiveness of actions taken for recent disasters, and how these could have been improved (June–August 2019), and a validation workshop with regional stakeholders including member states, regional organisations and others (Saint Lucia, 17–18 October 2019).
4. A virtual development partners roundtable on financing early action in the caribbean, with 41 participants (31 March 2020).
5. Follow-up discussions with regional development partners (July–October 2020).

This scoping study presents the results of the analysis and discussions held in 12 Eastern Caribbean countries and territories, supplemented by an in-depth review of secondary data, including disaster impact databases and disaster risk management policy documents and plans. In line with the terms of reference for this project, this scoping study reviews:

- past events and post-disaster response actions
- who benefitted and some of the gaps, including the lack of gender-disaggregated

data and need for a gender-transformative approach to FbA

- advances in forecasting hazards and impacts and measuring risk
- the roles and responsibilities of agencies involved in implementing preparedness and response activities
- the financing tools and delivery channels that have been used for post-disaster assistance
- lessons from gaps in preparedness and response, and recommendations for developing an FbA framework for the Eastern Caribbean.

The project team found a vast range of initiatives and actions across the region, from strengthening forecasting and national preparedness planning to policies and initiatives to improve the coordination of response measures and the search for sustainable sources of disaster risk

finance. However, there are also important gaps, most notably in the availability of resources for preparedness and in the formulation and implementation of critical aspects of preparedness plans.

The study finds that there is significant potential to strengthen existing regional preparedness initiatives and coordination mechanisms, and to improve national preparedness. Incentivising more detailed preparedness planning, targeting actions on the basis of impact-based forecasts, creating a regional financing mechanism and ensuring more reliable funding is available for early action and response, and using social protection systems to deliver support, could all help to reduce the impacts of extreme weather. The paper concludes by recommending a framework for forecast-based early action in the Eastern Caribbean that pulls together these recommended action areas.

2 Understanding past events

FbA refers to the use of forecasts of extreme weather to trigger actions and the allocation (or reallocation) of resources prior to a shock or before acute impacts are felt, to reduce the impact on vulnerable people and their livelihoods and improve the effectiveness of emergency preparedness and response (Wilkinson et al., 2018). A starting point for establishing an FbA framework is understanding the impacts of disasters and assessing what can be done to reduce them. Next, it is important to examine why these potentially beneficial actions are not being taken already and how policy and institutional reforms, capacity development and financial support could help to overcome these obstacles.

This chapter presents an analysis of the impacts of extreme weather events in the OECS region and their significance for SIDS. Particular attention is paid to damage and losses from Hurricanes Irma and Maria in September 2017, as these illustrate some of the most severe impacts ever experienced by Eastern Caribbean states.

The recent devastation caused by Hurricane Dorian in the Bahamas underlines the importance of longer-term measures to strengthen public infrastructure and housing – and the need for risk-informed physical planning and community resilience-building. Exposure and vulnerability to hazards will never be eliminated, and so anticipatory measures to avoid or minimise humanitarian impacts need to be systematically and continually implemented, evaluated and improved; FbA offers a technical, capacity-building and coordination methodology to meet this need.

2.1 A regional overview of hazard exposure and disaster impacts

The Caribbean in general has a long history of disasters associated with hydrological, climatological and meteorological hazards. The most common are hurricanes and wind storms (accounting for more than half of all disasters), followed by floods and droughts (Heger et al., 2008), which are intensified by the El Niño Southern Oscillation phenomenon (see Box 1 for a summary of available evidence on climate hazards and future projections in the OECS). However, the existence of hazards alone does not necessarily lead to disasters. Disaster is defined by the point at which loss of life, injury or the destruction of property occurs on a scale that surpasses the capacity of a society to cope without major changes in its normal operations (Collymore, 2008). Disaster risks and impacts are not simply a function of the intensity of hazards themselves; they are determined by hazard exposure and vulnerability, in addition to individual and collective capacities and actions taken to manage these risks.

The socio-economic, demographic, geographic and governance characteristics of each Caribbean island contribute to its risk profile. All islands are highly exposed to hurricanes, but not all face the same level of flood, drought and landslide risk. Volcanic, mountainous islands are particularly prone to rainfall-triggered landslides and river flooding, while islands with low levels of elevation, such as Anguilla, have very high levels of flood risk (IPCC, 2014). As small nations, they exhibit a high degree of specialisation, generally in agriculture and tourism. These two

Box 1 Priority climate hazards in the Eastern Caribbean

Heat stress	Extreme rainfall	Dry spells and drought
<p>Heat stress arising from excessive heat exposure has started affecting the OECS region. Heat stress increases mortality and morbidity in both humans and livestock, reduces children's learning ability at school, increases demand for cooling, decreases labour productivity, exacerbates drought and requires a re-envisioning of the urban environment. Heat impact potential has increased year-round from marginal to moderate across the OECS region since 1995, as shown by an observed positive trend in the annual number of hot days and nights and a decrease in the number of cool days and nights. During the heat season – when most heatwaves occur (May to October) – the heat impact potential will very likely be high to extremely high as soon as the 2020s, meaning more than 50% of days to more than 80%, respectively, will be hot days, regardless of the future scenario.</p>	<p>Flash floods occur when rainfall intensity exceeds the rate of soil infiltration and surface drainage. Quantifying the variability and changing nature of extreme rainfall thus helps in characterising the impact potential from flash floods and flooding. The Leeward and Windward Islands experience at least 80% chance of at least one flash flood per country/territory from August to November – peaking in November with a 40% chance. The Leeward Islands also experience a smaller peak in April and May with moderate potential (20–50% chance). There is little sign of a trend in flash flood potential either in the observed record or in projections out to the 2040s (medium confidence). However, by the end of the 21st century, heavy rainfall frequency could decrease by up to 25% (low confidence) and rainfall intensity may increase by 50–100% by the 2090s (medium confidence), with increasing flash flood severity in the second half of the 21st century.</p>	<p>Periods of several consecutive dry days are called dry spells. The longer and more frequent during the critical growth stage, the more damage to plants, particularly rain-fed crop production, common in the OECS region. Seasonal to multi-annual periods of rainfall deficits can result in drought. Water deficits in soil can appear within less than three months – triggering agricultural drought. Within six months of cumulative rainfall deficits, large streams and water reservoirs can be affected (hydrological drought). Within 12 months, the largest rivers, surface water reservoirs and underground aquifers can be affected, limiting freshwater availability, triggering socio-economic drought. The impact of dry spells, which peaks from March to May, is much higher on smaller islands and in areas with low topography than in mountainous areas (high confidence). Higher dry spell impact potential is expected after 2050 (high confidence), depending on the emissions scenario.</p>
Tropical cyclones	Sea level	Sea surface temperatures
<p>The activity and impact level of the Atlantic Hurricane Season (June to November) on the OECS region varies from year to year, but an average of 11.3 tropical storms, 6.2 hurricanes and 2.3 major hurricanes (Category 3 or higher) is noted for the period 1966 to 2009, with an upward trend between 1850 and 2015. The total number of named storms is not projected to rise (low confidence), but the strongest storms are likely to become 2–11% stronger and possibly more frequent (medium confidence). Rainfall rates inside hurricanes could increase by up to 30%, increasing flash flood potential. Rising sea levels combined with stronger winds in the strongest storms substantially increases the impact potential of storm surge and coastal inundation.</p>	<p>Sea level has risen at a rate varying from 1 mm per year in Grenada to around 2 mm per year in Guadeloupe, and up to 2.5 mm per year in the British Virgin Islands since 1950, and are projected to rise by 27–30 cm – with a 90% confidence range of between 20 cm and 40 cm – by 2050 and could exceed 1 m by 2100. Among the major future impacts of sea level rise facing the OECS region are coastal erosion; reduction of land space near sea level, including urban space; and saline intrusion into soils and aquifers.</p>	<p>Trends in sea surface conditions include an observed temperature rise of 0.2–0.3°C per decade between 1986 and 2016 and are projected to rise a further 0.77°–2.5°C by the end of the 21st century. While salinity tends to fluctuate between 36 parts per 1,000 in the dry season and 35.5 during the wet season, global salinity is projected to decrease as a result of glacial melt. Environmental changes in the upper ocean are expected to impact on coral reefs through more frequent and intense bleaching episodes, marine animal habitat changes and fish species migrations, as well as heat expansion of the water column as ocean temperatures rise, contributing to sea level rise and its associated hazards.</p>

Source: Van Meerbeeck (2020)

sectors are natural-resource dependent but also concentrated close to coasts and water resource systems, enhancing a country's susceptibility to natural hazards. Unlike larger countries, which can absorb the overall economic impacts of extreme events by spreading them over the entire

territory, these islands cannot necessarily dilute impacts in this way.

Emerging regional human and environmental health risks with complex impacts include increasing seasonal influx of Sahara dust² and high levels of Sargassum seaweed. A 2019 report

2 Sahara dust is an emerging hazard in the Caribbean. See www.bviddm.com/saharan-dust-approaching-the-eastern-caribbean/

in *The Lancet* cites research linking Sahara dust to increased mortality and morbidity at higher concentrations, and increased asthma attacks in children in the Caribbean, with studies from western Atlantic countries also claiming associations with increased incidence of meningococcal meningitis and cancer (Sakhamuri and Cummings, 2019). Another Caribbean children’s asthma study notes that ‘it has been shown that if you can recognize the dust event and give adequate warning, patients can take their medication in anticipation and therefore reduce the number of attacks or severity’ (Siegfried, 2018). Antigua’s Met service provides forecasting of Sahara air layer alongside the US National Weather Service³ and the Trinidad and Tobago Weather Centre.⁴ Antigua Met provides risk reduction action as part of its air quality bulletin,⁵ and Guadeloupe’s air quality index includes daily risk levels for both Sahelian dust and ‘off-gassing’ (the release of a gas that was dissolved, trapped, frozen or absorbed in some material from decomposition) of Sargassum seaweed, as well as advisories that include risk reduction actions for different risk levels.⁶ Since early 2018, Sargassum outlooks and monthly bulletins have forecast blooms in the Caribbean Sea.⁷

In the context of climate change, the compounding effect of multiple extreme events; new impacts overlapping with recovery from prior impacts; the gradual erosion of livelihoods and deterioration of infrastructure; and the increasing intensity of extreme events all contribute to high levels of loss and damage in Caribbean islands. Across the OECS, between 2004 and 2016 approximately 86 people died from tropical storms and 12 from floods, with 315,700 and 64,700 people affected by tropical storms and floods respectively (EM-DAT, n.d.).

Over the 20 years between 1995 and 2014, extreme weather events resulted in average annual losses of 4.2% of GDP and contributed to rapidly increasing public debt. Trade, tourism and, to a lesser extent, agriculture have also lost competitiveness due to the impact of these events (Gomez-Osorio et al., 2017). Economic losses are generally reported (although only direct losses, and these are not disaggregated), but detailed, disaggregated humanitarian impacts less so, making it difficult to detect trends and understand the nature of vulnerability to different hazards. Some description of impacts can be found in the reports of humanitarian appeals (see summary in Table 1).⁸ These disaster impacts are experienced differently across islands and sectors. By improving post-disaster needs data, a better understanding of disaster impacts for each state would be possible.

2.2 Impacts of disasters

Over the past few decades, the costs of disasters have increased dramatically worldwide. Figure 1 shows the costs in the Caribbean since 1980, highlighting the damage incurred by major tropical storms.

Increases in the costs of disasters can be attributed to population growth, especially in coastal areas, the rising value of assets (housing, infrastructure), the increasing frequency and severity of storms and sea level rise and better record-keeping since the 1990s. According to EM-DAT estimates and IMF calculations, the probability of at least one disaster a year is around 25% across Antigua and Barbuda, Dominica, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines (see Table 2). Over a five-year period, the probability goes up

3 www.weather.gov/sju/dss_sal

4 <https://ttweathercenter.com/saharan-dust>

5 http://antiguamet.com/Antigua_Met_files/SaharanDustAirQualityBulletin.pdf

6 www.gwadair.com

7 <https://optics.marine.usf.edu/projects/saws.html>

8 See IFRC (2010; 2018a; 2018b)

Table 1 Type of disaster impacts in the Eastern Caribbean, according to humanitarian reports

Climate hazards	Reported impacts
Tropical cyclones	<ul style="list-style-type: none"> • Destruction of and damage to housing, water, sanitation and energy access • Internal displacement (often due to damage or destruction of homes)ⁱ • Destruction of health facilities, equipment and supplies • Destruction of water supply systems and sanitation facilities, leading to increases in waterborne diseases • Psychological and mental distress as people lose belongings and are evacuated • Damage to infrastructure (including electricity, fuel, port services and roads) • Damage to and destruction of crops, boats and productive assets (and impacts on food security and nutrition) • Extra expenditure for families due to loss of clothing, hygiene products and other essentials • School attendance reduction, either due to damage or destruction of schools, or the use of schools as temporary shelters • Loss of biodiversity • Destruction of communication infrastructure and isolation of communities (roads and telecommunications infrastructure) • Destruction of buffer ecosystems, loss of livelihoods based on natural resources • Internal and cross-border displacement
Floods	<ul style="list-style-type: none"> • Damage to septic tanks • Disruption of proper storage and disposal of garbage, which leads to an increase in rats, flies and other vectors, exacerbating health impacts • Destruction of and damage to housing and household belongings • Psychological and mental distress • Health impacts through vector diseases, water pollution, pests • Damage to property and infrastructure • Damage to crops and loss of livestock (and impacts on food security and nutrition) • Death by drowning • Dangerous travel conditions • Internal and cross-border displacement
Droughts	<ul style="list-style-type: none"> • Destruction of vegetables, plantains, fruit and breadfruit crops • Water shortages, leading to loss of livestock • Decline in crop production • Reduced banana production • Increased production costs due to the trucking of water and labour • Increased prices for agriculture commodities • Decline in pasture for livestock • Internal displacement and in extreme cases international migration

i See www.tandfonline.com/doi/full/10.1080/14693062.2019.1640105?scroll=top&needAccess=true

Source: IFRC (2010; 2018a)

significantly. The economic impacts of individual hurricanes are often severe: for example, average losses represent nearly half of the GDP of Grenada and Saint Kitts and Nevis, and approximately a quarter of GDP for Antigua and Barbuda and Dominica (Table 2).

Figure 2 shows how significant the damage from several specific recent events can be, reaching up to 150% of GDP in the case of Hurricane Ivan in Grenada (by comparison, Hurricane Katrina caused damage worth an estimated \$125 billion – 1% of GDP – in the United States in 2005). Such high-impact, low-probability occurrences are the most visible on the international stage, and can

attract pledges, insurance or other pay-outs for reconstruction. Conversely, low-impact, high-probability events cut into revenues and hinder macro-economic recovery given their recurrence. In Saint Lucia, for instance, average annual damage from disasters is estimated at 1.5% of GDP, of which an estimated 1% is borne by the government (IMF, 2017). In Martinique and Guadeloupe, Maria caused damage equal to 0.5% and 1.3% of their GDP respectively, although this burden would have been shared, to some extent, with the French government.

Disasters can have long-lasting effects and recovery is often interrupted by subsequent

Figure 1 Losses for tropical cyclone events in the Caribbean from 1980 to 2016



Note: The figure illustrates the costs of tropical cyclones across the Caribbean from 1980 to 2016, including the proportion of insured losses. The following year, in 2017, Irma and Maria caused a massive \$96 billion-worth of damage, of which \$43 billion was insured. After Irma and Maria, Georges, Ike and Ivan incurred the highest losses, while Maria and Georges were the deadliest storms (MunichRe, 2019). Other meteorological events causing significant damage are not cited, including the Christmas Eve Trough of 2013.

Source: Authors, based on data from Munich Re (2019)

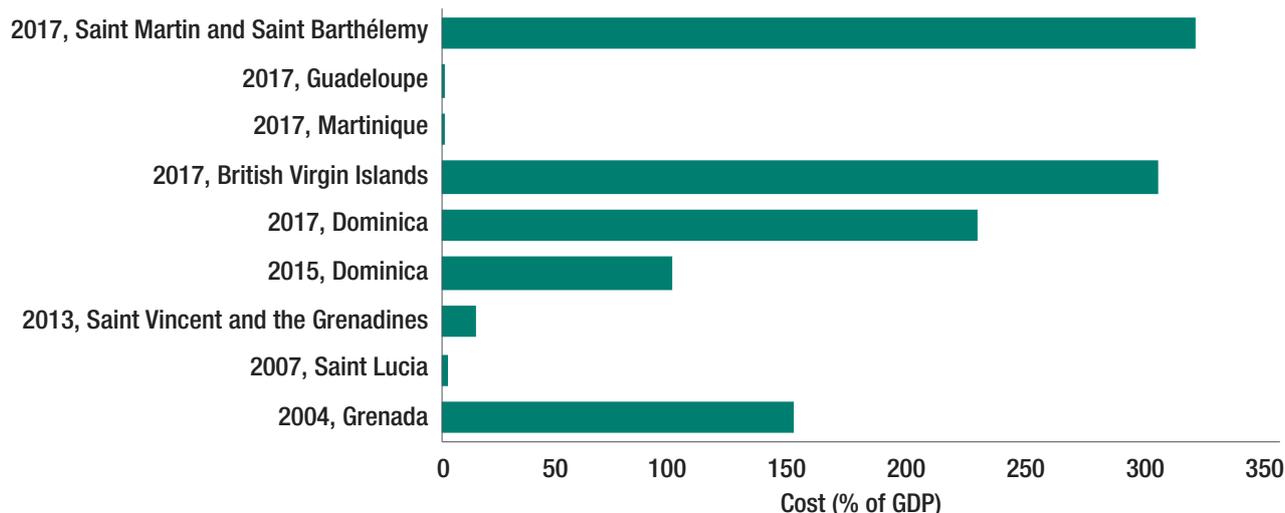
Table 2 Probability of disaster (1990–2014) and estimated disaster damage by 2030

Country	Probability of at least one disaster over time period (%)		Estimated disaster damage (% of GDP)
	1 year	5 years	by 2030
Antigua and Barbuda	24.4	45.3	23.4
Dominica	24.4	75.3	27.3
Grenada	18.1	63.2	41.1
Saint Kitts and Nevis	14.8	55.1	42.7
Saint Lucia	33.0	86.5	12.0
Saint Vincent and the Grenadines	27.4	79.8	8.7

Note: No analysis of overseas territories was included in this study.

Source: IMF (2016b)

Figure 2 Total damage from select storms in OECS member states



Source: Author, based on Waithe (2019), with data from Gomez-Osorio et al. (2017), INSEE (n.d.) and EM-DAT (2020)

disasters. Hurricane Ivan led to an overall decline in economic growth in Grenada, which plummeted from 9.5% in 2003 to -0.6% in 2004, and many Caribbean states face high costs of recovery and reconstruction leading to high sovereign debt and reduced fiscal space, in turn reducing the capacity to invest in disaster risk reduction.

Longer-term impacts are less easily or accurately portrayed in financial terms. These include disruption to public services and impacts on livelihoods, health, education, economic activities and well-being. Damage to major trade infrastructure, such as seaports and airports, complicates relief and recovery efforts by preventing goods from entering. Bottlenecks in the reception of goods such as food or machinery to help with clean-up operations can push prices up, worsening already difficult living conditions. The absence or temporary loss of access to water, sanitation and communication can also hamper reconstruction efforts. Education can be badly disrupted and hurricanes have been shown to have a negative impact on test scores (Spencer et al., 2016). From a broader perspective, ‘climate-sensitive events are already a critical obstacle for people trying to escape poverty and those who are vulnerable to falling back into poverty’ (Hallegatte et al., 2016).

Major storms can have a significant impact on the tourism sector. The return of cruise ships depends on ports being cleared, while destroyed

or damaged accommodation prevents overnight stays. There are fears that major storms are reshaping the structure of the tourism sector, favouring larger, high-end players (WTO, 2019), while increasing the vulnerability of smaller operators.

Agriculture, which supports many livelihoods across the Caribbean, is one of the slowest sectors to recover post-disaster. The nutmeg sector in Grenada, for example, is often cited as taking 10 years to recover following Hurricane Emily. Aside from the physical effects of wind uprooting crops and plantations, flooding associated with tropical cyclones or large storms destroys production and creates conditions favourable to the spread and proliferation of pests (for example, a fungus that affects banana plants). Hurricane winds can also spread invasive species. The slowdown of the agricultural sector post-disaster has wide socio-economic consequences, including loss of farm employment, movement from rural to urban areas and changes in agrarian structures (Commonwealth of Dominica, 2017). Dominica is an important producer and exporter of vegetables, tubers and fruits such as banana. The destruction caused by Maria compromised the national economy and food security of the local population, but also affected countries that rely on Dominica’s agricultural supply (FAO, 2017).

Disasters in the Caribbean affect people of different genders in different ways. These events

can reinforce ‘traditional’ gender roles, with men being assigned physically demanding tasks and women caring for community members who are sick or disabled (Smyrilli et al., 2018a; 2018b). People of different genders also experience different impacts on their productive assets. The design and operation of early warning systems⁹ and humanitarian responses to extreme events are both increasingly addressing needs that are specific to women,¹⁰ as well as strengthening the gender perspective of early warning systems in the Caribbean post the 2017 hurricane season (WMO, 2018).

A less-studied dimension of disasters is their environmental impacts, in both marine and terrestrial environments. Hurricanes can result in loss of biodiversity and ecosystem services, the transport and sedimentation of soils and increased erosion from loss of crop canopy (Commonwealth of Dominica, 2017).

2.3 Detailed disaster impact case studies: Hurricanes Irma and Maria

2.3.1 Hurricane Irma (2017)

Hurricane Irma struck the Caribbean and the east coast of the United States in September 2017. The hurricane developed on 30 August near the Cape Verde Islands, with high ocean temperatures and extremely low pressures over the Atlantic fuelling the storm’s intensity as it neared the Lesser Antilles. The hurricane first made landfall on 6 September along the northern coast of Barbuda with wind speeds of up to 282kph (175mph). It travelled north through the Lesser Antilles as a Category 5 hurricane affecting 16 islands including the four OECS member islands of Antigua and Barbuda, the British Virgin Islands, Anguilla and Saint Kitts and Nevis (see Figure 3).¹¹

Hurricane Irma caused massive losses. Total damage is estimated at \$81 billion, making it the

second most expensive hurricane ever recorded in the Caribbean. For the OECS member states, damage totalled about \$3.5 billion. The British Virgin Islands were particularly badly affected. Economic losses amounted to \$3 billion (adjusted for inflation), or the equivalent of 309% of GDP. In Barbuda, 95% of infrastructure and housing was destroyed. Hurricane Irma also caused considerable human loss, with 134 deaths, including 18 in the OECS.¹²

Some environmental services were severely disrupted: in Saint Martin, the productivity of fisheries was reduced by pollution stemming from increased runoff and erosion. In the ports, where yachting is an important part of the tourism economy, the wreckage of boats was, at the time of writing, still blocking certain passages. Communication networks were also affected: in Anguilla, all but three cell towers were knocked offline due to loss of power or physical damage; in the British Virgin Islands, Saint Barthélemy and Saint Martin, telecommunications were completely cut off.

Directly following Irma, shortage of fuel was a concern for Anguilla and Barbuda, where the only gas station was damaged. Desalination facilities were affected by electricity shortages and groundwater polluted by saltwater intrusion or other sources of contamination. Fully restoring the electricity distribution network took an estimated six months in Anguilla; electricity installations were severely damaged across the British Virgin Islands and on Barbuda. Ecological damage on Barbuda was significant, though temporary. In the British Virgin Islands, other concerns linked to mental health and well-being, including depression, post-traumatic stress disorder and violence were brought up in a post-disaster needs assessment (PDNA) after Hurricane Irma (ECLAC, 2018; UNDP, 2017). A summary of impacts associated with Hurricane Irma across the Eastern Caribbean is presented in Table 3.

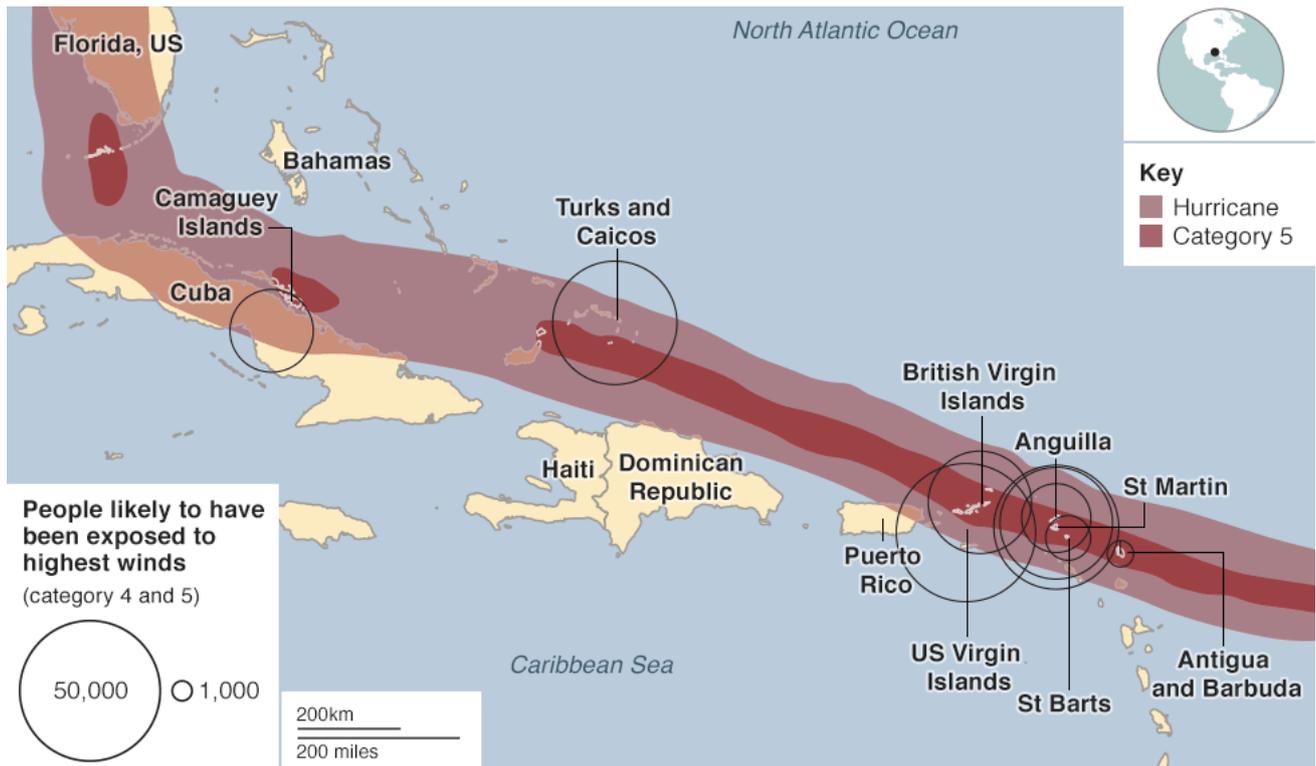
9 www.crews-initiative.org/en/projects/caribbean-lessons-learnt-early-warning-systems-following-2017-hurricane

10 www.unwomen.org/en/news/stories/2018/8/feature-caribbean-humanitarian-update

11 See <https://blogs.iadb.org/caribbean-dev-trends/en/avoiding-a-debt-disaster/> and www.thebalance.com/hurricane-irma-facts-timeline-damage-costs-4150395.

12 <https://repositorio.cepal.org/bitstream/handle/11362/43446/1/FOCUSIssue1Jan-Mar2018.pdf>

Figure 3 The Caribbean islands worst affected by Hurricane Irma



Source: BBC (2017)

Table 3 Hazards and impacts of the 2017 hurricane season in the Eastern Caribbean

Type of hazard or category of impact	Hazards or impacts
Cascading hazards	<ul style="list-style-type: none"> • Flooding (flash flood, river flood, waterlogging) • Wind • Storm surge • Silt deposited
Primary impacts	<ul style="list-style-type: none"> • Deaths • Injuries • Damage to buildings and infrastructure: gas stations, electricity network, hospitals • Damage to ecosystems • Damage to certain crops and loss of livestock • Dangerous travelling conditions
Secondary impacts	<ul style="list-style-type: none"> • Houses uninhabitable • Shortages of fuel • Electricity shortages • Shortage of drinking water • Health issues including mental health • Waterborne diseases • Loss of livelihood (e.g. tourism) • Loss of industrial production • Spikes in violence • Displacement/migration: long- and short-term

2.3.2 Hurricane Maria (2017)

A second hurricane followed barely two weeks after Irma, battering already damaged housing and infrastructure. Maria became a Category 5 hurricane near the Leeward Islands on 18 September 2017. It rapidly progressed from a tropical depression to a major hurricane (Category 3) within 48 hours, and subsequently to a catastrophic hurricane (Category 5) eight hours later. Maria hit Dominica at approximately 9.35pm on 18 September with wind speeds of 155mph, before moving over Saint Kitts and Nevis, Antigua and Barbuda and the British Virgin Islands from 19–20 September. Some parts of the Caribbean suffered near-total destruction.

The economy in most affected countries came to a halt with the destruction of roads, bridges and public utilities. In the British Virgin Islands, the most significant losses were to houses and tourism facilities, on which the country depends for income. In Dominica, nearly 90% of buildings were damaged or destroyed (see Table 4). The agriculture sector was devastated, with an estimated 100% crop losses. The destruction of roads represents a significant cost to the country,

Agricultural employment was disrupted and there were blockages getting agricultural products to markets. The cost of recovering losses and damage caused by Hurricane Maria is estimated at \$1.3 billion.

Other, less tangible, losses are linked to the severe disruption to public services. In Dominica, communications were cut off for three days; the main hospital and more than half of health centres countrywide were severely damaged; 75% of the electricity network went down, although there was little disruption to fuel supplies, and thanks to emergency repairs, 70% of the population had access to running water shortly after the disaster. A total of 24,000 people (around 30% of the population) were food-insecure following the disaster, and a number of households indicated that their only source of food was humanitarian aid. By mid-November, only 36% of schools had reopened (UNDP, 2017).

Hurricane Maria caused significant damage to Dominica's forests, with all trees nearly completely defoliated and about 20% flattened. Although forests are expected to recover within five years, the trees knocked down constitute

Table 4 Recorded losses and damage for Hurricanes Irma and Maria

Country	Insured losses (\$ million)	Total damage (\$ million)	Fatalities	Number affected	Sector suffering most damage ⁱ	% of housing damaged
Anguilla	6.7	200	4	5,000	Productive	13.5
Antigua and Barbuda	6.8	250	3	2,000	Infrastructure	95 (Barbuda)
British Virgin Islands	–	3,000	–	30,000	Productive (tourism)	47
Dominica	19.3	1,456	65	71,000	Social	90
Guadeloupe	–	120	4	–	–	70
Martinique	–	44	–	–	–	–
Saint Kitts and Nevis	2.3	20	–	–	–	10
Saint Martin and Saint Barthélemy	1.830	3,000	10 (247 injured)	–	Productive	–

i Productive sectors: agriculture, fisheries, forestry, commerce, tourism; social sectors: housing, education, health and culture; infrastructure sector: transport, electricity, water and sanitation, telecommunications, airports and ports.

Sources: EM-DAT (n.d.); UNDP (2017); reliefweb.org

requiring \$250 million to rebuild, equivalent of 55.8% of Dominica's GDP (in 2017 prices).

a lost resource (WTO, 2019). Ecosystem services provided by dense tree cover, such as

erosion control and provision of clean potable water, were also compromised (UNDP, 2017). Fruit tree plantations were also decimated,¹³ but plans to import new plants have run into phytosanitary restrictions.

Ports along the east coast of Florida were also partly incapacitated, further disrupting the recovery of Caribbean islands by cutting off potential cruise ship ports and hampering the movement of gasoline and containers (WTO, 2019).

A review of the 2017 hurricane season led by the World Meteorological Organization (WMO), the Caribbean Institute of Meteorology and Hydrology (CIMH) and the Caribbean Disaster Emergency Management Agency (CDEMA) specifically addressed the question of gender and differentiated impacts. Specific roles and responsibilities are known to affect responses to risk knowledge and monitoring, as well as decision-making, for instance with women more likely to use social media as a source of information and men relying on radio.¹⁴

Households headed by a single female are among the most vulnerable. However, gender-disaggregated impact data is not yet available. One analysis of Hurricane Maria, conducted by Oxfam in Puerto Rico, found that the disruption of water and electrical infrastructure meant that women had to do the arduous labour of caretaking and maintaining households without water and power (Smyrilli et al., 2018a).

The severity of impacts and disruption caused by extreme weather events in 2017, and the recent devastation of the islands of Abaco and Grand Bahama in the Bahamas in September 2019, are stark reminders of the costs of inaction. The level of exposure and likelihood of significant humanitarian and economic impacts from these events in the Eastern Caribbean is too high to ignore. In the following sections, we review existing actions and coordination mechanisms, and why further action is not being taken to move people out of harm's way, protect property and livelihoods and avoid human suffering.

13 In total, 65% of coconut trees, 80% of cocoa trees and 80% of citrus trees were damaged (Commonwealth of Dominica, 2017).

14 <https://public.wmo.int/en/media/news/lessons-learnt-from-2017-caribbean-hurricane-season>

3 Forecasting hazards and impacts

This chapter assesses the roles and capacities of regional and national meteorological and hydrological agencies in forecasting extreme weather events and their potential impacts. Critical to this is the availability – or lack thereof – of risk information to estimate how and where people, property, livelihoods and different economic sectors will be affected by storms and floods.

3.1 The role of regional organisations

3.1.1 Forecasting hazards

Regional forecasts of extreme weather events in the Eastern Caribbean are provided by international and regional organisations (see Box 2) such as CIMH and the National Ocean and Atmosphere Administration (NOAA). For tropical cyclones, the National Hurricane Center (NHC) provides information to countries in ‘Region 4’ (according to WMO’s classification), which includes all Caribbean countries. The Director of the NHC also chairs the WMO’s Hurricane Committee for Region 4. The Committee meets annually to discuss the hurricane operational plan, as well as training meteorologists, exchanging information and analysing case studies. The Caribbean Community Climate Change Centre (CCCCC) also provides forecasts and analyses of potentially damaging impacts from hazards.

NOAA produces a five-day hurricane forecast with a trajectory for the hurricane, then consults with countries in the hurricane path before issuing a warning. The respective national hydro-meteorological service (NHMS) informs NOAA of the area where the warning should apply and then issues an alert for their region or country.

Box 2 Coordination between hydrometeorological service providers in the Caribbean

The Caribbean Meteorological Organization (CMO) and Météo-France established formal working arrangements in 2016. This followed years of close collaboration between Météo-France and CMO on regional activities in the Caribbean, primarily on an ad hoc basis for specific activities of common interest. Activities have been coordinated between Météo-France’s regional headquarters in Martinique and the CMO headquarters in Trinidad and Tobago, or the Caribbean Institute for Meteorology and Hydrology (CIMH), the technical organ of the CMO, located in Barbados. The WMO Severe Weather Forecast Programme in the Eastern Caribbean (co-chaired by Météo-France Martinique and CMO HQ), the regional radar network and the CMO National Meteorological Services have free use of operational weather monitoring and forecasting tools developed by Météo-France. Météo-France also participates in the twice-yearly Caribbean Climate Outlook Forum (CariCOF), led by CIMH.

Source: Authors’ analysis based on Sutherland (2016)

Météo-France and the UK Met Office provide a similar service for islands under their jurisdiction, working directly with the NHMS or channelling information directly to disaster managers.

As the WMO Regional Climate Centre, CIMH is responsible for the Global Framework

for Climate Services (GFCS) in the region, and has established the Early Warning Information Systems Across Climate Timescales (EWISACTS) consortium¹⁵ to support the development of sector-specific climate services including implementation of CDEMA's Comprehensive Disaster Management agenda.¹⁶ The WMO established the Climate Risk and Early Warning Systems (CREWS) initiative in 2018, with a focus on strengthening 'end-to-end' early warning services in the wider Caribbean, and is in the process of developing a diagnostic analysis of the current status of early warning systems in order to inform the development of a regional strategy at the CARICOM level.¹⁷

In terms of seasonal advisories and drought information, CIMH produces a suite of outlooks available to the entire region. The CariCOF, held at the end of May/beginning of June, delivers forecasts for the wet/hurricane season. Forecasts currently include products for rainfall, temperature and drought, with forecasts and impact maps produced for the short term (7–15 days) and longer term (three months or more).

Other new, innovative forecast tools for extreme weather produced by CIMH include:

- Seasonal temperature outlooks. These include minimum, maximum and mean temperature for the coming three months, and subsequent months.
- Drought outlooks.¹⁸ These are provided through alert maps which show both short- and long-term drought impacts.
- Wet days and wet spells outlooks for the coming three months.
- Dry spells outlooks for the coming three months for 7–15-day dry spells.

- Heat wave outlooks in the dry season (1–6 months).

CIMH uses models from international agencies to provide guidance to countries on issuing warnings. For sub-seasonal timescales, it has recently started sharing NOAA forecasts and is presently downscaling NOAA forecasts to the Caribbean. This process will take approximately two years, although if the aim is to use downscaled forecasts for 'impact-based forecasting' (see Sub-section 3.1.2), this will take longer.

The performance of forecasts is measured by the NHC-NOAA through a verification system with data from 1970 to the present, showing the performance of the forecasts year by year, as well as errors in forecasting the trajectory and intensity of tropical cyclones. These verifications are performed for the five-day forecasts made by the NHC (see Figure 4), though the aim is to test the reliability of longer forecasts of up to seven days, which would be extremely useful for emergency managers and in planning early action. Similar forecast verification is essential for other hazards.

It should be noted that, overall, Atlantic basin hurricane forecasts are improving with regard to both intensity and track.

3.1.2 Forecasting impacts

International meteorological agencies, including the UK Met Office and NOAA, are starting to develop impact-based forecast (IbF) techniques in Central America and the Caribbean as a way of forecasting not just extreme weather, but also the impacts it will have, depending on, for example, a storm's intensity, trajectory and speed. The CREWS initiative is also implementing Impact-based Forecast and Warning Services to

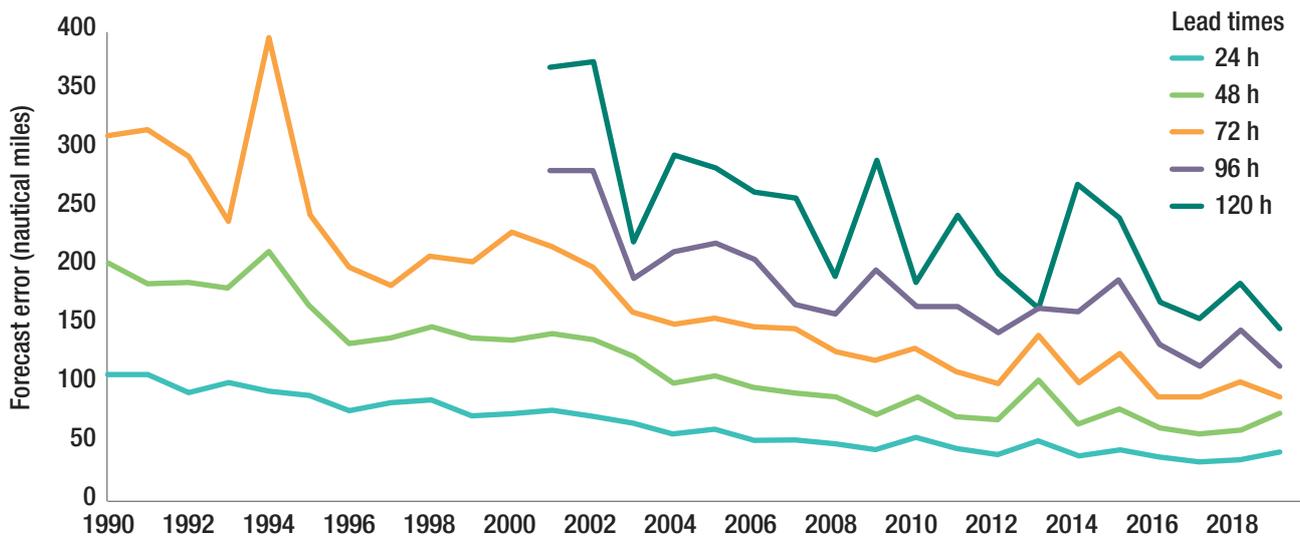
15 <https://rcc.cimh.edu.bb/ewisacts/>

16 www.cdema.org/cdm

17 <https://public.wmo.int/en/media/news/caribbean-strengthen-early-warning-systems-and-resilience-climate-change>

18 The Caribbean Drought Bulletin tracks how dry spells or droughts, and to a lesser extent excessive rainfall, have developed in the past few months and up to a year. The Bulletin details drought situations at regional and national levels and for one-, three-, six- and 12-month time periods through short- and long-term drought outlooks and drought alert maps. The classification is: NO Concern, Drought Watch, Drought Warning, Drought Emergency, Missing.

Figure 4 Trends in official track forecast error for the Atlantic basin



Note: A lead time is the period between the forecast and when the tropical cyclone hits. The track forecast error is the difference in forecast position and observed position of the centre of the tropical cyclone.

Source: National Hurricane Center (2020)

improve the quality of NHMS in the region and the services they provide. One major challenge in moving towards this type of service is the lack of good historical impact data (who was affected and how, including a gender perspective) and downscaled, high-resolution climate data, as well as up-to-date vulnerability and exposure data.

To address these constraints, the CIMH Caribbean DEWETRA platform (developed under the Enhancing Resilience to Reduce Vulnerability in the Caribbean project and funded by the Italian government, the CIMA Research Foundation and CIMH)¹⁹ is starting to capture loss and damage data for hydro-meteorological events (Collymore, 2016).

Another CIMH initiative, the Rapid Analysis and Spatialization of Risk (RASOR) project, is a platform for multi-hazard risk analysis to support disaster management. RASOR allows users to simulate future scenarios based on existing and assumed conditions, to compare with historical scenarios and to model multi-hazard risk both before and during an event. Disaster managers

can therefore determine, for example, the extent of flooding that might occur in a given area and assess risks to critical infrastructure.

Thanks to investments and commitments by the government of Saint Lucia, a flash flood guidance system is under development ‘that will enable local hydro-meteorologists to better predict flash floods for even small streams and creeks on the island, based on the latest actual rainfall estimates, as well as rainfall predictions from numerical weather models. The landslide threat for highly vulnerable locations will also be assessed through the system based on the latest rainfall and soil saturation estimates’.²⁰ The Global Facility for Disaster Reduction and Recovery (GFDRR)’s online Caribbean Handbook on Risk Management (CHARIM) includes vulnerability assessments, hazard maps and risk assessments for critical facilities due to storm/wind surge flooding, high wind, drought and debris flow in Saint Lucia and flash flood risk and landslide susceptibility maps for Grenada, and volcanic risks have been mapped and some

¹⁹ DEWETRA is a real-time data and information management platform to integrate data for forecasting and monitoring that provides warnings for communities exposed to hydro-meteorological risks. The effectiveness of the platform depends on the rapid availability and transmission of data, in order for the forecast system to produce reliable and up-to-date forecasts for decision-making purposes. The platform also allows for the co-production of triggers that integrate forecasts with risk information for different sectors.

²⁰ www.govt.lc/news/flash-flood-guidance-system-for-saint-lucia

coastal vulnerability analysis has been completed in Saint Vincent and the Grenadines. There has, however, been little or no integration of these recently developed resources into NHMS.

Another important area of progress is in tailoring seasonal rainfall forecasts to specific contexts and decisions. The CIMH drought bulletin brings together observed and forecast rainfall information to focus on potential impacts. This combines observed rainfall deficits with forecasts of rainfall for the coming months, indicating which places are likely to be most impacted. This is a first step towards moving from simple hydrometeorological information to impact-focused information, which can indicate when a crisis is likely to hit. This seasonal climate information and forecasts analysis is presented to decision-makers at regional and national levels at the CariCOF. According to one study, there has been a trend towards more advanced and diverse climate products, as well as greater participation in the CariCOF from various sectors: academic, agriculture, aid, defence, disaster management, education, electricity/energy, environment, health, marketing, media, NHMS, tourism and water (Gerlak et al., 2018). However, little is known about how stakeholders understand and subsequently use information from the CariCOF, and to what extent their networks find it useful.

3.1.3 Measuring risk

As the regional intergovernmental agency responsible for coordinating and supporting the disaster management activities and functions of CARICOM member states, CDEMA is critical to promoting the generation and centralisation of risk information. CDEMA supports national emergency management organizations or agencies (NEMOs/NEMAs) to prepare and disseminate information on vulnerable and affected populations, pre- and post- disaster. This role is, however, complicated because information is spread across agencies, there are substantial gaps in information and the capacity of local agencies to monitor changes in risk over time is limited. Disaster risk management (DRM) personnel at country level are frequently overwhelmed by requests for information, particularly during a crisis. A Rapid Review of the Regional Response to Hurricanes Irma

and Maria (2017) recommended that countries undertake an assessment of their information management systems and the information used by the Regional Response Mechanism (RRM). The review highlights the need to improve information sharing, technology application and capacities (Collymore et al., 2017).

RASOR (described above) could help with this by filling some of the information gaps and providing a single method for states to determine impacts. The CCCCC has developed some new services since 2017 that could help generate risk information for FbA. The CCCCC provides longer-term climate projections (for the 2030s, 2050s and 2080s) and related services to support decision-making, including an Information Clearing House, climate modelling, environmental scans and Lidar Surveys. Of particular relevance to FbA is CARiDRO, a web-based online tool to facilitate assessments of drought events at regional and grid point levels, using modelled and observed data. The tool was designed to process and use data from several databases from regional and global climate models, as well as datasets of grid point observations. The tool produces results based on two drought indices: the Standardised Precipitation Index (SPI) and the Standardised Precipitation-Evapotranspiration Index (SPEI). The SPI is used widely to assess and monitor drought events, while the SPEI was developed to evaluate the impact of climate change on drought and is based on water balance as well as precipitation. The indices are calculated at different time-scales (one month, two months, six months, 36 months, etc.), which allows for the identification of different drought events, such as meteorological or hydrological drought.

3.1.4 Supporting the use of forecasts and risk information

CIMH and CCCCC will play different but complementary roles in encouraging Caribbean states to use forecasts and risk information in decision-making. CCCCC focuses more on longer-term planning, producing downscaled Global Climate Models and regional outputs that states are starting to use for their National Adaptation Plans. It also conducts training on the use of climate tools developed by the Centre,

such as the Coral Reef Early Warning System (Crews)²¹ and the CARIWIG portal.²² The portal is intended for use by regional and national institutions, consultants and scientists concerned with climate and the impacts of future climate change in the Caribbean. CIMH, on the other hand, provides information directly to CDEMA on approaching weather systems that have the potential to cause severe human and economic loss and damage. CDEMA uses this information to liaise with governments to enact preparedness actions ahead of the approaching system. These approaches form the basis of IbF: with more detailed impact information and exposure and vulnerability data, combined with more accurate hazard forecasts, regional agencies such as CDEMA are better placed to know when, who and what is likely to be impacted, and where and what early action is needed.

3.2 National meteorological and hydrological agency use of forecasts and risk information

We need data and science to inform our decision-making – and we do not have that necessary data, that necessary information. As we move down this climate change path – that to say this is our new normal – we also need to appreciate that it is dynamic, it is ever-changing. So, until we have the necessary capacity, skills, competencies, in order to collect, analyse, predict, and feed into our decision-making processes, we’re going to be in the react mode. (Government minister, Grenada)

3.2.1 Interpreting forecasts

NHMS²³ are responsible for monitoring and disseminating information about weather. In the Caribbean, most NHMS have a manual weather station based at the national airport, which is used to gather data on temperature, pressure, windspeed/direction, humidity, visibility and cloud cover, among other variables. Their main responsibility is to provide services for the aeronautic sector. Several countries have additional manual weather stations elsewhere. There are, as yet, no automatic weather stations in any OECS state.

In order to produce hydro-meteorological forecasts, NHMS use data from weather stations and radar and satellite data and compare this with information received from global and international forecasting agencies. For example, NOAA’s global weather forecasts are consulted when NHMS produce weather forecasts. Forecasters then interpret this information using their expert judgement, in order to produce a national forecast.

Radar data is collected and shared regionally, but smaller NHMS without a radar have to use doppler digital radars from Barbados, Belize, Guyana and Trinidad and Tobago, which provide broad areal coverage of the Caribbean islands out to 400 km from each site. This enables the NHMS to provide images and guidance to the public and key sectors, such as the aviation industry, water resources sector, agriculture and NEMOs. Countries without a radar of their own²⁴ are keen to have one so they can produce higher-resolution local warnings, especially for extreme rainfall.

Forecasts are disseminated in different ways depending on the hazard. Typically, NHMS cooperate closely with the national disaster

21 The Crews network, developed through a collaboration with NOAA, establishes an integrated regional network of climate and biological monitoring stations to strengthen the region’s early warning mechanism. Crews stations help with climate risk planning, management and action particularly to reduce coral bleaching.

22 CARIWIG is a web-based portal that provides data and information on observed climate, regional projections of future climate, future scenarios of weather downscaled from Regional Climate Model projections, and scenarios of weather derived from hypothetical tropical cyclone events.

23 Most Caribbean countries have not merged their hydrological and meteorological services yet, but we refer in this section to the NHMS as one.

24 Jamaica, the Dominican Republic, Guadeloupe, Martinique, and French Guyana have their own radar.

management agency to disseminate forecasts. For example, in Saint Kitts and Nevis NEMA receives forecast information from the NHMS and communicates it to the public through media channels (TV, radio, internet) (see Chapter 4 for more examples of how forecasts are communicated). In French territories, forecasts are transmitted directly from Météo-France to the media.

NHMS also cooperate with each other. The NHMS of Antigua and Barbuda, for example, supports other nearby islands (such as Anguilla, the British Virgin Islands, Montserrat and Saint Kitts and Nevis) with forecasts for heavy rains, winds, swells and flash floods, and watch/warning statements for tropical cyclones. Barbados supports Saint Vincent, Dominica and other Lesser Antilles islands.

In most cases, there is no operational verification of weather forecasts after they are produced, to gauge their success and assess how they can be improved in future. While this could help build confidence and understanding of forecast alerts and warnings, lack of infrastructure capacity and human resources are major barriers.

3.2.2 Towards impact-based forecasting

IbF combines information on historical disaster impacts, vulnerability and exposure with a real-time forecast to understand the likelihood and severity of potential impacts in specific locations. In most OECS countries, the NHMS issues hydrometeorological information only; risk is not analysed to produce impact forecasts or provide information on thresholds for action. While impact-based forecasting is a priority for WMO, there are several barriers to NHMS producing operational impact-based forecasts in the short term.

Accessing useful vulnerability and exposure information is the first hurdle to IbF. While there is data on vulnerability and exposure for some locations and in relation to some hazards, it is scattered and held by a variety of agencies. Data quality is often affected by the way it is gathered and how often it is updated. For example, Saint Lucia has not updated

contingency plans for about a decade, rendering the data irrelevant, particularly if the objective is to prioritise early action based on exposure and vulnerability conditions. For NHMS to produce impact forecasts, they would need previous hazard and impact data as a baseline from which to produce quality forecasts. Most OECS countries do not have the resources to conduct regular risk mapping, though initiatives such as INTASAVE-CARIBSAVE are seeking to promote changes in risk information management across the Caribbean. Another valuable example is CHARIM, which aims to build capacity in Belize, Dominica, Saint Lucia, Saint Vincent and the Grenadines and Grenada to generate landslide and flood hazard and risk information, and apply this to infrastructure and planning decisions (i.e. health, education, transport and government buildings) through the development of a handbook and hazard maps, use cases and a data management strategy.²⁵

A second challenge is forecast verification, which is rarely done. There is potential to engage researchers and apply citizen science to determine the reliability of forecasts and their usefulness for early action. One notable example is Saint Vincent and the Grenadines Met Service, which verifies extreme rainfall forecasts. French territories have similar capacities. Progress on forecast verification across the Caribbean is a key step towards producing IbF services.

A third challenge is that few NHMS have a legislative mandate to produce sectoral forecasts or other information that can be used for planning. NHMS vary in their structure and sit in different government departments across the Caribbean, making it difficult for them to provide standardised services in terms of type and quality.

One thing OECS countries do have in common is their relationship to strong regional institutions. CDEMA and CIMH are each working to strengthen and institutionalise key foundations for IbF. CIMH offers training to meteorologists and could include IbF modules in this. Informal peer-to-peer networking and knowledge-sharing reported by hydromet and spatial data management professionals in the OECS region is indicative of the potential for

25 www.charim.net

peer learning networks to support regional capacity-strengthening in IbF. International agencies such as NOAA, the UK Met Office and Météo-France are working on impact-based forecasting methods and could provide support and training to local meteorologists.

3.2.3 Information management: constraints and recommendations

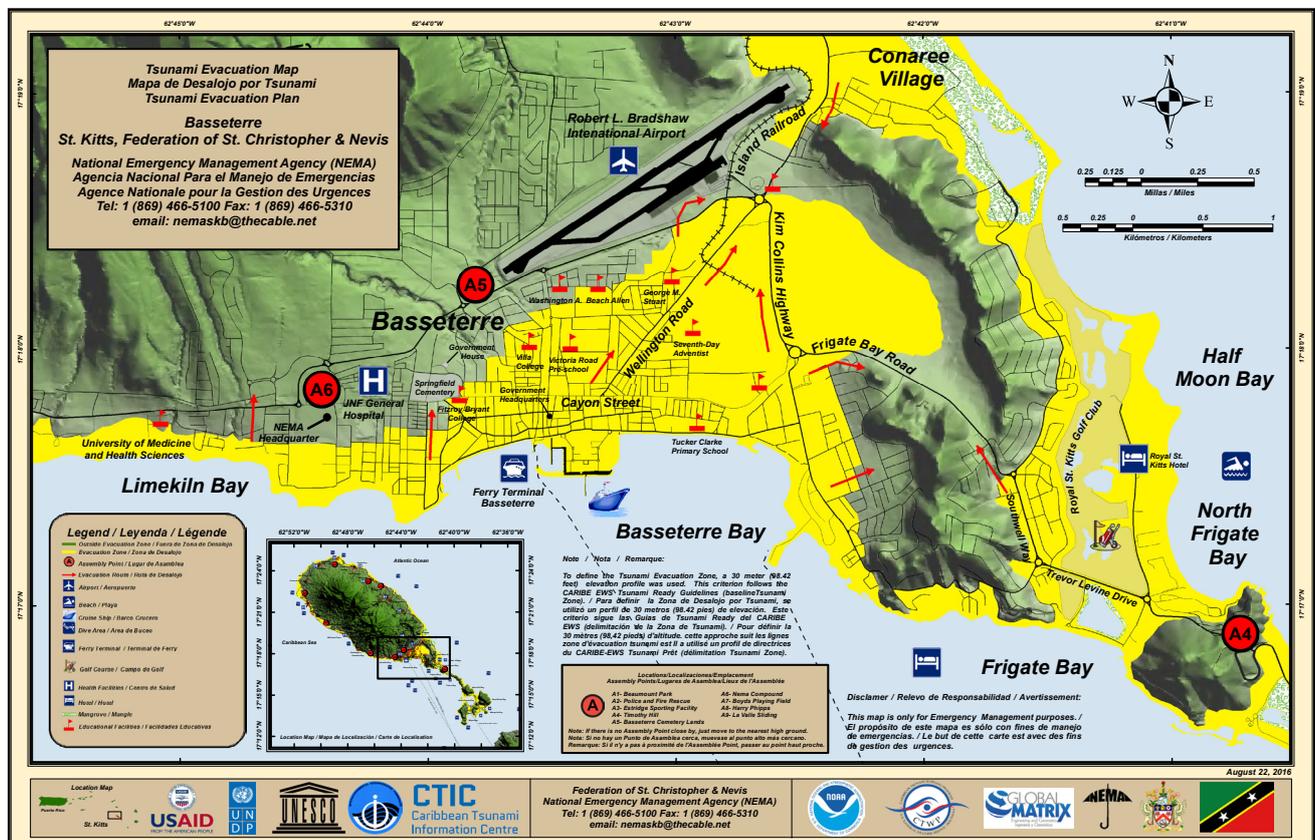
Some form of risk information management system is needed to support the identification and implementation of early actions to reduce impacts and deliver more effective disaster response. Across most of the OECS, data is shared between ministries and departments and other actors. However, data sharing practices are often ad hoc, with no formal process or management system in place to facilitate sharing and use of data. Much of this only happens during disaster response. In Grenada, two key elements were highlighted by one minister as critical for risk information management: the ability to collect data, and the ability to analyse and interpret it, and then make decisions based

on that. This view was shared by many of the OECS representatives participating in this study.

Policies to incentivise sharing of risk information across government departments and between national and sub-national actors are lacking. In Saint Lucia, with investment from the World Bank, a National Spatial Data Infrastructure (NSDI) will be set up to enable a more collaborative approach to the management of risk information. There is currently an informal process to share technical risk management data, but new policies under the NSDI will promote more effective data-sharing. One of the crucial aspects identified in the study relates to the need to standardise the way data is gathered, coded, analysed, stored, shared and disseminated.

A common practice identified across the region is the co-development of risk and evacuation maps. Several agencies took part in the mapping process in Saint Kitts, with the aim of enhancing contingency planning (see Figure 5). This type of cooperation can act as the basis for more systematic information sharing.

Figure 5 Tsunami evacuation map in Saint Kitts



Note: Actual map shown.

Source: http://itic.ioc-unesco.org/index.php?option=com_content&view=article&id=1976&Itemid=2776

Non-governmental organisations (NGOs) and community-based organisations play a key role in disaster preparedness and response and can be key promoters of community-level risk data collection and analysis, as well as quality control and promoting greater transparency in reporting on disaster impacts. At the national level, government agencies – in partnership with the private sector – can ensure that risk data is collected systematically, stored, protected and shared with regional and international agencies.

Disaster impact data produced through post-disaster damage and needs assessments could be used to develop impact-based forecasting tools, but government agencies and NGOs will have to ensure that the data recorded is disaggregated, compatible (with previous datasets and international standards) and at the scale needed to enable decisions for different types of hazard.

This study found that, in some states, relevant information is being produced, but is not always integrated in disaster planning and operations. Focusing on early action can help by providing a rationale and activity around which statistics offices, NHMS departments, NEMOs and other government agencies and NGOs can collaborate in sharing and analysing risk information, particularly to target those most vulnerable and likely to be impacted by a hazard.

In most cases, information management systems are funded by external donors, which means they are unsustainable and risk information is unlikely to be regularly updated.

This presents a major challenge for any type of DRM intervention, including early action. Sustainable investment in this area is crucial.

Across the research process, there was a widespread perception that IbF could improve decision-making before a disaster and would have a positive impact on the coordination of early action and response. Models that can predict what the weather will do, rather than what the weather will be, are needed. Stakeholders in Saint Lucia felt strongly that the GIS unit within the Ministry of Planning and Development could play a key role in developing these decision-making tools, in cooperation with other agencies.

During a crisis, CDEMA also plays a key role in supporting DRM agencies to centralise crisis information/updates for preparedness and response, to help ensure that DRM personnel are not overwhelmed by requests for information. This needs to be further reinforced, so that staff at the national level can prioritise emergency preparedness and response, rather than spending time answering requests for information from multiple actors.

Overall, there are significant gaps in the data that would need to be filled to accurately forecast hazard impacts. Regional initiatives are doing some of this, and supporting national agencies to enhance decision-making before a crisis. This needs to continue, with a focus on ensuring that detailed data on hazard exposure and vulnerability is centralised, updated and managed at the national level.

4 Preparedness planning

This chapter describes the Comprehensive Disaster Management framework (CDM) in the Caribbean, which guides preparedness planning across the region. It then provides an overview of disaster planning in OECS member states, describing the kinds of measures taken to prevent, reduce and manage negative impacts through general preparedness activities, as well as specific actions once a potential disaster is forecast and imminent. The chapter concludes with a discussion of some of the limitations in planning and targeting actions before disasters occur. It outlines approaches that could help improve action planning for preparedness and anticipation.

4.1 Regional support to planning

In addition to its core function of leading disaster response when member states request assistance (described in Chapter 5), CDEMA also has a mandate to lead, facilitate, drive, coordinate and motivate states to reduce disaster risk and enhance regional sustainable development – an approach known regionally as CDM:

CDM is defined as the management of all hazards through all phases of the disaster management cycle – prevention and mitigation, preparedness, response, recovery and rehabilitation – by all peoples – public and private sectors, all segments of civil society and the general population in hazard prone areas. CDM involves risk reduction & management and integration of vulnerability assessment into the development planning process. (CDEMA website)

CDEMA's specific functions in promoting CDM include reducing the immediate consequences of disasters, encouraging the adoption of disaster loss reduction and mitigation policies

and practices at the national and regional level, facilitating a 'culture of disaster loss reduction' and coordinating support to emergency disaster response. To do this and strengthen compliance with CDM, CDEMA applies several policy and technical instruments (Kirton, 2013):

- training for disaster management personnel and development of model training courses and learning aids
- institutional strengthening of disaster management organisations
- development of model disaster legislation, policies and guidelines
- contingency planning
- resource mobilisation
- improving emergency telecommunications and warning systems and developing disaster information and communication systems
- education and public awareness
- establishing a dynamic CDEMA website for information dissemination.

Notwithstanding the actions and policies described above, CDEMA is not actually responsible for the implementation of CDM strategies. Rather, the agency functions as a facilitator and enabler for participating states to do this. An assessment of national policies and plans is provided in Section 4.2.

4.2 National preparedness planning

If you do not have a plan in place, the what, when, where and who – it is so difficult to construct in the midst of a crisis – as opposed to if you already have one. Following a plan is easier than trying to create one. (Secretary General of a Red Cross National Society)

4.2.1 Seasonal preparedness planning

All sovereign OECS member states have national disaster laws that govern preparedness and response planning. Disaster preparedness and emergency response in Antigua and Barbuda, for example, is under the authority of the Emergency Powers Act of 1957 and the Disaster Management Act of 2002, and disaster management is executed through the National Office for Disaster Services (NODS). Disaster plans (also referred to as preparedness or emergency plans, disaster risk management plans or comprehensive disaster management plans) are developed by national disaster management agencies. These define key stakeholders, outline the roles and responsibilities of different actors and specify general processes for each stage of the disaster management cycle. In French Overseas Departments, the *Préfet* is responsible for providing risk information for different types of hazards and developing a disaster plan (*Plan de protection des risques naturels* (PPRN)). Civil protection and defence teams, in conjunction with other agencies, local authorities and the armed forces, support the *Préfet* in all phases of disaster risk management (Nicholson, n.d.). A PPRN gives Departments access to a preparedness fund operated by the French government (*Fonds de prévention des risques naturels majeurs*), which can be used to fund studies, as well as disaster prevention, preparedness and protection work (Lenormand, 2019).

Some Eastern Caribbean states are updating their DRM legislation. In Dominica, the new DRM bill is expected to improve coordination of emergency preparedness and response. This might also be an opportunity for more sustainable capacity development as most initiatives are externally funded and are short-term projects or pilots. Many DRM decision-makers across the OECS region cite lack of ongoing funding as a key impediment. In Saint Lucia, for example, the lack of sustainable long-term funding for DRM is seen as a major challenge; in Saint Vincent and the Grenadines, a lack of sustained capacity development is a problem, and similarly in Grenada, ongoing investment in people is seen as fundamental.

All states have disaster management plans, but many are not up to date (see Table A1 in

Appendix 1). Preparedness activities described in these plans include training, exercises and simulations; reviews of plans and procedures; ensuring the availability of resources, assets and supplies in case of emergency; operation of emergency shelters and evacuation planning; maintenance and capacity of disaster management stakeholders; carrying out public information and awareness campaigns; emergency communication and early warning systems; and reporting and documentation (Government of the Virgin Islands, 2008). These activities are described in general terms, rather than in relation to a particular type of event or with reference to specific groups.

Some states also have hazard-specific plans, standard operating procedures (SOPs) or protocols for specific hazards, particularly for hurricanes, tsunamis and volcanic activity (droughts, landslides, earthquakes, heatwaves and other natural hazards are less prevalent in existing disaster planning). Hazard-specific plans are either issued as separate documents or included as annexes in national disaster plans. They specify relevant stakeholders, roles and responsibilities and outline emergency procedures, encompassing timelines and actions to be taken. Examples include the Montserrat National Hurricane Plan; the Saint Kitts and Nevis Tsunami Protocol and National Action Plan; a plan for hurricanes and for volcanic activity in Saint Vincent and the Grenadines; hurricanes, landslides and volcanic eruption plans in Saint Lucia; and Tsunami Warning Protocols and a Flood Plan in Anguilla. A smaller set of countries have established plans for disease outbreaks and technological and human hazards, such as the Saint Lucia Oil Spill Plan and a National Oil Spill Plan and Terrorist Response Plan in the British Virgin Islands. There are also sector-specific plans, for instance in health, transportation, the extractive industries and tourism, though conversations with stakeholders indicate that this may not be the case in every country, or at least these sectoral plans are not widely known.

National management disaster plans typically provide details on preparedness activities to be undertaken ahead of any event and at the start of different seasons (wet and dry). Those

activities most clearly defined are for rapid-onset events such as hurricanes and floods, with much less detail on slower-onset events such as droughts. For hurricanes, some plans detail the different stages and related activities once a forecast is issued:

- storm watch (48–72 hours out)
- storm warning (36 hours out, with further steps at 24, 12 and six hours)
- impact
- response.

Disaster management plans in the past have tended to focus on the roles of government agencies, with limited detail on what is expected of private utility, telecommunications and retail companies. In the British Virgin Islands, however, new legislation requires critical utility services to ensure they are protected in case of disasters and are able to meet the needs of the population. In Saint Kitts and Nevis, NEMA has recognised that cooperating with Chambers of Commerce is crucial to engaging small and medium-sized businesses in disaster risk management planning. Likewise, multi-sectoral disaster planning is a priority for most states, in order to identify needs and actions to reduce impacts.

4.2.2 Actions in advance of disasters

In the Eastern Caribbean, disaster management plans describe activities to be carried out at various points ahead of a disaster, either as general preparedness measures (which in the case of hurricanes and related flooding means seasonal activities), or as early actions once an event has been forecast. Some activities aim at reducing impacts, while others facilitate a more effective response once a disaster has occurred (and help avoid secondary impacts of a delayed or inadequate response).

General and seasonal preparedness

Disaster management plans for OECS member states all define critical preparedness actions for different hazards. Due to the cyclical and recurring nature of the hurricane season, most countries undertake an annual revision of hurricane plans at the start of the season. In Montserrat, for example, the Disaster

Management and Coordination Agency (DMCA) and the Red Cross revise their plans and share them with stakeholders to ensure alignment at the beginning of the season. The DMCA hosts a hurricane conference each year, to share information with stakeholders, present seasonal outlooks and conduct table-top simulation exercises. In the Virgin Islands, readiness plans are issued at the start of each season, helping the national Department for Disaster Management (DDM) assess where different stakeholders are in terms of preparedness ahead of an event.

Disaster agencies and National Red Cross Societies or subsidiaries train staff, stakeholders and volunteers and undergo exercises and scenarios to test their systems. Other common activities include seasonal restocking of emergency supplies and the preparation and stocking of shelters. In Saint Kitts and Nevis, containers are strategically placed around the islands and restocked with tarpaulins, kitchen sets, blankets, hygiene kits and shelter toolkits before the start of each season. The Saint Kitts and Nevis Red Cross Society equips its district leaders with phones and kits before the start of the hurricane season to support communication and facilitate damage assessment after a hurricane. Kits comprise hard hats, blankets, raincoats, batteries and other supplies.

To accompany these preparedness activities, agencies also tend to step up public awareness efforts. The British Virgin Islands DDM, for instance, aims to transmit messages about disaster preparedness throughout the year, but the frequency and urgency of messaging is increased as the hurricane season approaches.

Regular information and coordination meetings are also implemented as a means to enhance preparedness. In Saint Lucia, for example, flood and drought committees meet monthly at the offices of NEMO. Meetings, which are co-chaired by the National Meteorological Office and the Water Resource Management Agency, serve as platforms to discuss climate and weather outlooks, water resources, waterborne diseases and other information from hazard monitors and forecasts.

Preparedness based on forecasts

Once a credible and severe threat is forecast and stakeholders have received this information, a

range of protocols and actions are set in motion. For tropical storms and hurricanes, a tropical storm or hurricane watch is issued, followed by a warning when impact is imminent (within a matter of hours). Activities are then undertaken by the government, Red Cross, NGOs, UN agencies and civil society organisations, police and other emergency services. These actions, described in disaster preparedness plans, vary according to the level of alert, but include:

- Maximise capacity to respond, in particular through pre-positioning items, preparing family kits and mobilising volunteers. This is especially the case for rapid-onset events such as hurricanes and flooding, where stakeholders felt that forecasts were not accurate or timely enough for action to be taken in advance to reduce impact.
- Avoid or reduce potential impacts, include shuttering buildings, clearing drains, securing objects that could cause damage, clearing evacuation roads and evacuating people to safety.

Warning messages to the public usually provide information on the type of hazard, alert level, expected magnitude and anticipated time of impact, along with recommendations for actions to take. This includes instructions to continue monitoring the situation, clear debris, fit shutters or evacuate and move to the nearest shelter in the case of an expected hurricane or anticipated flooding. For droughts and heatwaves, common advice is to limit water use and stay hydrated. Sector-specific information may be disseminated by agriculture and water specialists or healthcare professionals, depending on the situation. Information is sometimes provided on anticipated secondary impacts, such as health threats from mosquito-carried or waterborne disease. This seems to be done more systematically in the British and French overseas territories than in independent OECS countries.

Communication channels for early warnings include television, radio, disaster agency

websites and social media, apps and passing on information through volunteer networks, sirens and loudspeakers. Many disaster agencies operate their own radio programmes on national channels or are able to interrupt radio programmes to deliver warnings. In the case of hurricanes, initial information is shared with the public from up to one week out, followed by watch and warning stages. As the anticipated impact approaches, additional and more detailed information is provided, alongside advisories for appropriate action, adapted depending on how the situation develops. Swift communication is key to ensuring that people have as much time as possible to prepare for an event. In some agencies, the process for getting warnings out to the public has been minimised, in the case of the Anguilla DDM, bringing the time from receiving a warning to dissemination down to about five minutes. The system relies on pre-written text and templates that can be quickly filled out with event-specific information when needed.

Emergency Operations Centres (EOCs), usually located within the national disaster agency or another safe location, are activated to coordinate critical anticipation and response activities before, during and after an event. The EOC brings together key stakeholders and decision-makers including representatives of the disaster agency or department, sectoral ministries, the Office of the Prime Minister, offices of the Governor and Chief Minister in the British overseas territories, the police, fire department, media and the Red Cross (Government of Saint Lucia, 2002; Anguilla Department of Disaster Management, 2012). Some sectors and districts and National Red Cross Societies or subsidiaries set up their own EOCs to coordinate more specific activities.

Government actors, as well as the Red Cross Societies,²⁶ also verify the readiness of stocks, backup systems, generators and shutters, undertake checks in communities, prepare for evacuations and check shelters where relevant, and make sure the most vulnerable can access assistance. In Antigua and Barbuda, for instance, a series of consultations is undertaken to gauge

26 This includes the Caribbean Red Cross National Societies, the Regional Intervention Platform for the Americas and the Caribbean of the French Red Cross, subsidiaries of the British Red Cross in the OTs, and the International Federation of Red Cross/Red Crescent Societies (IFRC).

whether there are any response gaps and how these can be addressed. For hurricanes, NODS will discuss the status of stocks at a pre-strike meeting, with ministries of health, utilities and public works, the military, police and other stakeholders. This ensures that it is clear before any impact occurs what the response capacities of different actors are, and that plans to deal with gaps or shortfalls have been identified. As a standard measure, messages also go out to District Disaster Coordinators to be prepared to open shelters. However, where a storm rapidly intensifies relatively shortly before making landfall, as was the case with Hurricane Irma, and watch and warning messages are issued back to back, having sufficient time to undertake early actions becomes a challenge. NEMO in Saint Vincent and the Grenadines has recently increased its focus on pre-positioning ahead of impending storms and set up Memoranda of Understanding (MoUs) with supermarkets to support this.

Alerting and mobilising volunteers and ensuring they have the necessary equipment to prepare communities and respond post-disaster is a priority for the Red Cross. Red Cross National Societies and subsidiaries also assign first-aiders to shelters and to pre-stock essential supplies, in coordination with national disaster agencies. Through vulnerability assessments and networks of community volunteers, Red Cross actors are often well aware where vulnerable people are located, allowing them to do pre-disaster community checks, assess the situation of vulnerable people and assist where needed.

For hazards where physical damage is expected, reinforcing infrastructure and securing assets becomes a priority. Public works departments, utility companies, water and sewage departments and private contractors are critical actors in coordinating and undertaking actions such as clearing roads, securing government buildings and equipment and securing shelters. Beyond securing personal property and assets, communities also clear drains to reduce the risk of flooding. Sector-specific actions, such as securing vessels, are initiated by the relevant government department. In Montserrat, the DMCA collaborates with the Ministry of Works

and private contractors to pre-position large machinery and heavy building equipment in strategic and safe locations, so they can still operate if access ways are blocked by flooding, landslides or debris.

Closer to the expected event and with increasing certainty of impact, attention turns to shutting down government services and initiating evacuations. Special assistance is often provided by the government, volunteers or communities to particularly vulnerable populations who may have difficulty moving on their own, such as the elderly, children and people with disabilities or health issues. Most countries cannot order mandatory evacuations, though there are exceptions (for instance, in the evacuation of residents from Barbuda to neighbouring Antigua ahead of Hurricane Irma). In Antigua and Barbuda, NODS opens shelters once a storm or hurricane warning is issued and advises people to move to friends and relatives in safe locations as a first option, or to public shelters as a second. People are advised to move early to avoid being on the road when winds start to hit. In Montserrat in the run-up to Hurricane Maria, measures were taken to relocate not only people, but also the country's hospital, which was considered to be in an unsafe location, to a shelter. Although Montserrat was not as badly affected by Maria as neighbouring islands, the operation to move the hospital to the shelter and back to its main building afterwards was considered a success and regarded as valuable experience by stakeholders in the Montserrat DMCA.

Consultation with stakeholders has proved critical in identifying actions ahead of a disaster. In St Kitts and Nevis, for instance, NEMA credits a younger staff member with a proposal to disseminate early warnings via WhatsApp. This was used for the first time during Hurricanes Irma and Maria. The new channel was considered a success and has since become the main way NEMA ensures its chain of communication. Early warning messages and advisories in Anguilla were developed in conjunction with entities responsible for sectors likely to be affected or to face heightened risk. Public service announcements after a hurricane or flooding, for instance, were

developed with health actors to provide advice on reducing the potential threat from mosquitoes or waterborne diseases.

Preparedness activities and early actions can be based on past disaster experience. Stakeholders from Montserrat and the Virgin Islands mentioned how Hurricanes Irma and Maria highlighted gaps in existing plans and systems and led agencies to rethink activities. In the Virgin Islands, this prompted the DDM to work more closely with communities at the start of the hurricane season to carry out vulnerability assessments.

Preparedness actions are clearly evolving in the Eastern Caribbean, based on experience and under guidance from CDEMA. Yet many

activities are ad hoc – they are not well described in a disaster management plan. Disaster management agencies do not regularly review or adjust the plans.

Overall, stakeholders consulted for this study confirmed that a wide range of preparedness activities take place during hurricane season focused on improving awareness of the risks, communicating alerts, preparing to evacuate people and checking shelters. But not all actions identified in disaster management plans are being implemented (see Chapter 7 for further analysis of these constraints). The limitations are described further in the next chapter in relation to Hurricanes Irma and Maria in 2017.

5 Coordinating and delivering aid

This chapter looks at improvements to aid coordination and delivery through the CDEMA-led RRM, and ways in which this mechanism could be enhanced to support countries in preparing for and reducing impacts before disaster strikes. The rest of the chapter examines emergency response and aid delivery from a national perspective, focusing on the actions of national agencies and their partners in preparation for – and response to – the 2017 hurricanes.

5.1 The role of regional agencies

5.1.1 The Regional Response Mechanism

CDEMA plays a key role in coordinating regional responses to disasters for CARICOM Participating States,²⁷ mobilising and delivering disaster relief, and in collaboration with international and regional partners, including UN agencies. Critically for this scoping study, CDEMA's direct support to states through the RRM currently focuses only on post-disaster response measures (including preparedness for that response). Established as a platform to deliver timely and coordinated support to disaster-stricken participating states, the RRM is supervised by CDEMA's Coordinating Unit and governed by a Regional Disaster Response Support Doctrine (RDRSD) (see Figure 6).²⁸ The RDRSD recognises the negative socio-economic and environmental effects of natural

and anthropogenic hazards on Participating States, and refers to the political agreement among CARICOM members to assist each other through mutual aid when a disaster occurs (CDEMA, 2019).

The RRM is funded through participating state contributions. States are also expected to put money into an Emergency Assistance Fund (EAF), which has a target level of capitalisation of \$3 million, based on an estimate for a worst-case scenario. Currently, however, there are fewer funds in the EAF, and these are used mainly to support the deployment of security and logistics personnel (often nationals) in affected states.

Hurricanes Irma and Maria in 2017 both tested and demonstrated the value and relevance of the RRM to participating states and partners in coordinating aid delivery. The RRM, under the mandate of CDEMA, supports participating states on the basis of the following categories:

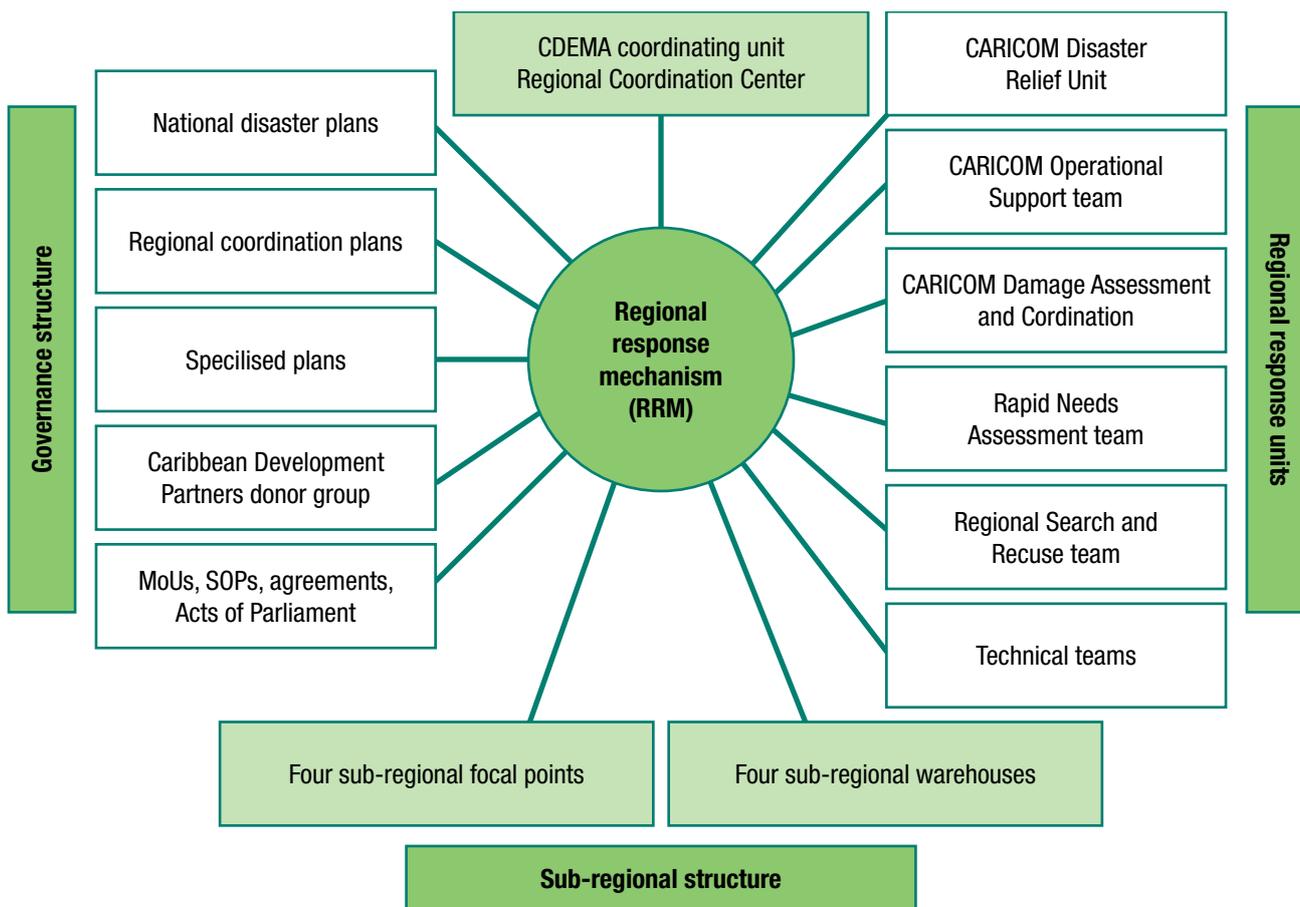
1. threatened, affected or impacted, but do not need support
2. higher threat level and request for support
3. threat of devastation.

A review of the RRM in 2017 found that the mechanism was highly effective in coordinating humanitarian support to affected states (Collymore et al., 2017). However, there is a

27 Current Participating States are: Anguilla, Antigua and Barbuda, Commonwealth of the Bahamas, Barbados, Belize, Commonwealth of Dominica, Grenada, Republic of Guyana, Haiti, Jamaica, Montserrat, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Republic of Trinidad and Tobago, Turks and Caicos Islands and the British Virgin Islands. French overseas territories are not part of CARICOM, but negotiations are ongoing and advanced towards the signature of a MoU between the French government and CDEMA, which would allow the RRM to deploy in response to emergencies in French territories.

28 www.cdema.org/rrm

Figure 6 Conceptual framework for the regional response mechanism



Note: CDEMA, Caribbean Disaster Emergency Management Agency; CARICOM, Caribbean Community; MoU, Memorandum of Understanding; SOP, standard operating procedure.

Source: CDEMA presentation on the regional response mechanism (www.humanitarianresponse.info/sites/www.humanitarianresponse.info/files/documents/files/rrm_booklet_final1_7.29.16_1.pdf).

need to build capacity to implement actions before disasters strike. There are also challenges in logistics and the timely delivery of supplies and personnel through the RRM. The cost of providing assistance to an affected state is met mainly by donors and other development partners. This funding is, however, unpredictable (Collymore et al., 2017): states cannot be certain how much they will receive or in what form.

Although the trigger mechanisms for the RRM are based on threat levels and need for support, and the mechanism could be triggered before a disaster, support is almost always requested post-impact, starting with help with loss and damage assessment. To trigger support earlier, states would need to have developed a credible methodology for estimating potential losses. This is starting to happen. CDEMA now requests

information by phone from disaster management agencies on exposed populations and assets at risk, and any supplies that will be required in the response. On this basis, development partners within the RRM can begin to make offers of support. The RRM can be enhanced by expanding the current focus of pre-impact activity on DANAs²⁹ to include forecast-based early action planning with an associated budgeting exercise as part of the standard disaster management cycle.

Separate from the RRM, the Pan American Health Organization (PAHO) has an emergency fund that has been triggered for pre-positioning personnel, medicine and other supplies. For Irma and Maria, personnel and resources were pre-positioned in some countries. When PAHO judges that impacts will be severe, it

29 www.cdema.org/CDEMA_DANA_Continuum_one_pager_published.pdf

sends individuals into countries to work with Ministries of Health directly. The Office of US Foreign Disaster Assistance can also pre-position resources in-country, and deployment teams go in to work alongside National Disaster Offices. The release of funding is tied to impact reports.

5.1.2 Social protection

The World Food Programme (WFP) and the World Bank are developing another initiative that could provide more predictable funding for affected populations in the wider Caribbean region – referred to as ‘shock-responsive social protection’ (SRSP), which in the long term aims to make social protection systems more adaptive to climate change. The initiative has begun with assessments of social protection programmes and climate vulnerability in a number of countries, including some in the OECS region. The results of these preliminary studies could provide a basis for linking climate and disaster risk financing (DRF) to social protection systems, so rapid support can be delivered to families affected by climate hazards – and perhaps even to those that are vulnerable and likely to be impacted.

In the Dominican Republic and the eastern provinces of Cuba, WFP is developing SRSP mechanisms to transfer cash to vulnerable families.³⁰ The aim is to link early warning systems for drought to social protection programmes, so families can receive support before a drought has serious socioeconomic impacts (WFP, 2019). Work has started to improve the observation capabilities of meteorological monitoring networks and strengthen collaboration between hydrological and meteorological services.

Although there are only a few examples around the world where SRSP has been linked to forecasts, it is possible to infer models under which such integration could occur based on existing experiences with FbA. Social assistance or safety nets (including cash transfers, cash-for-work programmes, temporary employment programmes and school feeding programmes) could be critical ways of delivering support to households based

on a forecast. Depending on lead time, a number of social protection actions can be triggered. For example, on the 1–3-month timeframe, public works efforts could be expanded to reinforce critical infrastructure. On the 3–7-day timeframe, unconditional cash transfers could be released to support the evacuation of people and assets or to help them avoid taking out high-interest loans. Actions would need to be consistent with government preparedness plans and SOPs or early action protocols.

Another potential area for linking FbA to social protection relates to climate- and disaster-driven displacement and migration. In the aftermath of Hurricane Maria in Dominica, one-fifth of the population left, some never to return.³¹ The need to anticipate future needs for partial or full evacuation, including the definition of FbA triggers and detailed scenario-based action plans, was the subject of a side event organised by the OECS Commission during the United Nations Climate Change Conference in Madrid in 2019. Some of the issues discussed included how to anticipate large-scale evacuation, and what kinds of measures need to be put in place to ensure capacity to meet the needs of displaced people or people migrating, especially in terms of the transfer of benefits, including school enrolment, health, employment and other areas covered by social protection systems, when people are forced by extreme events to move within the OECS islands.

5.2 National coordination and delivery

5.2.1 Coordination between national-level stakeholders

At the national or island level, a diverse range of actors are involved in preparedness and response. Coordination between national and sub-national actors is particularly important and has improved over time and with experience – it is considered to be broadly effective in all 12 member states. NEMOs and other disaster management agencies play a key role in developing and

30 This new SRSP scheme builds on experience with cash transfers in 2017 and 2018. WFP supported 25,000 people through cash transfer programmes in Dominica.

31 www.thenewhumanitarian.org/feature/2017/10/18/exodus-hurricane-hit-dominica-recovery-remains-elusive

implementing DRM strategies and disaster plans (see Chapter 4), while civil society actors tend to be more focused on community preparedness and increasing awareness of disaster risks. In Guadeloupe and Martinique, for example, simulations are run by schools, and there is an emphasis on creating a ‘culture of risk reduction’ among students.

Informal relationships are critical to maintaining coordination between stakeholders in disaster preparedness and early action. According to regional stakeholders interviewed for this study, some cross-sectoral collaboration is less bureaucratic and more manageable in Caribbean islands than elsewhere, perhaps due to the relatively small size of their bureaucracies. However, the relationship between DRM agencies and NHMS is considered suboptimal in many countries, with the roles and responsibilities of each not entirely clear, resulting in slow decision-making. Cooperation between national and sub-national actors is also essential, and it is common for local Red Cross branches to be named in DRM plans and involved in data gathering and implementing community preparedness and resilience activities. In Saint Vincent and the Grenadines, Red Cross volunteers record river-level data, which is transmitted to the NEMO as part of its flood EWS monitoring. National and sub-national agencies have also coordinated response efforts – for example during Zika and Chikungunya outbreaks, though in some countries there is still a need to reinforce epidemiological early warning and action, defining roles and responsibilities for different actors beyond those strictly defined as public health agencies. Heightened preparedness triggered by the emergence of Zika points to the importance of preparedness for all mosquito-borne diseases. With malaria and dengue on the rise, in addition to the emergence of Zika and Chikungunya, the role of agencies like the Agences Régionales de Santé in the French Territories is critical. Other important actors involved in early warning and action that might seem less obvious include national and regional natural park officials. In Guadeloupe, Martinique and Saint Martin, these work with municipal governments to inform people living near national parks and tourists of impending hazards.

5.2.2 Pre-positioning aid

Governments, DRM agencies and international organisations often use pre-positioned relief items from distribution centres based on some of the larger islands in the Caribbean and in Panama. This pre-positioning is more accurate and can reduce suffering after a disaster, if the type of support needed is based on robust exposure and vulnerability data. Pre-positioning also needs to consider the different stages of the response, as emergency priorities change rapidly post-disaster. In Anguilla, because most of the housing stock is built of concrete, tarpaulins were never considered to be a major relief item. Nonetheless, in the first few days after Irma tarpaulins were desperately needed to protect damaged roofs. As these items were not pre-positioned, the response was not as efficient as it could have been. Water and food were another major priority initially, along with toiletries, but after a few weeks interest shifted to financial assistance and home repairs. Understanding these needs in advance can help prioritise supplies that need to be pre-positioned.

The private sector, formal and informal, plays a key role in delivering aid. For example, food is made available by businesses at the local level; people rely on stocks in local shops to sustain themselves during and in the aftermath of storms. In Saint Vincent and the Grenadines, for example, the Red Cross encourages community emergency teams to build relationships with small food shops and to keep tabs on stocks of basic items available in communities. NEMO has also developed MoUs with supermarkets as part of response planning.

5.2.3 Communicating with the public

As a disaster develops, DRM agencies communicate with the public on the status of aid delivery, starting with an ‘all clear’ which triggers the deployment of response teams, advice on shelters and distribution points for relief supplies, the status of roads and public transport, resumption of business activities and the reopening of schools. The public is informed throughout the response phase via the media, including radio, TV, the internet, social media and telephone. In Saint Lucia, an agreement with mobile phone providers enables NEMO to

reach all users of their networks. In the British Virgin Islands, legislation is being tabled that will define communications as critical infrastructure. This will require providers to have preparedness plans and supplies of vital equipment in place to restore networks quickly. For example, when the transmission towers for one mobile phone carrier were destroyed in Saint Kitts and Nevis, disaster managers used other channels including social media to communicate with first responders and the public.

5.2.4 Issues and delays in emergency response

A number of challenges were experienced in the days and weeks after Hurricanes Irma and Maria in 2017, pointing to gaps in preparedness across all OECS member states. These include the following five.

Inadequate planning. Strengthening preparedness planning is critical for effective aid delivery. DRM agencies are far from consistent in their ability to develop detailed plans. Yet they are tasked with coordinating and sequencing efforts to maintain and reduce risks, including to power, communications, transport, health and education. There is an attachment to the standard way of doing things; response generally begins with the ‘all clear’ as the signal to assess damage and needs, starting with a situation overview and proceeding through increasingly targeted damage and needs assessments. This process can take several days, delaying the delivery of aid, and could be speeded up through scenario planning and simulations and drills to test and refine scenarios before a disaster occurs.

Lack of core funding. The Saint Kitts and Nevis Red Cross was able to help a community seek funding to clean up after Irma, reducing health risks ahead of heavy rainfall. They did this by linking these actions with a project on Zika prevention, but generally it is difficult for governments and Red Cross Societies to scale up preparedness actions – there is no core funding for these activities.

Red tape and delays. In the British Virgin Islands, the Ministry of Water is facing problems mobilising equipment because the private

contractors who need to be engaged for large-scale emergencies have become wary, based on past experience of red tape and delays in receiving payments. Bureaucratic delays are damaging relations and choking the response system.

Accountability in aid delivery. In Dominica after Hurricane Maria, equipment and supplies used in emergency response reportedly went missing. Dominica is not the only country where it is hard to know where things have gone or whether people have received things twice. To address this, Dominica has begun to formalise some preparedness planning, assigning and registering supplies for communities at the start of hurricane season. Collecting this data for all 166 communities will take three years. In general, it is of critical importance that early and post-disaster response actions are designed and implemented transparently.

Preparedness for emergency response is piecemeal. In Dominica, the Red Cross is working with some community members who might need extra help post-disaster, such as the elderly or housebound. However, between them and the ODM it is not clear how many people will need this extra support. Another issue is the sole focus on hurricanes – the Red Cross provides training on preparedness for hurricanes, but not for floods, landslides or geophysical hazards. Similarly, the government is planning to build two jetties to help with evacuations in case of a volcanic eruption, but evacuation routes have yet to be planned. Training is not standardised and simulation exercises infrequent. Although pre-positioning of relief items has improved in recent years, this can be further enhanced by using disaster impact data and recovery analysis, to decide in advance what is more likely to be needed quickly in each country, and where post-disaster availability of relief and rehabilitation items has been an issue in the past.

Overall, there are significant limitations in response capacity, despite stronger coordination between external agencies through the RRM. Lack of investment in capacity-building makes it less likely that emergency plans will be implemented.

6 Financing early action

There has been increasing interest in recent years within the OECS (and wider Caribbean) in the use of financial instruments to improve the response to disasters. There are many different risk financing instruments available to OECS states, but only a handful are available through regional organisations, and hence suitable for channelling forecast-based finance to OECS member states. This section examines the main products offered by regional organisations and how these could be adapted for FbA, before assessing the capacity of OECS members to finance preparedness, and in particular early action, through existing mechanisms. This is important in understanding opportunities and challenges for developing a financing mechanism for early action in the region.

6.1 Regional mechanisms for channelling forecast-based finance

Extreme weather generates huge economic losses in the Eastern Caribbean (as described in Chapter 2), and the funds mobilised to mitigate and recoup these losses must derive from multiple sources. In this chapter, several sources of disaster-linked finance are catalogued.

6.1.1 Loans from multilateral financial institutions and donor organisations

The World Bank, IMF, regional banks and other donor organisations offer various types of financial assistance post-disaster, including debt relief and conditional loans.

The Caribbean Development Bank (CDB) contributes to the economic growth and

development of member countries by promoting economic cooperation and integration, with a particular focus on the needs of the less developed members of the region (CDB, n.d.). In July 2014, the CDB launched the National Disaster Risk Management (NDRM) framework, a multi-million-euro initiative of the African, Caribbean and Pacific group of states, funded by the European Union, with CDEMA, the CDB and the government of the Dominican Republic as implementing partners. The aim of the NDRM is to reduce vulnerability to the long-term impacts of natural hazards, including the potential impacts of extreme weather events and a changing climate.³² Although the NDRM has only been operational for a few years, the CDB has provided loans, equity and grants to OECS member states in excess of \$400 million between 1970 and 2018 for environmental sustainability and disaster risk management programmes (CDB, 2019). Regional (multi-country) projects and toolkits for road infrastructure³³ and the water sector³⁴ have increased resilience to natural hazards and will help governments make better investment decisions in the future.

The CDB also has mechanisms to support member states severely impacted by a natural hazard, including the Emergency Relief Grant, the Immediate Response Loan and the Relief and Recovery Loan.

1. The Emergency Relief Grant has a limit of \$200,000 and is released after a member country requests assistance in responding to the severe impacts of a disaster. The Immediate Response Loan is used to assist

32 www.caribank.org/our-work/programmes/natural-disaster-risk-management-programme

33 Guyana, Saint Lucia and Dominica.

34 Antigua and Barbuda, Dominica, Grenada and Saint Kitts and Nevis.

the government of a member state in the provision of emergency relief supplies and humanitarian assistance, cleaning and clearing debris and restoring critical infrastructure and essential public services.

2. The Relief and Recovery Loan is disbursed approximately three to four months after a disaster. The amount is initially driven by the PDNA. However, there have been occasions where the costings as shown in the PDNA do not reflect the amount of damage and loss sustained by the time the funds are mobilised, resulting in the Relief and Recovery Loan providing insufficient assistance.

The CDB has provided loans on concessionary terms to OECS countries post-disaster, notably Immediate Response Loans and Emergency Relief Grants. After Maria, the CDB provided a \$65.2 million loan for recovery and reconstruction and a \$50 million loan to restore economic stability and build resilience.

For the CDB, the allocation of funds is usually aligned with a country's DRM programme and is tied to risk and vulnerability assessments. Since the bank uses these assessments to justify the release of funds for disaster management purposes, there is a need for regular assessment and updating in order to enable access to appropriate funding.

Since 2008, the World Bank Group has offered Catastrophe Deferred Drawdowns (Cat DDOs), a quick-paying line of credit linked to a drawdown trigger (typically the declaration of a state of emergency) and accessible to countries that possess an adequate macroeconomic policy framework and a satisfactory DRM programme. Dominica, Grenada, Saint Lucia and Saint Vincent and the Grenadines, as IDA-IBRD³⁵ 'blend' countries, are eligible for Cat DDOs, but only the Dominican Republic and Jamaica have a Cat DDO in place. The World Bank's Crisis Response Window is also available for blend

countries; it disbursed \$50 million to Dominica post-Maria.³⁶

The IMF's contingent disaster financing tools include the Rapid Credit Facility (RCF) and the Rapid Financing Instrument (RFI), both of which offer support for urgent balance of payment needs without formal adjustment programmes. The RCF is concessional³⁷ and only available to Poverty Reduction and Growth Trust (PRGT) countries; the RFI is available to all IMF member countries to support disaster-related needs. Dominica, Saint Vincent and the Grenadines, Saint Lucia, Saint Kitts and Nevis and Grenada have all accessed IMF contingent disaster financing in the past.

Since the 2008 economic crisis, Caribbean countries have become less successful in securing official development assistance (ODA) funds from bilateral donors such as the UK, US, Canada and Japan. China is also emerging as an important source of aid. Although direct flows are decreasing, aid from bilateral donors is also distributed to multilateral and regional financial institutions, making total contributions greater than first appears (Bourne, 2015).

Other untapped funds or mechanisms for post-disaster assistance include:

- The Inter-American Development Bank (IDB)'s contingent credit facility and contingent credit line for natural disasters, launched in 2012 (none of the OECS countries is a borrowing member, although a number of their Caribbean neighbours are and the CDB has an MoU with the IDB).
- A contingent credit line operated by the Japan International Cooperation Agency (JICA), Stand-by Emergency Credit for Urgent Recovery (SECURE). SECURE provides post-disaster financing of up to ¥10 billion or 0.25% of a country's GDP, whichever is lower, immediately following a disaster, based

35 International Development Association and International Bank for Reconstruction and Development; the former extends loans to countries in risk of debt distress with low gross national income.

36 <https://reliefweb.int/report/dominica/world-bank-provides-us65-million-dominica-s-post-maria-reconstruction>

37 Loans extended on more generous terms than market loans, generally with long grace periods.

on prior agreement with JICA. Peru signed a ¥10 billion loan agreement in 2014.³⁸

- World Bank intermediation of bonds, derivatives and insurance can be used to help countries tap into markets that will most effectively hedge their risk (this was used by Uruguay in 2013).³⁹

A caveat to all these sources of funding is that post-disaster borrowing adds to already excessive debt burdens in many countries in the region, thus limiting resources for potential investment in resilience and protection against future shocks (Hares, 2018).

6.1.2 Sovereign risk insurance: the CCRIF

The Caribbean Catastrophe Risk Insurance Facility Segregated Portfolio Cover (CCRIF SPC) is the world's first multi-country risk insurance pool. It provides parametric insurance coverage against hurricanes, earthquakes and excess rainfall (CCRIF SPC, 2019b) a through short-term liquidity (see Box 3). For participating countries, the regional risk pooling arrangement is a means to mutualise risk and create economies of scale for accessing international capital and/or reinsurance markets. The CCRIF SPC has rapidly built its capital and risk-bearing capacity, and as its financial strength has grown premiums have been lowered to make it more affordable.⁴⁰

The CCRIF SPC has worked with regional organisations to help build capacity and the knowledge base for the development of disaster risk management and climate adaptation strategies in the Caribbean. It has MoUs with at least 10 organisations, including the OECS, CIMH, CDEMA, CCCCC and the CDB. The CCRIF has also funded capacity-building and awareness-raising initiatives in ministries of finance and with disaster management officials, including on how to quantify risk (CCRIF SPC, 2019b).⁴¹

The CCRIF presents two major benefits for participating countries:

- Transferring risk to the facility at a much lower cost than if they were to individually obtain coverage (Suarez and Linnerooth-Bayer, 2011).
- Prompt pay-outs provided by the CCRIF help governments overcome short-term liquidity problems after a disaster, and so maintain critical functions (OECD, 2015).

These benefits are clearly recognised by Caribbean countries: 19, plus Nicaragua and Panama, are currently part of the CCRIF. In 2019, nine Caribbean governments increased coverage for at least one of their policies and one country purchased cover for an additional hazard (tropical cyclones) (OECS, 2019). As of 2018, the CCRIF had made 37 pay-outs totalling \$136.3 million to member governments, each within 14 days of the event (Insurance Journal, 2018) (see Table 5).

Close to \$55.4 million has been paid out across all policies to OECS countries, with the largest amounts – over \$37 million – released for hurricanes Irma and Maria in 2017 (CCRIF, 2019b) (see Table 6).

Table 5 illustrates how pooling risks can pay off, as in 2016 and 2017, two occasions when pay-outs exceeded the sum of paid premiums. The Excess Rainfall policy, meanwhile, has generated pay-outs every year since its inception in 2014. Generally, the sum of premiums paid for tropical cyclones and earthquakes has fluctuated between \$18 million and \$24 million since 2007.

Early dissatisfaction with events causing significant damage without triggering pay-outs led a number of countries to underinsure for some hazards or not to renew coverage. In response, the CCRIF has developed new instruments and policies to answer demand.

38 www.jica.go.jp/english/news/press/2014/140401_02.html

39 <https://treasury.worldbank.org/en/about/unit/treasury/ibrd-financial-products/disaster-risk-management#3>

40 www.ccrif.org

41 Activities included training OECS countries and OECS Commission personnel in RTFS and assessments of vulnerable communities in Saint Lucia and the development of strategies and action plans for reducing vulnerability within these communities – to be done in all OECS member states, continuing next with the British Virgin Islands and Dominica.

Box 3 Risk models used by the Caribbean Catastrophe Risk Insurance Facility

Governments signed up to CCRIF can purchase earthquake, hurricane and excess rainfall catastrophe coverage. Pay-outs are then made when pre-defined levels of hazard occur (e.g. windspeed, volume of rainfall) that exceed a pre-established threshold for expected losses associated with that kind of event.

The current model for tropical cyclones and earthquakes is based on the Multi-Peril Risk Evaluation System (MPRES). The MPRES can handle multiple hazards and hazard assessment methodologies and accommodate a variety of input/output formats and detailed exposure classifications, and produces accurate loss estimates with known statistical uncertainty (CCRIF SPC, 2019b). The MPRES model was used for the 2018/19 EQ and TC policies. It has been in place since 2011 and has performed adequately, as particularly demonstrated by the pay-outs made in 2017.

A new model, known as the System for Probabilistic Hazard Evaluation and Risk Assessment (SPHERA), has been developed and used to underpin CCRIF SPC's TC and EQ policies starting from policy period 2019/20 (CCRIF SPC, 2019b). This new model, incorporating new information and employing the most up-to-date scientific findings and methodologies, has achieved a higher precision in the evaluation of losses from earthquake and tropical cyclone hazards. As part of the process, new country risk profiles were developed and are being shared and discussed with member countries.

The current model for excess rainfall is the XSR 2.1 model. For the 2019/20 policy year, an upgrade known as XSR 2.5 will be used. Improvements include consideration of soil saturation in addition to pure rain fall in the loss calculation, as well as a multi-trigger covered area rainfall event based on additional WRF1 configurations (CCRIF SPC, 2019b). These changes have been made to better represent smaller, regional severe rainfall events in the model.

CCRIF SPC has recently launched a web-based platform that allows its members to monitor earthquakes as well as the development of potentially damaging heavy rainfall and tropical cyclones; analyse their intensity and assess their impact; and confirm whether an active insurance policy with CCRIF is likely to be triggered.

Table 5 Evolution of coverage limits, premiums and pay-outs for the Caribbean XSR and EQ/TC portfolios

Hurricane season	Excess rainfall policy features (\$ millions)			Tropical cyclone policy features (\$ millions)		
	Aggregate coverage limit	Premiums paid	Pay-outs	Aggregate coverage limit	Premiums paid	Pay-outs
2014	–	3.6	0.49	388	18.3	2.9
2015	55	6.8	2.4	294	24.3	–
2016	74	6.2	8.1	342	21.4	22.5
2017	104	7.6	12.4	369	23.7	48.9
2018	–	–	8.3	–	–	–

Source: Author compilation from CCRIF Annual reports 2014–2018 and www.ccrif.org/content/about-us

Table 6 Caribbean Catastrophe Risk Insurance Facility pay-outs for Irma and Maria

Event	Country	Type of coverage	Pay-outs (\$ millions)	Estimated damage (\$ millions)
Tropical Cyclone Irma, September 2017	Saint Kitts & Nevis	Tropical cyclone	2,294,603	20
	Anguilla	Tropical cyclone	6,529,100	200
	Anguilla	Excess rainfall	158,823	
	Antigua & Barbuda	Tropical cyclone	6,794,875	250
Tropical Cyclone Maria, September 2017	Dominica	Tropical cyclone	19,294,800	1,456
	Dominica	Excess rainfall	1,054,022	
	Saint Lucia	Excess rainfall	671,013	–
	Saint Vincent & the Grenadines	Excess rainfall	247,257	–
	Saint Lucia	Aggregated Deductible Cover (ADC)	123,750	–
	Anguilla	ADC	29,250	–
	Antigua & Barbuda	ADC	32,400	669
	Saint Kitts & Nevis	ADC	27,150	–

Source: CCRIF and EM-DAT: The Emergency Events Database – Université Catholique de Louvain (UCL) – CRED

In 2017, it introduced Aggregate Deductible Cover (ADC) and Reinstatement of Sum Insured Cover (RSIC). The ADC can provide a minimum payment for tropical cyclone and earthquake events that are objectively not sufficient to trigger a CCRIF policy because the modelled loss is below the attachment point (or deductible). The RSIC provides access to coverage during a policy year even after the maximum coverage limit is reached. This prevents a situation where the insurance cover is exhausted early in the policy year, thus leaving a country exposed until the policy renewal date of 1 June the following year. Both ADC and RSIC were offered at no cost for the 2019 season. In July 2019, the inaugural Caribbean Oceans and Aquaculture Sustainability Facility (COAST) fisheries parametric insurance policy was issued to Grenada and Saint Lucia, through a CCRIF SPC–World Bank partnership. The US State Department provided initial funding for COAST coverage, with the aim of helping fisherfolk and others in the fisheries industry recover from extreme events (CCRIF, 2019c).

The CCRIF-SPC tracks and reports on the specific needs addressed with pay-outs.⁴² The annual ‘use of CCRIF pay-outs reporting and

analysis’ process offers an interesting potential entry point for FbA, as a methodology for informing action planning and normalising and streamlining the expenditure of CCRIF pay-outs. Combining this analysis of expenditure according to needs met could inform targeted FbA to reduce those risks and accelerate response, improve pay-out allocation to meet anticipated needs and ultimately boost results derived from more efficient spending.

6.1.3 Funds for resilience-building

Some funds are geared towards building resilience (see Figure 7). The World Bank has spent \$13 million on technical assistance for building resilience in the Caribbean, and provided loans of over \$576 million. A Caribbean Disaster Risk Financing Technical Assistance scheme has been piloted in Jamaica, Belize, Grenada and Saint Lucia, and will be expanded to other CARICOM countries or overseas territories (OTs) at the request of ministries of finance (World Bank, 2018a). Up to 2017, the CDB had signed off on €7.6 million of technical assistance financing in the context of the Natural Disaster Risk Management Programme. In May 2017, the CDB signed a

42 www.ccrif.org/publications/use-ccrif-payouts-2007-2018

\$110 million line of credit with the European Investment Bank for climate action investments. The CDB has also established a Community Disaster Risk Reduction Fund (CDRRF), with grant support from the UK, which provides funds for communities seeking to implement climate change adaptation or DRR projects. Grants have been distributed to communities in Saint Vincent and the Grenadines, the British Virgin Islands, Belize and Jamaica (CDB, 2017).

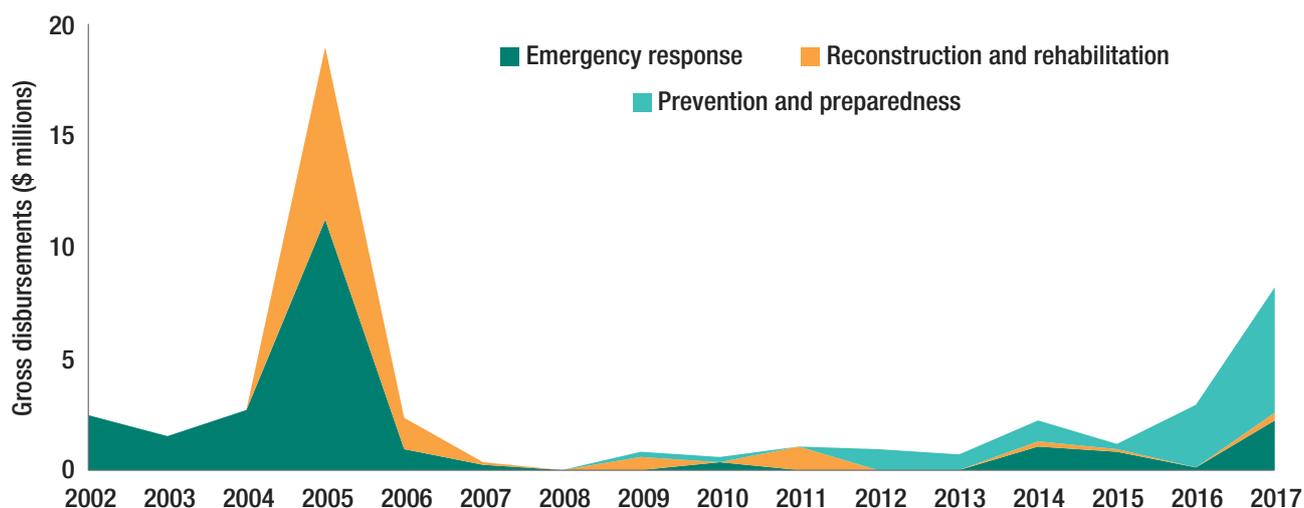
Climate funds can also be mobilised for the resilience-building facet of disaster risk management. The EU has allocated €30.7 million to GFDRR for the Caribbean Regional Resilience Building Facility,⁴³ and a Technical Assistance programme for Disaster Risk Financing and Insurance.^{44,45} AFD has allocated \$33 million to the CDB to finance sustainable infrastructure

projects in the region.⁴⁶ Encouraged by the establishment of regional ‘direct access’ accredited entities,⁴⁷ Caribbean countries are increasingly eyeing the Green Climate Fund (GCF) as a potential source of funding. There are currently seven projects in the region totalling \$456.7 million, although only one had moved to the implementation phase as of mid-2019. A recent Mexico-CARICOM-FAO initiative has enabled 40 climate experts to participate in a GCF project formulation workshop.⁴⁸

6.1.4 Humanitarian disaster funding

Access to humanitarian disaster funding from aid grants varies from year to year and is correlated to the occurrence of major storms, as illustrated in Figure 8. The average amount received in grants over the period is \$1.2 million/year.

Figure 7 Gross disbursements of official development assistance to OECs countries from 2002 to 2017



Source: Authors, based on data from the OECD’s Creditor Reporting System (<https://stats.oecd.org/Index.aspx?DataSetCode=crs1>)

43 This includes Antigua and Barbuda, Saint Kitts and Nevis, Saint Vincent and the Grenadines, Saint Lucia, Dominica and Grenada.

44 Includes the British Virgin Islands, Montserrat and Anguilla.

45 www.worldbank.org/en/news/press-release/2019/01/31/euro-30-million-to-help-caribbean-enhance-climate-resilience-and-adaptation

46 www.caribbeanclimate.bz/usd33-mn-to-finance-climate-change-resilient-infrastructure-in-the-caribbean

47 The Ministry of Environment of Antigua and Barbuda and the CCCCC are Direct Access Accredited Entities, as are CCRIF and CDB: see www.greenclimate.fund/how-we-work/tools/entity-directory

48 www.fao.org/americas/noticias/ver/en/c/1202094

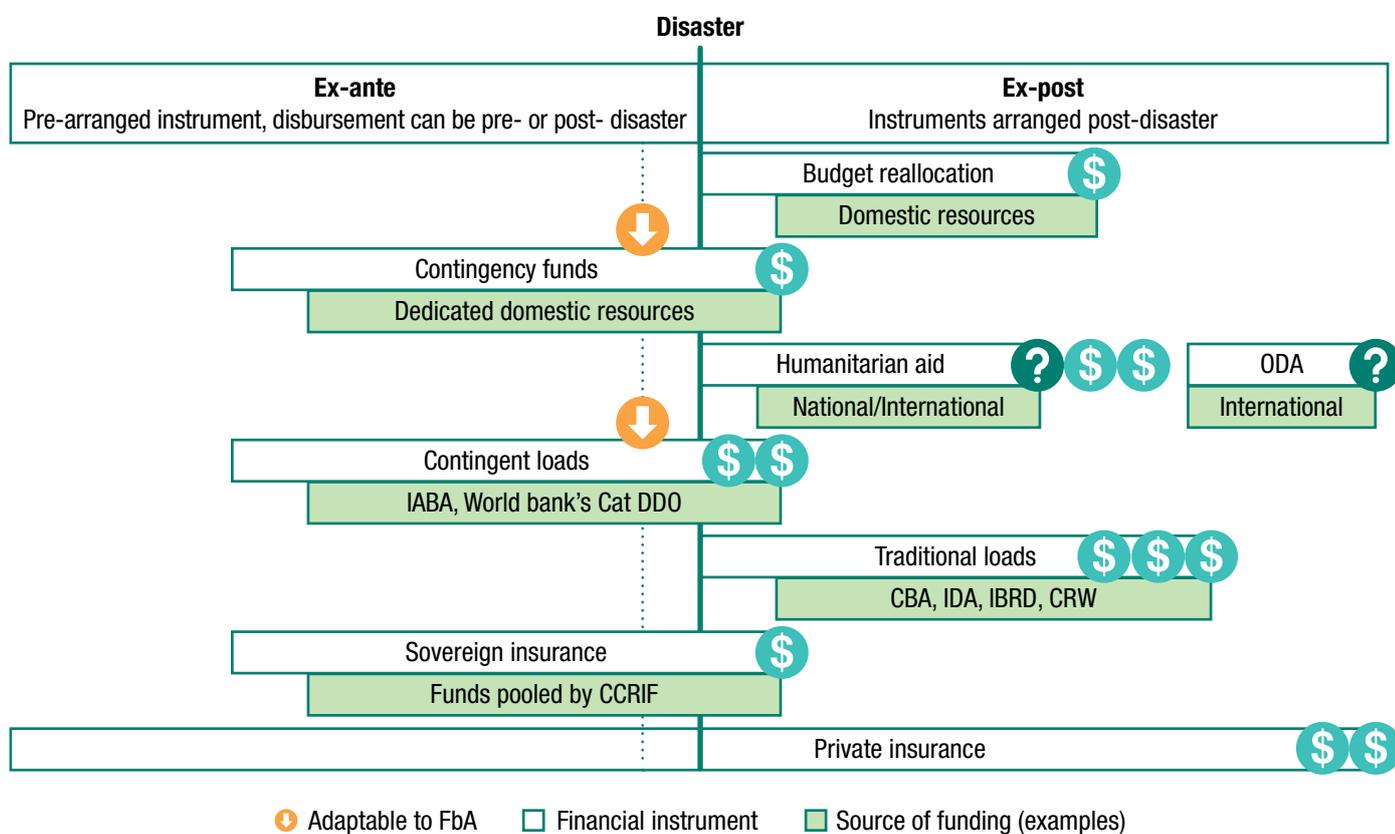
Some specific funds can be accessible on a continuous basis and thus eligible for FbA, such as the IFRC Disaster Relief Emergency Fund (DREF) and CDEMA's EAF.

The DREF enables national Red Cross Societies to submit an emergency appeal for funding assistance in the event of an extreme event at a scale which exceeds national capacity. While the DREF does allow for submission based on a forecast, it is rarely utilised for early action as it is not designed for sufficiently rapid delivery of funds before the forecast event occurs. To address this, the IFRC has recently created a new mechanism for FbA by the DREF, where a request is submitted based on the likelihood of an extreme event above a certain level of risk occurring in the near future. FbA by the DREF requires that an Early Action Protocol (EAP, similar to Standard Operating Procedure, or SOP) is prepared, detailing the forecast threshold which will trigger the specified risk management actions (based on a likely future scenario), with the associated budget required to carry out the action plan. These

mechanisms are currently available to national Red Cross Societies in the Caribbean, although they need to work with their NHMS to define the forecast trigger in order to develop their EAP.

CDEMA's EAF was established to receive donations and channel resources to participating states impacted by a disaster. When the fund was set up in 1991, \$250,000 was deposited in the account, but this has not been replenished since. Instead, CDEMA has built the fund slowly using grants. Funds are released post-disaster for humanitarian support, which can be in-kind or through grants of up to \$60,000, and is used to purchase emergency relief supplies, conduct needs and damage assessments and facilitate early recovery and rebuilding efforts. The EAF Articles of Agreement allow funds to be spent before a disaster, and more scientific triggers could be developed for the release of funds. Currently, the EAF and support provided by CDEMA is only available to participating states, so this does not include the French OTs, but a MoU for mutual support is due to be signed that

Figure 8 Summary of the instruments and sources of funding available to OECS states for disaster risk finance



Source: Author, adapted from World Bank Group (2018c)

could mean these territories can access funds in the future.

6.1.5 Private insurance

Most losses from tropical cyclones in the Caribbean are uninsured. For example, only 0.5% of losses were insured for Hurricane Ike in 2008 and only 48.6% for Hurricane Irma in 2017. Even where insurance is in place, uncertainty about private insurance pay-outs and limited private sector financing can undermine recovery. Almost a year after Hurricane Maria, claims amounting to around 15% of Dominica's GDP were still outstanding. Large proportions of these outstanding claims were held by a domestic insurer, which turned illiquid and accumulated a capital shortfall of 2% of the country's GDP after the event (IMF, 2018a).

Most hotels, tourism-related properties and businesses across the Caribbean are insured. However, an estimated 70–85% of homes in the Eastern Caribbean are uninsured (World Bank, 2018b). The reasons for low levels of insurance are multiple and complex. First, there are challenges in expanding insurance markets in developing countries: the high costs of offering products, a lack of awareness of risk exposure or reluctance to take advance action, the scarcity of trained personnel and dearth of reliable data (Mahul and Signer, 2015). One study (Grislain-Letrémy, 2017) indicates that 'charity hazard'⁴⁹ and uninsurable housing (houses not conforming with regulations), rather than overly expensive premiums, are the root cause of under-insurance in the French OTs (which have access to a well-regulated and plentiful supply of insurers compared with sovereign nations in the region). Homeowners may buy insurance when obliged to do so (on a mortgage, for example) and later cancel the policy.

Agricultural insurance and social protection mechanisms offered through local schemes (e.g. crop insurance schemes, index-based livestock insurance and Productive Safety Nets Programmes), and global initiatives (e.g. the

Global Index Insurance Facility; the Micro Insurance Catastrophe Risk Organization) are starting to take hold in the Caribbean. As part of the Climate Risk Adaptation and Insurance in the Caribbean Project,⁵⁰ new Livelihood Protection Policies have been set up in Saint Lucia, Jamaica and Grenada. These are weather index-based insurance products for low-income households, supplying quick pay-outs in the case of extreme weather events – e.g. high winds and heavy rainfall. Pricing of coverage is based on a fixed rate of 8% of the total sum insured, up to \$4,000 per policy (individuals may purchase more than one policy).⁵¹ The severity of weather events is evaluated on a local level (39 grid cells across Saint Lucia, for example), and in the event a pay-out is triggered the money is directly credited to the individual's bank account (OECD, 2015). In Saint Lucia, an annual premium of \$48 provides coverage up to \$370, the lowest level offered. In Jamaica, an annual premium of \$53 will provide coverage up to \$400.

6.2 Disaster risk financing strategies in eastern Caribbean states

This section synthesises information on DRF used by each OECS member state (described in more detail in Appendix 1) and the implications for developing, setting up and maintaining a forecast-based early action mechanism for the region.

6.2.1 Components of a DRF strategy

Over the past 20 years, the approach to managing disasters has evolved significantly. As the costs of disasters rose, so the inadequacy of international ex-post aid became more obvious. Although funding has increased, requirements have rocketed, and the deficit between aid required and delivered has widened. Beyond the availability of funding, an aid-driven risk financing paradigm creates distortions by failing to align incentives towards better risk management. Indeed, this system reduces incentives for the affected nation to

49 Where assistance is a substitute for formal insurance and decreases demand for it (Grislain-Letrémy, 2017).

50 Implemented by a partnership between Munich Climate Insurance Initiative, CCRIF, MicroEnsure and MunichRe.

51 www.ccrif.org/projects/crai/livelihood-protection-policy-lpp

invest in preparatory measures and risk reduction, and de-incentivises accurately estimating the cost of disasters. The discretionary nature of these funds and the timing of their distribution also hinders countries' capacity to plan for mobilising other sources of capital and start rebuilding.

By contrast, insurance-based models can in theory provide predictable, faster pay-outs, while aligning incentives for investment in disaster risk reduction. Accordingly, the perception of ex-ante⁵² risk financing as a more efficient disaster management strategy has rapidly emerged. It is worth noting the nuanced approach set out by Ghesquière and Mahul (2007), who find that sovereign insurance is optimal when it aims to cover immediate needs, but too costly to address long-term expenditures. Notwithstanding, international organisations such as the World Bank and the IMF have begun working with governments on elaborating DRF strategies. Outstanding recommendations are to set aside budget reserves (dedicated funds), and to use a layered approach involving multiple risk transfer instruments. This layered approach involves segmenting risks according to when it makes most sense to address them. Figure 8 presents a synthesis of disaster financing instruments and distinguishes them according to their ex-ante or ex-post nature.

Some of these DRF instruments enable speed and predictability of funding for disaster response, but there is also potential to enhance their risk modelling and adapt funding structures, so finance is available earlier. The Eastern Caribbean Currency Union is creating a regulatory body to oversee the opening of a single market for insurance, enabling insurers to design ex-ante insurance products for a larger pool of clients (ECCB, 2018), and potentially linking with seasonal or short-term forecasts. Further analysis should be done to determine how forecast triggers can be set up, using the existing risk modelling process, potentially including additional sets of data representing the risks that could be addressed through early action, and redesigning the financial flow process to enable disbursements of funds based on a forecast, before disasters happen. Similar models are being explored for other DRF instruments,

such as the African Risk Capacity, and preliminary discussions are taking place for the South East Asia DRF and Insurance Facility.

6.2.2 Overview of existing DRF strategies

A regional and country-by-country assessment of all risk financing instruments used by OECS members finds that none currently has a fully functional, comprehensive DRF strategy in place. Eastern Caribbean states currently finance only minimal levels of preparedness. The money comes through regular budgets, and in the event of a major disaster resources need to be reallocated in order to respond. No financing mechanism is currently in place in any of the OECS countries that could reliably provide resources to be applied before a disaster, based on a forecast or early warning. Some early actions taken or coordinated by governments in anticipation of a disaster are resourced through sectoral budgets or reallocations, or advanced by private contractors. Countries also use financial instruments that are prearranged to make funding available after a disaster strikes (referred to here as ex-ante funding). Some OECS members operate disaster funds, which can be triggered for disaster response. For these, FbA triggers could be established that would allow funds to be released quickly for earlier action. Discussions to this end are under way in the British Virgin Islands.

Table 7 and Box 4 summarise some of the gaps in DRF in the OECS. The governments of Grenada and Saint Lucia, recipients of technical assistance from the World Bank, have a more diversified approach to DRF, but overall the portfolios of DRF instruments used are heterogenous across the OECS, reflecting the diverse profiles and capacities of these countries and territories (for a full assessment see Appendix 1). Improvements in the cost-effectiveness and coverage of existing DRF systems will be needed in parallel to establishing a regional financing mechanism for early action.

Few states have a reserve fund in place, and across the region the use of pre-approved loans or risk transfer instruments remains low. Governments have not considered what finance needs to be available or made available for

52 Ex-ante is defined as an instrument that is pre-arranged, regardless of whether money is disbursed pre- or post-disaster.

early action (including pre-arranged sources of finance, domestic insurance markets or shock-responsive social protection mechanisms to target vulnerable populations). Box 5 provides an overview of how DRF strategies could be

enhanced to improve post-disaster response, and pave the way for early action across the Caribbean. Current implementation of these points is uneven across the region, and all need further development.

Table 7 Summary of sovereign risk financing instruments used by Eastern Caribbean countries

Type of pre-arranged instrument for financing disaster risk	Antigua and Barbuda	Dominica	Grenada	Saint Kitts and Nevis	Saint Lucia	Saint Vincent and the Grenadines
Budget contingencies	?	No	Yes	?	Yes	Yes
Reserve fund	No	No	Yes	?	N/O ⁱ	Yes
Contingent debt facility	Yes	No	No	?	No	?
Parametric insurance	Yes	Yes	Yes	Yes	Yes	Yes
Alternative risk transfer (cat bonds, index securities)	?	No	No	?	Yes	?
Traditional re/insurance	?	Yes	Yes	?	Yes	?

i N/O, not operational.

Box 4 Risk financing instruments accessible to overseas territories

Overseas territories of the UK and France have separate governance structures but often receive budgetary support, or at least easier access to emergency funding, from the mainland. The role of risk financing instruments should therefore be analysed differently from that of sovereign states.

The French OTs (Martinique, Guadeloupe, Saint Martin and Saint Barthélemy) operate under the same regimes as mainland France; that is, heavy state intervention in DRM through a mutualised insurance arrangement. Insurance is mandatory and modulation of premiums according to risk level is regulated (Dumas, 2005). A specific fund, the ‘Barnier Fund’, managed through a public–private collaboration, is drawn on to compensate insured homeowners for damage. These funds can be mobilised by the authorities for specific risk-reduction and prevention projects, such as drawing up communal prevention plans. Other funds for prevention actions can be called down through the European Regional Development Fund programme. It is not clear to what extent contingencies exist within the specific budgets of the Prefecture (island governing authorities). The Central Reinsurance Company,ⁱ fully owned by the state, is the principal holder of reserve funds in case of disasters. French OTs are not members of the CCRIF and do not have access to concessional loans, as they fall into the high-income category.

The British OTs (Anguilla, the British Virgin Islands and Montserrat) follow a distinct regime based on private insurance/re-insurance markets. Here, each territory has decision-making authority in terms of social and economic planning (i.e. risk reduction and prevention), while internal security decisions are the responsibility of the central government (i.e. emergency response). The British Virgin Islands holds contingency funds. All three are members of CCRIF and have paid premiums for parametric insurance, but none has access to the private insurance schemes available to UK homeowners. Like the French OTs, these islands do not have access to concessional loans.

i Caisse Centrale de Réassurance (CCR).

Box 5 Considerations and components of a disaster risk financing strategy

- 1. Investment in national physical capital.** This is one of the most common budget items in the national accounts for building resilience. The small size of the islands and lack of industrial base means that most construction materials need to be imported. This has consequences for balance of payments (in Saint Vincent and the Grenadines and Dominica). However, these investments will have long-term benefits on both employment and the economy. In Dominica, for example, the IMF estimates that gains from resilient investment post-Maria are higher than the costs by a factor of three (IMF, 2018a).
- 2. Provision for national contingency funds.** This is insufficient across the OECS. For Saint Lucia, the IMF recommends that ‘the size should be determined by considering (i) expected damage, (ii) likely available support from the international community, (iii) ability to borrow in an emergency, and (iv) opportunity costs for building up buffers. Given opportunity costs, the fund should not get too large because (i) its primary purpose is to “buy time” by covering immediate expenses during which time longer-term financing can be arranged, and (ii) a large fund will generate pressures to tap it for other purposes’ (IMF, 2018b).
- 3. Contribution to CCRIF insurance.** Most countries participate in the CCRIF, and so have some pre-arranged finance for disaster response. Countries with low contributions are strongly encouraged by the IMF to maximise the benefits of the CCRIF by increasing their contribution (Saint Vincent and the Grenadines, Saint Lucia). This needs to be balanced against other investments to reduce risk and improve preparedness.
- 4. Self-insurance.** Domestic self-insurance is critical if countries are to be able to rapidly disburse funds after a disaster. This self-insurance can take various forms, such as saving/disaster funds or budget provisions. ECCU countries should be self-insuring between 6% and 12% of GDP through reserves. In addition to providing an initial reserve, setting aside 0.5% to 1.9% of GDP per year to ensure the financial sustainability of these funds is also viewed as a necessary measure (IMF, 2016b).
- 5. Flexible fiscal rules.** Fiscal rules are long-lasting constraints on fiscal policy aimed at providing a credible commitment to fiscal discipline. Adapting fiscal rules for disasters is important to facilitate an agile response, as these events can result in a large but temporary deterioration in the fiscal deficit and public debt. Many countries have escape clauses to deviate or suspend fiscal rules and make emergency budget changes, but these need to be transparent and temporary (i.e. based on a disaster declaration by the government and for a set period of time).
- 6. National reserves.** Mobilising domestic resources for prevention is complex to organise and implement. Countries face two main issues: (i) variable levels of savings and (ii) the low level of the funds. Donors can contribute by building reserves, as FCDO has done in Dominica. A ‘big push’ can help countries escape the vicious circle of low savings and frequent disaster impacts. To this end, countries should seek to save 1% of GDP and prioritise high liquidity investments and a diversified portfolio (IMF, 2016b).

Box 4 Considerations and components of a DRF strategy (continued)

7. **Legal environment and laws to enable transparency and efficiency in self-insurance.** In the case of national contingency funds, objectives are not always clearly defined. Legislation must clearly stipulate the objective of the funds and the types of disasters covered by such funds. Where national contingency funds are not exclusively dedicated to disasters, there may be competition for funds so the rules for allocation need to be clear. In the same way, triggers must be clearly defined, and the governance structure of the fund enforced by law (Nichizawa et al., 2019). Legal arrangements must provide transparency and accountability in the mobilisation of the fund: ‘The release of funds needs to comply with Public Financial Management regulations. The fund balance should appear in financial statements, and drawdowns from the fund should appear in the budget execution reports. The Audit Office should also examine and audit the financial statements of the contingency Fund and publish its reports’ (IMF, 2019b).
8. **Investment in the management and implementation of disaster risk financing instruments.** Even when countries receive emergency funds from a regional fund, financial expertise is still needed at the national level to link these regional mechanisms to national funds, and to allocate funds at sub-national level.
9. **Managing debt.** All of the OECS countries and territories have moderate to high levels of debt. The ECCU fixes a debt-to-GDP ratio of 60%, which for some countries in the region severely limits options for financing resilience and enhancing preparedness.

7 Challenges to advancing forecast-based early action

Despite the enormous costs of disasters in the Eastern Caribbean, particularly those linked to tropical cyclones and floods, there are clear challenges constraining further action in advance of these events. These need to be understood before any new mechanisms are introduced, to ensure that any changes will help address these constraints. This chapter summarises the most critical political economy, financial and technical challenges identified by stakeholders interviewed for this study.

Most of the technical challenges are linked to a lack of investment in capacity-building, and to some extent the political will to prioritise those investments over others. One issue is the quality of forecasts. For floods, in particular, forecasts are not accurate enough, whether for river flooding in mountainous regions or flash flooding in low-lying and urban areas. Linked to this, but applicable to all hazards, is the lack of detailed information on impacts. The data collected after disasters tends to be aggregated and tells us very little about the exact location and mechanism of impact.

Lack of adequate risk data, and in some cases challenges with sharing data, severely limit the capacity of DRM agencies to plan in any detail. There is a perceived burden related to intensive data collection, as there are no immediate benefits. This means that necessary information – i.e. forecast information that is impact-based and sector-specific – to help identify appropriate actions and public communication measures is simply not available. Where data is available it is often not shared across government departments and there appear to be limited incentives for

them to do so, particularly when they can charge for the data.

These data, equipment and technical capacity limitations are common across all OECS states, with the exception perhaps of the French OTs, which receive sustained central government investment in climate and weather services. Elsewhere, few resources from annual government budgets are allocated to improving models and data.

Another technical difficulty with respect to using forecasts to trigger early action is the very short lead times for forecasting tropical cyclones, hurricanes and floods. Drought is also a problem in the Eastern Caribbean, but the visibility and intense sudden impacts associated with tropical storms and related hazards make them a higher priority for early action among more stakeholder groups. However, it is very difficult to forecast with any certainty the damage to be expected from a hurricane until 72 hours before impact, and even then the track can change, and impacts felt elsewhere. So, while it is important to collect data on vulnerability and target vulnerable communities through early action, this targeting is extremely complex.

One logistical challenge noted by stakeholders in delivering support in anticipation of flooding is the difficulty of pre-positioning aid – some islands may be entirely flooded, so food and non-food items will be damaged wherever they are stored. This underscores the need for detailed, up-to-date national preparedness plans that specify the needs and resources of each community, to allow regional agencies to effectively pre-position aid in advance of storms

that could hit entire or multiple islands and may leave some without any supplies.

For slow-onset events such as drought, the lead time between forecast and impact is longer and more can be done to anticipate and reduce impacts, but less attention has been paid to understanding and preparing for drought in the OECS.

Many states already have SOPs for different hazards within their preparedness plans, and so in theory have identified actions and responsibilities for implementing them in advance of a disaster. However, the challenge is that those plans are often not activated or fully implemented due to insufficient capacity in disaster management agencies (and lack of support from other government agencies), plans have not been tested on a frequent basis, if at all, and limited funding has been allocated for their implementation.

Two major limitations in disaster preparedness were identified in this study:

1. Proposed preparedness actions (in disaster management plans) lack detail. The Anguilla National Disaster Plan (Anguilla Department of Disaster Management, 2012), for example, lists ‘clearing and maintenance of drains and drainage channels’ as a key preparedness activity, but does not specify which, or when this needs to happen.
2. Many preparedness activities are not fully implemented. In Dominica, shelters were not adequately stocked when Maria hit. According to one official: ‘There are enough resources and vehicles to get non-food items into the communities before disasters ... but this requires greater coordination in emergency preparedness and response’.

Some of the constraints holding back more effective action are economic and linked to the wider financial difficulties faced by small states, and a focus on immediate needs and priorities above potential future needs. This leads to insufficient funds being earmarked for ex-ante action generally, including early action.

Stakeholders in a focus group discussion in Anguilla, for example, noted the lack of willingness to dedicate resources to planning for ‘what-ifs’:

it’s like people’s attitude towards being on the NDMC [National Disaster Management Committee]. People kind of feel like, ‘Okay, well, disaster is part of my job, but I don’t really know this is going to be a disaster, and I know I have these other things to do, so why am I dedicating all this time and energy to something that might not even happen?’.

High levels of debt and scarcity of funds create an environment in which governments do not want to spend more money on preparedness: they are reluctant to commit the funds they do have to prepare for an event that might not materialise. A few national stakeholders that we spoke to were aware that they could request support for early action through the RRM, but many more complained that there are no rapid sources of funding at the start of the hurricane season, let alone when a hurricane looms.

Another issue, and not one that is easy to resolve, is the perceived trade-off between investing in longer-term resilience, including retrofitting and relocating housing and infrastructure, and paying for preparedness and early action to manage what is often referred to as ‘residual risk’. Most stakeholders agreed that, for rapid-onset events, the window to reduce impacts is limited and an FbA mechanism should not replace or ‘crowd out’ investments that can reduce hazard exposure and vulnerability. As one stakeholder put it:

I think, when our schools are available, buildings are available, for 40 years, it slowly, you know, Irma took down some, totally, and left some a lot more shaken than they were before, so you really need to start thinking about a long-term plan, but in terms of what we could have done before Irma? I don’t think that we could have done anything else than we did – Government stakeholder, British Virgin Islands.

At present, national governments are not setting aside sufficient funds either to safeguard people and property when a disaster is imminent, or to reduce risk in the future. One of the

difficulties is the way donors fund DRR, which is characterised by a large number of small-scale investments. For FbA to be successful in the Eastern Caribbean, it will have to overcome the political and economic disincentives to spending more before disasters, and will also have to complement and promote, not replace, longer-term investment in building resilience.

Broader governance problems in many Eastern Caribbean states also create problems for disaster planning. Most preparedness is based on common sense and experience rather than data, research and evidence, and these institutional practices are difficult to shift. Scenario planning and simulation exercises are not commonly used to inform planning decisions, but this will need to change.

Another challenge is the ‘political cost’ of spending money early if there is a false alarm. If

there are too many false alarms or events that end up having minimal impacts that could have been dealt with locally, this could reduce action for larger events in the future, where support is really needed. This risk aversion towards early action was mentioned by some stakeholders we interviewed, but was not widespread.

Stakeholders, particularly at the regional level, were keen to avoid new internationally driven external agendas and new instruments being introduced into the region when much is being done already. FbA is only needed to the extent that it can add value, strengthen current preparedness planning and aid delivery processes, and address the constraints and concerns facing all policies and plans to manage disaster risk and build resilience outlined in this section. Only then will governments sign up to this early action agenda.

8 Conclusions, recommendations and next steps

This paper highlights the need for a step change in the way OECS member states are dealing with disasters. These small island nations and overseas territories suffer frequent and crippling impacts from tropical storms and floods. According to the *IPCC special report on the ocean and cryosphere in a changing climate (SROCC)* (IPCC, 2019) these are likely to worsen in the future, and heatwaves and droughts will become more prevalent. Significant and sustained investment is needed to reduce risk and adapt to climate change long-term, but some risks will inevitably remain and cannot be ignored. The recent devastating effects of Hurricanes Irma and Maria and more recently Dorian – and preparations for those events – demonstrate the need for enhanced decision-making when severe storms, floods, heatwaves and drought are anticipated. These islands should be prepared for the worst-case, not best-case, scenario, but there are costs associated with this level of preparedness that are difficult for islands to bear and are inhibiting this level of preparedness. Current preparedness planning and financing mechanisms are inadequate even to respond to disasters, because of the high levels of debt in many countries. Lack of contingency funds, planning and capacity to deliver mean that they are heavily reliant on external financial assistance.

Additional funds and incentives are needed to reduce the impacts of extreme weather events and better prepare to respond to these events once they are forecast. Detailed preparedness planning can help reduce some of the immediate impacts even of rapid-onset hurricanes, tropical storms and river floods, but the most important function

for these hazards will be to avoid the indirect and cascading impacts that occur in the days, weeks and months following a disaster when plans are not detailed enough and the level of damage was not as expected, and people have lost their homes and cannot access food and medicine. For drought, given the longer lead time, early action could help to reduce destruction of crops, and minimise water shortages.

Enhanced preparedness will require vastly improved risk data on the impact of different hazards on communities and economic sectors, as well as vulnerability and exposure. Appropriate early actions will need to be identified and costed through risk analysis, scenario planning and modelling exercises, and plans will need to be updated regularly through simulations and the use of new risk data as it becomes available. Sectoral ministries, not just NEMOs, will need to become implementing agencies. They must be well trained, equipped and ready to act upon a trigger. Implementing those plans will require funding to be predictable and fast, channelled through national and regional mechanisms (see Table 8).

Critically, and fortunately for the region, many initiatives are under way and there is a regional coordination mechanism for disaster response, which can be further developed and strengthened by having risk information related to sectors and topographies across the islands, IbF services that calculate potential impacts of extreme weather, detailed national preparedness plans, with specific early actions linked to these forecasts, and additional pre-positioned finance in a regional fund that can be used to take action

that would normally be considered too expensive or too risky (given the inaccuracy in forecasts). This could include full evacuations of low-lying islands. FbA can promote actions that are not being taken at all, or not widely enough.

8.1 Synthesis of progress on forecast-based early action in the OECS

FbA is still in its infancy as a concept and an area of attention within DRM and CCA, but has much to offer the Eastern Caribbean in terms of enhancing national preparedness, and joining up regional action and support around extreme weather forecasting, preparedness planning, aid delivery and DRE. If the approach is to be embraced and driven by governments and regional agencies, it needs to be embedded in these existing systems and nomenclature. For that reason, we have assessed ‘progress’ in the region in terms of the four key components of FbA that already exist, in order to establish where greater support and coordination is needed for preparedness to be more effective in reducing disaster impacts and in enabling response and recovery. A summary of this progress is provided in Table 8.

8.2 Recommendations

Despite the challenges described in the previous chapter, this scoping study identifies significant opportunities for advancing early action across the OECS region through regional and national financing mechanisms, making the most of technical advances and new initiatives in the Eastern Caribbean, and by incentivising improvements in preparedness planning.

8.2.1 Developing impact-based forecasting for decision-making across sectors

As described in Chapter 3, there have been important advances in the development and use of different forecasting methods in recent years, but these are currently being under-utilised for decision-making in the Eastern Caribbean. As extreme weather forecasts become more accurate and CIMH develops methods to assess the magnitude and location of potential

disaster impacts and better communicates this information, a strong regional mechanism will be needed to support national governments in collecting, analysing and managing risk data on the one hand, and on the other to make better use of the outputs of these models for preparedness.

IbF and climate modelling can help facilitate early action, but improvements in vulnerability, exposure data and more comprehensive social registries are needed. Such decision-making systems should be co-produced between technical government agencies, academia and users. CIMH is a lead on this topic, and some countries, such as the British Virgin Islands, are moving in this direction, but there is a need for greater collaboration between DRM, statistical departments and social protection agencies to join up data sets so they can identify who and what is more likely to be impacted and when, to enable planning and targeting of early action. Semi-automatic triggers for early action based on forecasts and risk analysis can allow for quick decision-making in advance of disaster.

8.2.2 Mandating simulation exercises

CDEMA is supporting participating states to develop scenarios and conduct simulation exercises. These can be used to better prepare for extreme weather events, not only by better understanding the chain of impacts from hazards, but also the potential costs and logistics needed to respond. A major evacuation exercise could be developed for low-lying islands, and used to design more precise early actions that would be triggered for major flood or hurricane warnings.

Low participation in simulation exercises has presented a challenge to preparedness in Dominica, but new legislation clarifies the mandates of government departments and makes simulations mandatory. Stakeholder participation in these planning exercises remains low, and a call for participation from the highest political level will be needed to ensure these mandatory exercises are undertaken regularly and used to inform early action plans. Learning uptake plans after simulation exercises would be essential to improve the quality and performance of the FbA system over time.

Table 8 Progress within the OECS on the four components of forecast-based early action

Components of FbA	Progress so far
1. Forecasting, risk assessments and early warnings	<ul style="list-style-type: none">• Range of regional forecast tools and products for extreme weather – seasonal and sub-seasonal• CIMH starting to downscale NOAA forecast; will take a few years before these can be used for Ibf• Performance of five-day forecasts being assessed• Methodological convergence on determining impacts from forecasts (RASOR)• Data sharing initiatives and platforms• Still many data gaps (exposure and vulnerability)• Limited use of regional forecast products by sectoral ministries• Limited data sharing across departments• Need for standardisation in data collection, analysis, storage, etc.
2. Preparedness planning	<ul style="list-style-type: none">• Harmonisation of CDM institutional frameworks and policies (CDEMA ‘model’ instruments)• Legislation governs preparedness and response actions and responsibilities• All states have disaster management plans, but many are not up to date• Only some have hazard-specific plans and SOPs• Focus on roles of government, less on private utilities, civil society, etc.• Strong regional coordination around <5-day forecasts• Regular, seasonal preparedness activities (for hurricane season) – restocking, awareness-raising• When warning issued, range of actions set in motion, e.g. activating EOCs, and sector-specific information provided (more systematically in OTs)• Most actions based on experience and knowledge of vulnerable locations and groups, rather than formal scenario exercise or risk assessment• Not clear if seasonal preparedness implementation is monitored – what is status when the alert level is raised?
3. Coordination and implementation of preparedness and response actions	<p>Regional:</p> <ul style="list-style-type: none">• RRM coordinated effectively by CDEMA, but funding unpredictable; support mainly requested post-impact, although can base request on threat level• EAF, but limited funding and used for response/logistics• PAHO, OFDA and other partners can pre-position supplies• Early stage exploration of SRSP and use of forecasts to trigger payments• Recognition of need to better anticipate large-scale evacuations <p>National and sub-national:</p> <ul style="list-style-type: none">• Generally good coordination of seasonal preparedness activities between authorities and civil society (e.g. of simulations run by schools in French OTs)• Roles and responsibilities between NHMS and NEMOs sometimes unclear in alerts/communication• Strong role for Red Cross in preparedness and response activities• Some stockpiling and pre-positioning, but should be more strategic and based on assessment of likely needs, plus more formal arrangements with shops• Problems with communications post-disaster. Need for continuity plans and supplies of vital equipment
4. Pre-disaster risk financing	<ul style="list-style-type: none">• Large volume of DRF initiatives in the region: several for post-disaster response and rehabilitation of infrastructure/services – CDB grants and loans; World Bank Cat DDOs; IMF rapid support; CCRIF sovereign risk insurance• Climate funds but not used for early action yet• DREF and other NGO and UN early action financing (not yet in OECS)• CDEMA EAF with very low amount, only for participating states• A range of DRF instruments being used but none trigger before a disaster, based on forecast• Only a few states have operational disaster funds (Grenada, Saint Vincent and the Grenadines and the French and British OTs); some discussion in the British Virgin Islands on establishing FbA triggers• Legal constraints on using public funds for early action

8.2.3 Developing a legal framework for early action

Specific legal, institutional and operational arrangements are needed to permit early action. The French OTs offer an example, where the prefecture coordinates all state and civil society actors. Colour-coded alert levels are linked to prevention and preparedness action and advice to the public for major hazards (cyclone, coastal flooding and severe weather), and the prefecture is legally empowered to use public finance for prevention, preparedness and response. Security, medical and emergency personnel and resources can all be mobilised ‘early’ towards a national response mechanism. However, in the French OTs and across the Eastern Caribbean, resources are insufficient to avoid devastating impacts from severe storms and flooding, and more resources are available once a disaster has been declared. All government agencies will need to be given more legal authority to act before a disaster – for example, to reallocate budgets for public works on critical facilities under their purview (e.g. clearing blocked drains) or to support pre-positioning of supplies that will be needed after the disaster. The rules for allocation of national contingency funds – and a regional fund if one is created – need to be clear. Triggers must be clearly defined. All of this will require legislation in all participating states, as currently none has binding thresholds or decision protocols linked to alert levels.

Most importantly, for any contingency fund and related DRF instruments used for early action, the governance structure needs to be transparent and accountable. This will avoid misuse of funds or the perception that funds are not being used for critical measures to avoid disaster losses before those losses or even the hazards are visible.

8.2.4 Delivering early action to vulnerable communities and valuable economic sectors

Responsibility for implementing early action extends beyond disaster management agencies and humanitarian stakeholders. Water and sewage authorities, for example, can monitor reservoir levels and turn water off, for example to protect the quality or quantity of supplies and maintain environmental flows. CIMH is developing heat products and health ministries have started putting out messaging on the need to hydrate.

As described above, in-depth disaster impacts analysis, simulation exercises and participatory processes can be used to develop sector-specific and gender-comprehensive early actions. For example, the fishing sector can calculate the time and resources needed to secure vessels in designated hurricane shelters, and the farming sector can do the same for livestock, as well as producing an inventory of standing and stored crops. In the case of evacuations, early actions could be tailored specifically to reduce risks that women and girls face while they are in shelters.

Early action can also be delivered by and with the private sector. Many companies have their own early action procedures: Scotia Bank, for example, which operates across the Eastern Caribbean, takes corporate responsibility for the safety of its structures and has established standardised operating procedures to ensure the protection and well-being of its employees and their families during a disaster. It takes an active role in community relief and aid delivery, even to the extent of maintaining its own stocks, which are not branded. This experience and good practice can be shared through chambers of commerce and small business associations in the region, encouraging the development of business continuity plans.

For cash and other assistance to be delivered to households or communities before a disaster, new approaches are needed for targeting. If vulnerabilities are better understood it should be possible to mobilise immediate and ‘good enough’ targeting of relief based on the hazard, exposure and vulnerability data available. The impact of this support should be regularly evaluated using technologies such as smart phones, drones and GIS-supported tracking systems. Red Cross National Societies can help select early actions by working with communities to understand their priority risks and identify actions that are feasible to implement given lead times and existing capacities.

Investment in institutional delivery capacity to implement early actions must also be a priority. Without the necessary human resources, logistical, administrative and technological capacities in place, early action is almost impossible given the forecast lead times and scale of potential disaster impacts. Coupling investment in the financing mechanism with

preparedness investment is essential for any FbA system to flourish.

8.2.5 Improving the reliability of pre-disaster finance for early action

The financial obstacles faced by national authorities in managing disaster risks should not be understated. Nonetheless, they cannot afford not to reduce risks where possible and address residual risk when a disaster is imminent. This will require a comprehensive DRF strategy and budget lines, not just for implementing activities, but also for ongoing maintenance, capacity-building and upgrades to equipment – for example, for early warning systems. These may need to be financed on a project-by-project basis using donor funds, but the financing strategy nonetheless needs to be put in place.

An important start is to calculate the full economic benefits of risk reduction and early action or ‘enhanced preparedness’ (the avoided losses and other co-benefits). This is the economic incentive for governments to invest in DRM. Governments need to weigh up and balance the various components of a DRF strategy, including the costs of early action where families, housing and critical infrastructure are ‘at risk’; the annual expenditures needed to strengthen and protect lives, assets and livelihoods and reduce potential impacts; and the costs of implementing physical development plans that seek to limit exposure to hazards over the long term. The full cost of early action is unlikely to be borne by national governments, however, particularly if action is taken on the basis of the worst-case scenario. Nonetheless, it is the responsibility of governments to make these calculations and develop appropriate and detailed plans that allow for these actions to be taken, when necessary with external funding.

Matching appropriate financing instruments to different types of early actions at different scales and under different types of hazard scenarios is also required in order to reduce disaster impacts of various frequencies and magnitudes in a way that is cost-effective. Each type of instrument has its comparative strength – e.g. market-based instruments such

as insurance are generally considered better-suited for covering hazards with severe impacts but with a low probability of occurring, while budgetary instruments such as funds with soft triggers, like local contingency funds, or humanitarian funds such as the DREF, are better geared towards hazards that occur frequently but are less severe (Charles et al., 2018). Any approach to financing early action or enhanced preparedness should build on such considerations and principles related to DRF more broadly, so that financing instruments can be effectively layered. Existing guidance aiming to inform policy and operational frameworks on DRF, such as provided by the World Bank,⁵³ can support governments and organisations in navigating through this process. Nonetheless, enhanced preparedness also imposes specific requirements on financial instruments, for instance with regard to disbursing money rapidly enough for government agencies, contractors and households to implement early action and rapid response measures. Depending on the source of the funds (donor funding versus domestic resources), additional rules guaranteeing transparency in deployment of funds may be necessary.

Three types of funding needed for early action

Any regional FbA mechanism would need to secure finance for three types of activities:

1. **Capital to set up an FbA financing mechanism and to maintain and update the mechanism.** External funds from bilateral and multilateral institutions were used to capitalise the CCRIF, and external funding would likely be needed to launch an FbA initiative (in the French OTs, there is greater opportunity to build FbA into existing budgets). According to the IMF, national-level self-insurance needs to amount to 6–12% of countries’ GDP. For a regional FbA mechanism, however, the initial sum needed would be lower, as the cost of FbA would be less than for response and would be spread across participating states. Maintenance needs (managing and replenishing funds, at least to cover regional

53 See for example: www.financialprotectionforum.org/publication/disaster-risk-finance-a-primercore-principles-and-operational-framework

inflation, and maintenance costs for regionally owned material or equipment) could be met through a number of different funding routes. One option is for national governments to pay into a regional fund using domestic sources of revenue. Dedicated resources from taxes assigned through a new budget line to a national fund could help secure a constant flow. In Saint Lucia, domestic sources of funding are being channelled through the Citizenship Investment Program. These resources will not, however, be available in all countries, in particular those that are highly indebted, despite the fact that early action could help to reduce the significant post-disaster costs described in Chapter 2. Another option would be to allocate funds annually through national climate funds. In both cases, national institutions will need to develop legislation or rules for a quick disbursement of funds to be made. National rules must enact the conditions (trigger) for fund release and ensure that there is liquidity in the fund to pay for the maximum cost of early action that might be required, according to a detailed preparedness plan.

2. **Channelling finance through a regional mechanism.** Early action will require prearranged, reliable and quickly disbursable funds, with high potential basis risk (as forecasts of impacted areas are not very reliable for hurricanes and floods until 24 hours beforehand). Much larger sums will be needed occasionally (for very high-intensity, low-probability forecasted events). This makes FbA an ideal candidate for regional risk pooling – i.e. a mechanism for distributing funds at the regional level – rather than setting up separate national FbA mechanisms. One possibility would be to set up a regional parametric mechanism (perhaps even extending the mandate and functionality of the CCRIF) that could draw on contingent credit loans or regional climate funds, and be triggered by forecasts.

This option is not without potential difficulties – for instance, the unequal income status of

OECS countries means that some are ineligible for concessional loans, and the definition of a trigger that could lead to preliminary disbursement would need to be approved at regional level. Delivery mechanisms would also need to be clearly defined and standardised throughout the region, while at the same time preserving national authority. A form of contingent lending with funds being disbursed pre-disaster was pioneered in 2011 in Peru with a Global AgRisk Initiative based on El Niño forecasts. The insured entity was entitled to solicit funds in advance of expected important El-Niño-linked flooding to mitigate potential losses.⁵⁴

3. **Funding long-term investment in resilience, risk reduction and seasonal preparedness.** Investments are needed to enhance seasonal preparedness and the accuracy of impact forecasts, and to generate the information needed to pre-agree and execute early action at scale when a disaster is imminent. Many of these measures are already being supported in the OECS region through donor technical assistance loans or grants. Financing is needed to scale up these programmes and harmonise the support offered to each state, so they are in a position to focus efforts and direct resources to address the residual risks that remain when a disaster is forecast. Several recent agreements provide funding for a combination of technical assistance and resilient infrastructure projects in the region (described above in Sub-section 6.2.1). Establishing a GCF direct access Accredited Entity in the region should facilitate access to GCF funding for national and regional projects.

In addition to having adequate financial instruments in place and access to financing, fiscal rules and policy priorities need to be considered in setting up an FbA mechanism. Without this ‘enabling environment’ at national and regional levels, any enthusiasm for radically reforming DRF in the OECS will be short-lived.

The following section underlines some of the common obstacles faced by the small islands of the Eastern Caribbean in preparing better for

⁵⁴ For more information on this scheme, see http://globalagrisk.com/Pubs/2013%20Press%20Release_First_Ever%20Forecast%20Insurance%20Peru.pdf

the disasters they face. We also identify ways to overcome these challenges.

Three proposed early action financing mechanisms

Capitalising on known disaster funding sources and using the principles of forecast-based financing as stepping-stones, the basis for a pilot mechanism emerges. Three complementary modes of functioning are explored here. The initial ideas for these financing mechanisms for early action were developed by stakeholders at the Regional Forecast-based Early Action workshop in Saint Lucia on 17–18 October 2019. Further discussions followed at the 11th Caribbean Comprehensive Disaster Management Conference in Sint Maarten on 2–6 December 2019, and the UN Climate Change Conference of Parties (COP25) in Madrid on 2–13 December 2019. Further refinement of these proposed mechanisms will take place through consultations with regional and national financing, technical and implementing entities in order to develop a concept note for funders.

1. **A donor-funded and enhanced regional EAF, able to release funds earlier.** As described in Chapter 5, the RRM is an emergency relief mechanism which coordinates external response and relief operations in support of impacted CDEMA participating states. It is composed of a network of national, regional and international disaster stakeholders and regulated through a regional coordination plan. The RRM budget is split into core operating costs and costs of replenishing the EAF. These are drawn from state contributions, paid on a tiered basis towards an annual fund of \$3 million. CDEMA struggles to maintain a balanced account sheet, as budgetary limitations in participating states are compounded by the rising costs of disasters. Recent evidence is provided by the Irma–Maria situation in 2017, during which CDEMA provided emergency relief funds up-front, and international donors later reimbursed costs. Predictable resources estimated at \$5–6 million will be needed to cover regional support to preparedness and response.

The RRM currently spans three levels of intervention:

- a. Level 1: Monitoring.
- b. Level 2: Request for specific types of support, whether rapid assessment or a particular action at state level to help states respond.
- c. Level 3: CDEMA deploys its entire relief mechanism.

The EAF could be used to enable forecast-based actions in participating states. Funds could be distributed on the basis of a predefined forecast trigger and attached to carrying out specific actions (such as clearing drains, pre-positioning supplies and carrying out large-scale evacuations). In this model, funds would be provided by donors in advance of the hurricane season, in recognition of the fact that such preliminary actions reduce the social and economic impacts of disasters – some of the cost of which is borne post-disaster by the same donors. The distribution of funds and their rapid employment for predefined actions requires updating both the Regional Coordination Plan and the national disaster plans to include triggers (based on anticipated impact and capacity of the participating state to act) and action pathways; this could require the enactment of enabling legislation in the participating states. Further, enabling early action within the scope of the RRM must not detract from country-level responsibilities. This could be avoided by defining thresholds where regional rather than national action is appropriate, based on an estimation of ‘residual risk’, or gaps in preparedness. Using the EAF to pay for FbA means making the most of existing tools: grafting onto pre-established and recognised coordination protocols at regional level is particularly useful. Partitioning funds delivers an opportunity to examine the direct benefits of FbA for affected countries without compromising on the other functions of the RRM.

2. **National and incentivised ‘disaster savings’ accounts, which could be placed in a dedicated regional organisation.** One of the financial instruments most conducive to

FbA is a dedicated ‘contingency fund’ set up by the national government. As explained previously, such funds are difficult to set up and replenish because of the high political opportunity cost of setting funds aside for use by successors; tight budgets and a lack of liquid funds in national governments; and the complexity of establishing rules for appropriate use. Some of these could be overcome through the implementation of a layered mechanism, managed by a dedicated regional entity and designed to incentivise the development of national DRF strategies.

The proposal is to establish a three-tiered system within a dedicated regional entity skilled at fund management. This could be situated within regional entities already engaging with countries in the region on DRF. It would involve setting up a separate portfolio for each participating state, where states could place their disaster funds. The funds would be paid out on the basis of preparedness, vulnerability and exposure.

The three tiers:

- a. The first tier is self-funding by OECS states, which place these funds with the new portfolio of the regional entity. The minimum recommended amount of disaster funds could be based on CDEMA evaluations, as well as IMF recommendations. By placing funds with a regional entity, states ensure that they will be accessed only for specified disaster management purposes (including FbA). The portfolio would cover multiple hazards.
- b. Building on states’ commitment to placing funds with a disaster savings scheme (and following World Bank and IMF guidelines), donors could provide support to the mechanism through matched funding or top-ups. This would help incentivise saving. Donor funds, linked both to performance and to risk, constitute the second tier of the mechanism.
- c. The third tier would be to set up a preparedness progression scale (measured for instance from 0–100%). The status of a nation on this preparedness scale, with regard to hurricane season and to a specific

forecast hazard, would be measured by national disaster management agencies with support from CDEMA. Triggering and the amount of disbursement could be based on the gap from current status to attaining a minimum level of preparedness, for instance 75%. Event magnitude could be incorporated to calibrate the amount of funds withdrawn. The exact delivery procedure for these funds (whether they should go towards large-scale actions, be distributed at community level, or be used to encourage livelihood protection actions) should be decided at national level, upon initial fund set-up. The definition of the parameters to build the indicator would involve other stakeholders (government agencies, civil society, academics, private sector, etc.).

Creating this platform would help centralise and organise information needed for forecasting and action planning at the regional level, and allow countries to continuously assess weaknesses and address them.

3. **A regional shock-responsive social protection mechanism.** A range of activities are already happening around the region to strengthen social protection systems and prepare them for scaling up when there is a shock. In part, these are based on lessons and recommendations emerging from previous post-emergency assistance delivered through existing social protection systems (for example in Dominica and the British Virgin Islands).

Our proposal is for a regional shock-responsive social protection support programme that would address needs in two ways:

- a. Allowing countries to make better use of forecasts to speed up shock-responsive assistance delivered through existing social protection systems, primarily in the form of cash transfers or public works programmes.
- b. Supporting regional integration of social protection to facilitate portability of short-term, post-disaster assistance within the region (e.g. within the OECS or CARICOM, building on existing agreements such as

the OECS Convention on Social Security and the CARICOM Agreement on Social Security). A regional buffer mechanism could assist countries suddenly catering for large numbers of migrants who may not be included in the national social protection system, and/or alleviate pressure on host countries faced with inflows of disaster-driven migrants, to enable them to fast-track inclusion in national social protection systems (cash transfers, cash-for-work, school feeding, etc.).

Recent reviews of the joint cash responses in the British Virgin Islands and Dominica highlight the need to strengthen data collection and management structures that can support shock-responsive social protection in the region more generally. In particular, better data is needed on disaster displacement – where people move from and to, when they move and how long they stay. A review of Contingent Rights legislation and other relevant laws is needed to understand how a regional social protection transfer system could work, and how to identify beneficiaries. These ideas are still very new and have not been well explored by agencies working on strengthening social protection systems in the Caribbean, so further scoping work would be required before a pilot could be developed.

8.2.6 Summary of recommendations

Table 9 summarises the recommendations and assesses the likelihood that progress will be made over the next 12 months. Given the impact of Covid-19 on Eastern Caribbean economies, some of these actions are likely to be further delayed.

8.3 Next steps

There is no blueprint, as no other regional FbA mechanism exists, but the results of this scoping study suggest that, for an FbA approach to gain traction and reduce disaster impacts, it needs to build on existing initiatives and complement the current CDM framework, enhancing preparedness, not replacing it. Ten core principles should be adopted for all FbA initiatives:

1. Build on existing initiatives and coordination mechanisms.
2. Ensure transparent decision rules and full accountability for use of funds. Legal, institutional and operational platforms need to be adequate to permit early action.
3. Mandate planning for disaster preparedness and early action across government, which is detailed and institutionalised as part of a government's routine process.
4. Enhance data sharing and develop robust, comparable risk data (linked exposure, vulnerability and hazard data, including climate change projections), which is standardised across Eastern Caribbean countries. Build capacity to interpret this data.
5. Encourage the development of scenarios linked to different hazards and complex risks and regular mandatory simulations as a basis for identifying and updating preparedness plans.
6. Target vulnerable communities and valuable sectors with early actions, working with civil society.
7. Ensure that early action is gender-responsive and socially inclusive, e.g. by adopting participatory processes at every stage of early action planning and implementation.
8. Leverage external funding for early actions which are justified as the losses are high if the hazard occurs.
9. Promote comprehensive DRE, from longer-term investments in risk reduction and resilience to pre-positioned finance for early action in national and regional funds.
10. Ensure investment in institutional delivery capacity to implement early actions as a priority.

Based on discussions at the roundtable on 30 March 2020, regional partners were keen to see how all elements of FbA would fit together and add value to existing initiatives to strengthen preparedness and response across the broader Caribbean region. The project team produced a joint work plan for enhanced preparedness in the Caribbean (Wilkinson et al., 2021). This reviews existing interventions and coordination mechanisms and highlights where additional support is needed to improve the efficiency and

effectiveness of disaster preparedness. A regional early action fund and complementary incentive and delivery mechanisms are proposed. The next

step towards enhanced preparedness for extreme weather across the Caribbean is to undertake a feasibility study and pilot this mechanism.

Table 9 Summary of recommendations and likelihood of progress over the next 12 months

Recommendation	Likelihood of progress
Develop impact-based forecasting (IbF) for decision-making across sectors	There are a large number of initiatives in the region aimed at improving the quality of hazard forecasts and forecasting impacts, but IbF could easily be undermined unless risk data is well managed and shared between ministries and across states (the politics of which is too complex to go into here). Consistency in the use of risk data for early action planning is probably the most ambitious recommendation in this study.
Mandate simulation exercises	CDEMA recommends running scenario exercises and provides materials to participating states, but these still only occur sporadically and are not run as simulations (artificial representation of a real-world event to refine policies and protocols through experiential learning). A mandatory regional (or sub-regional) bi-annual policy-making exercise (for wet/hurricane and dry season) is needed. This would be relatively easy to draft but requires lobbying for endorsement by member states, financial and technical support for implementation and annual monitoring.
Develop a legal framework for early action	Legal and institutional reform is generally a lengthy process, but specific changes to permit and facilitate early action are more likely to occur where disaster or reserve funds are already in place. Quantifying the real costs of preparedness (seasonal and post-forecast) would help to build support across sectors for reforms that allow funds to be properly allocated to forecast-based early action (FbA).
Deliver early action to vulnerable communities and support valuable economic sectors	Across the Eastern Caribbean, there have been significant efforts to assess and identify particularly vulnerable groups, communities and sectors. While gaps remain (e.g. harmonisation for IbF, as described above), these assessments help guide seasonal preparedness activities to some extent. To target and deliver support more effectively when a threshold is reached (of likely impact), for rapid-onset disasters in particular, a full assessment of the window of opportunity is needed to determine what can realistically be delivered in time to reduce impact. This kind of assessment can be undertaken immediately, but delivery mechanisms, which require high levels of coordination (and may depend on legislative reforms), will take longer to establish.
Improve the reliability of pre-disaster finance for early action	All three types of finance will be difficult to obtain/sustain: (i) capital to set up an FbA financing mechanism and maintain and update the mechanism; (ii) channelling finance through a regional mechanism; and (iii) funding long-term investments in resilience, risk reduction and seasonal preparedness. One of the main issues for accessing external finance is the different income status of OECS member states – not all are eligible for official development assistance (ODA). Climate finance could potentially be used to replenish a regional FbA fund and to enhance seasonal preparedness planning. These options need to be examined in detail, and applications to the GCF or similar will take at least 12 months to develop. In terms of (ii) channelling finance through a regional mechanism, one proposal is to establish separate portfolios for each state, where they can place their disaster funds – incentivised ‘disaster savings’ accounts placed in a dedicated regional organisation. An in-depth cost–benefit analysis is needed to establish whether this is the best option for using public funds for early action, followed by sensitisation of the results. One priority recommendation in this study is to increase support to the CDEMA Emergency Assistance Fund, and to allow it to release funds earlier. This can be done relatively easily with a small change to the operating rules. A regional shock-responsive social protection system could be developed to use forecasts for regional pre-positioning, paying for public works and/or preparing to make cash transfers, hence speeding up assistance. It could also offer portability of post-disaster assistance within the region, when people move. Such a system will take some time to set up as it requires extensive preparation work (building up beneficiary registries, bank details and clear, auditable transfer mechanisms).

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Appendix 1 Risk financing instruments in OECS member states

This Appendix presents an in-depth look at the financing instruments used by OECS member states. It forms the basis for the synthesis presented in Table 6.

Antigua and Barbuda

In 2018, Antigua and Barbuda's Department of Environment became the first sovereign Caribbean entity to be accredited by the GCF, allowing the country direct access to climate finance. The department has received approval for a multi-country project that will mobilise private sector finance and extend credit to high-risk, low-income households to strengthen resilience. This is an illustration of how to catalyse the private sector in a state with a constrained domestic market for disaster risk reduction investments. The latest available IMF reports do not mention any specific budget planning decisions in response to disasters, even though the consequences that such a disaster could have on the economy are highlighted (IMF, 2015).

Antigua and Barbuda have a CCRIF policy covering earthquakes and tropical storms, but not excess rainfall. They also have access to an emergency loan facility from the CDB, a short-term facility from the Central Bank and a contingency facility with commercial banks. Although the government is seeking to establish a contingency fund, owing to the frequent occurrence of catastrophic events which wipe out revenue streams, it does not possess the liquidity to do so. The government has considered issuing debt instruments prior to the hurricane season for rapid access funds, but is constrained by the fact that all its sinking funds go towards securing existing debt.

Dominica

Dominica has both a traditional indemnity-type insurance cover and a parametric insurance policy with the CCRIF. It also has legislation in place making budget reallocations possible. A 1998 in-depth study of Dominica's insurance market notes the limited role of the catastrophe insurance market in transferring risk. Factors contributing to under-insurance included the high and volatile cost of insurance in the whole of the Caribbean, linked to the 85% rate of transfer to reinsurers, a transaction susceptible to market fluctuations and the proliferation of property insurance players in the region. High premium prices have attracted many new players, whose capacity to capitalise the 15% share of risk they retain is uncertain (Benson et al., 2001).

The latest IMF Article IV consultation took place just after Hurricane Maria in 2017, and thus provides detailed information on the government's response. The hurricane had important consequences for Dominica's fiscal situation, including a fall in tax revenue after the hurricane and increased costs of reconstruction due to a long recovery period. In order to compensate for some of these losses, the government relied on public deposits, international grants, insurance pay-outs and buoyant Citizenship-by-Investment (CBI) sales revenues (IMF, 2018a).

Since the 2017 event, the government is more than ever engaged in budget planning that takes into account the risk of national disasters. Building a disaster-resilient state is stated as a priority for budget planning. These planning efforts are visible at various levels:

- The implementation of adaptive fiscal rule is recommended by the IMF, with ‘escape clauses for natural disasters based on verifiable criteria’ (IMF, 2018a).
- The government’s desire to create a savings fund for natural disaster is supported by the IMF’s Executive Board and staff. The government has committed to the creation of this fund since October 2015. The provision that may be required for natural hazards (under this fund or other mechanisms) is estimated at 1.5% of GDP per year from 2018 for additional costs of future disasters, i.e. ECU 20.8 million (estimates from IMF, 2016a). In 2015, the IMF assisted Dominica in the implementation of the savings funds (the vulnerability risk and resilience fund (VRRF)), recommending resourcing it through the national budget and the CBI scheme. In May 2018, all investments regarding the VRRF were pending due to recovery prioritisation (IMF, 2018a).
- The purchase of additional coverage under CCRIF for Dominica. The country was ‘substantially below the maximum eligible’ (IMF, 2018a) for the facility.
- Investment in major reconstruction expenditures aimed at strengthening resilience. On average, the additional cost of building resilience is estimated to be 50% higher than the identical replacement costs, according to the PDNA prepared by the World Bank. However, the national authorities and the IMF defend this choice in view of the country’s strong historical exposure to national disasters. In addition, staff estimates indicate that catastrophe-resilient infrastructure can have significant co-benefits for growth, wages and employment. Based on simulations of natural disasters at their historic average every five years, resilient infrastructure investment would be recovered through tax revenues generated by economic activity. Estimates indicate that production gains from a resilient investment more than offset additional costs by a factor of three (IMF, 2016a).
- A redirection of investments through companies held by the state towards reinforcement of their resilience. Although these investments constitute a short-term burden on the state budget, this investment strategy is estimated to be profitable in the medium and long term in view of the likely occurrence of disasters.

These budget planning choices are backed by the establishment of a national disaster management framework. Organising DRM governance around a national agency, the Climate Resiliency Executing Agency of Dominica (CREAD), an independent public agency financed by FCDO, ensures the execution of resilience investments. This agency will also support the enforcement of zoning legislation based on vulnerability to disasters. It remains to be seen whether CREAD will continue beyond the term of the FCDO project.

Grenada

Grenada was recently supported by the World Bank in developing a more robust Disaster Risk Financing Strategy. Its annual budget allows allocations of between \$18,500 and \$37,000 to its contingency reserve fund, signifying that these funds would be rapidly depleted at the onset of a disaster. In addition to this dedicated fund, Grenada has set up a National Transformation Fund and a Reconstruction and Development Fund. Post-Hurricane Ivan, the government mobilised an additional source of funding, the National Insurance Scheme, to respond to the impact on short-term unemployment. Finally, Grenada is a member of the CCRIF SPG, and has an insurance policy on windstorms and earthquakes. From 2013 to 2017, its premiums were paid by the World Bank.

Grenada has paved the way for Caribbean nations struggling with debt by introducing ‘hurricane clauses’ in its agreements with creditors including Taiwan, the Paris Club and private bondholders. These clauses are legal provisions which defer the payment of both principal and interest, or enable fast-tracked debt restructuring in the aftermath of a disaster. Over the course of 2014–2015, Grenada

restructured \$318 million's worth of debt, granting the country greater fiscal space in case of a disaster (Robinson, 2016).

In terms of private insurance, Grenada has low penetration rates in a soft market, consistent with the Caribbean situation; this increases the government's indirect contingent liability, being perceived as a last-gasp insurer. Fifteen insurance companies currently operate in Grenada. WINCROP handles banana crop insurance, and is expanding to cover nutmeg and cocoa (World Bank, 2018b).

The importance of investing in climate resilience when times are good is well recognised by senior government officials. However, although major solutions in terms of infrastructure (burying power lines, maintenance of drainage and road systems, sea walls) are identified, finding the financial resources to implement them is a stumbling block.⁵⁵ Grenada is also constrained by its fiscal situation of high debt and low GDP. Priority sectors for investment in FbA as highlighted by stakeholders in Grenada are agriculture and housing, in respect of the fact that deterioration of these assets leads to slower recovery (e.g. due to resulting food insecurity and inability of first responders to attend to others).

Concerning insurance, there is a caveat to home insurance: affordable premiums, such as on windows, carry very little liability because they are not linked to the structural integrity of the house (unlike roofs, which incur higher premiums). Specific assistance to vulnerable communities, such as through the enhanced direct-action project (through the GCF), which provides soft loans to vulnerable communities, is essential. In this case it allows for communities to secure their homes through hurricane straps, for example. It is argued that the most vulnerable communities need to be involved in articulating how inclusive financial instruments and incentives function, to make them accessible.

Saint Kitts and Nevis

The government of Saint Kitts and Nevis has embraced the shift from a reactive to a proactive approach in DRM – and as such is open to setting up forecast-based financing mechanisms, although NEMA states that there is no specific financing linked to early action as yet. In the private sector, particularly concerning small businesses, there is a reluctance to prepare through insurance or preventive measures, which is risky considering that one in four businesses affected by disaster never reopen.⁵⁶

There are nine private insurance companies operating in Saint Kitts and Nevis for a population of 56,000, including the National Caribbean Insurance Co., where a senior manager viewed housing and agriculture as the two sectors most relevant for FbA.⁵⁷ Crop insurance schemes are suggested for agriculture, but in other parts of the world these suffer from low take-up and renewal rates unless subsidised. In general, the National Caribbean Insurance Co. posits that, although insurance exists for various catastrophes, individual clients are not convinced that pooling risks is in their economic interest, and this remains one of the main barriers to better insurance coverage. The concept of shared risk pools (as opposed to risk transfer, which is more beneficial to insurance companies) is likely to generate interest from communities; these could function with insured revolving funds.

The Saint Kitts Development Bank offers agricultural and industrial loans, as well as smaller private loans (mortgage, student, personal). As yet, there are no mechanisms for linking loans to parametric insurance schemes, for example by making loans conditional on risk reduction measures or insurance coverage. Credit protection for loans is very limited. However, the bank has a promising entry point in that it currently asks its clients to make 'lodgements', a mechanism whereby clients pay in excess during the high season so that they can keep paying back on the loan during off-/low-income seasons. There is potential for the bank to redirect some lodgements as buffers in times of crisis, instead of mobilising them only during the down season. An option discussed is for clients to have access to some

55 Author interview with government stakeholder, 2019.

56 Author interview, SKN NEMA, 2019.

57 Author interview, SKN National Caribbean Insurance Co., 2019.

of that advance money to start risk reduction. Following the idea that ‘an ounce of prevention is worth a pound of cure’, such an arrangement could help clients maintain the capacity to pay back their debts. Furthermore, business owners who comply with lodgement demands may be rewarded with reduced rates.

Another consideration in terms of financing is how to improve Met services, especially data collection, equipment and staff training. The Red Cross receives no funding from the government but must self-sponsor and is occasionally funded by donors, but project-by-project funding is not conducive to participating in longer-term mechanisms.

Debt reduction remains a major goal in coming years, in part through strengthening the country’s resilience to natural disasters. The economy and the national budget are considered extremely vulnerable to climate shocks (IMF, 2017).

The government has initiated the creation of a growth and resilience fund (GRF) mainly fuelled by CBI flows. However, these flows are unstable: a simulation carried out by the IMF shows that a sudden end to CBI combined with a disaster shock could lead to a debt ratio of 70% by 2021. It is therefore essential to strengthen the country’s climate resilience. As such, the IMF Board suggests prioritising the replenishment of this fund for debt reduction and resilience-building against natural disasters. The implementation of a GRF as announced by the government would also allow CBI revenue savings to be used for financing early action. The modalities of this fund, its functioning and its governance remain to be defined.

A further concern is that improvements in disaster risk assessments are needed in order to use these effectively for budget and debt management frameworks.

Saint Lucia

Saint Lucia’s financial strategy is derived from the Financial Administration Act. Among its provisions are a contingency fund, an emergency disaster fund and an imprest⁵⁸ account for NEMO. The contingency fund is not disaster-specific, nor are the allocations determined by law; as of September 2016, the balance was \$314,000. The emergency disaster fund, although enacted into law, is not considered operational. A World Bank overview of the catastrophe insurance market concludes that the private sector is often underinsured, and contributing to the government’s contingent liability, being perceived as the last-gasp insurer. The report also recommends that the government insure its public assets (World Bank, 2018b).

A weather index-based micro-insurance product known as the Livelihood Protection Policy was launched in 2012. The aim of the policy, developed by a consortium of partners involved in the Climate Risk Adaption and Insurance in the Caribbean Programme, is to provide livelihood protection for low-income populations against adverse weather risks, offering a safety net for those whose incomes are affected by severe climatic events, such as strong winds and heavy rainfall during hurricanes and tropical storms. It is accessible through local distribution channels, such as cooperative banks, credit unions and farmers’ associations (World Bank, 2018b).

Interviews suggest that having dedicated budgets specific to disaster management would help mitigate the impacts of a disaster. NEMO apparently has no specific budget and must wait for the government to solicit funds from other agencies. The question was raised of using GIS information to better manage disasters, perhaps to trigger pay-outs or compute avoided losses. Any forecast-based actions or systems will rely on completion of a spatial data integration project currently supported by the World Bank. The government will likely be able to identify benefits (or disadvantages) based on hazard, exposure and vulnerability mapping within the next two years.⁵⁹

58 A cash account typically maintained at a fixed balance and set aside for a fixed purpose, and allowing for close monitoring of disbursements.

59 Author interview with government stakeholder, 2019.

Aside from specific contingent budget mechanisms, one of the priorities in putting an FbA system in place is for the government to fund positions within the relevant agencies (e.g. water resource management agencies and NHMS) enabling ongoing monitoring of hydrometeorological parameters.

The IMF Article IV report from 2018 presents information on the country's national accounts (2017 national accounts and projections to 2023). This highlights the importance accorded by the government to building resilience to disasters. The link with climate change is also clearly defined. In 2018, the IMF recommended a major fiscal adjustment of 2.7% of GDP (1.5% planned by the government) to align with ECCU's regional debt target. However, this effort should not affect the trends initiated in recent years in terms of enhancing resilience to climate change and natural disasters, which is also considered a priority objective. Strengthening resilience through the development of financing policies and strategies must also be integrated within a coherent macroeconomic framework, thereby 'improving growth prospects while strengthening the country's fiscal position' (IMF, 2018b).

Saint Lucia has budgetary mechanisms in place (in the form of provisions and the creation of a dedicated fund) to guide and resource disaster management activities in anticipation of future events. These funds are intended to cover the impacts of disasters and the implementation of appropriate responses (logistics). DRM budget planning is also supported by the development of a DRF strategy based on several components, including insurance (CCRIF) and national contingent financing (Cat DDO) with the support of the World Bank. The government initially plans an annual provision of 0.5% of GDP for the management of disasters. The updated scenario proposed by the IMF suggests a contribution of up to 5% of the GDP by 2021, taking into account the costs covered by the CCRIF and private insurance (IMF, 2017).⁶⁰ The savings fund was to be supplemented by 5% of GDP between 2018 and 2020 with an annual recovery of 0.56% of GDP. The purpose of the provision is to cover the average annual costs of disasters.

Domestic sources for stocking and replenishing the fund identified by the IMF include a Citizenship Investment Program; a Climate Change Policy Assessment and carbon tax programme; and eliminating non-targeted liquefied petroleum gas subsidies. The funds provided for the reserve are, according to the 2018 Finance Act (0.5% of revenues), considered insufficient. Instead, the IMF suggests a provision of 0.7% of GDP. In view of the difficulties encountered in creating a sufficiently large savings fund, a recapitalisation of the CCRIF was considered a better option.

This shows the importance of grant funding for launching and capitalising such an initiative and the 'big push' needed, provided that countries have the capacity to absorb such financial support (management of finance, transparency in the use of funds, monitoring and evaluation, human capacity). The capacity needed to implement and operate such mechanisms makes it attractive for small countries such as Saint Lucia to share fixed costs at the regional level.

The country's budget planning provides both dedicated funding for natural disasters, and anticipates the impacts of these events on the economy through a modelling exercise. These two elements, combined with a dedicated funding strategy (under development), an identified authority for the disbursement of these funds and contingency plans give Saint Lucia a driving role at the sub-regional level. However, all of these elements are still recent, and their operationalisation in coming years must be followed for a more precise assessment in the medium and long term. For example, changes in the tax law to set rules of disbursement for the fund are strongly recommended to secure this budget line for the management of disasters.

Finally, the Executive Board of the IMF and the national authorities agree to emphasise the key role of donors and the private sector, which must play an important supporting part in the macroeconomic dynamics being initiated. Donations constitute a particularly relevant form of assistance in the implementation of such a financing scheme, and the ongoing budgetary adjustment.

⁶⁰ Without consideration of CCRIF and private insurance, a savings fund of 8% of GDP, replenished on an ongoing annual basis, would be 'sufficient to cover the budgetary costs of natural disasters without incurring additional debt with a 95 percent probability'.

Saint Vincent and the Grenadines

Accessing resources for executing early action plans put in place by NEMO remains a thorny issue in Saint Vincent and the Grenadines. At the regional level, NEMO suggests that budget contingency is the most likely solution to setting up a fund. The government levies a tax on hotel rooms which feeds into an emergency fund. It is mobilised partly to ensure phone communication during a disaster (and other areas) but could be repurposed for FbA. The possibility of accessing climate financing in order to set up forecast-based systems for protecting productive assets (agriculture, fishing) could be another source of financing relevant to establishing mechanisms for early action.

The Red Cross assesses that, despite increasingly powerful storms, donor contributions have not risen. In addition to overall limited availability of funds, the Red Cross raises the issue of donations being more 'glamorous' post-event rather than for preparedness. As the Red Cross operates on donor financing and private donations, this is an obstacle to shifting financing flows and subsequently modes of action from response to anticipation. Saint Vincent and the Grenadines' Red Cross Society representative emphasises that, although at odds with their view, there is a general lack of faith in the ability of communities, leading to a reluctance to channel funds in their direction.⁶¹

Strengthening resilience to disasters is a key priority of national budget planning in Saint Vincent and the Grenadines. Moreover, more severe and frequent disasters are considered a key domestic risk with the loss of correspondent banking relationships, and materialisation of financial sector risks (IMF, 2019b). In order to assess this risk, a recent IMF Article IV consultation report implemented stress tests incorporating disasters as part of the country's Debt Sustainability Assessment. The results of the analysis confirm that strengthening resilience will provide important growth and fiscal dividends. Different scenarios of future disaster impacts indicate that impacts on GDP and fiscal costs would result in debt ratios of between 72% and 80%, i.e. surpassing the ECCU objectives with little to no margin for possible financial adjustment in the extreme case.

The establishment of a Contingency Fund in 2017 is considered a central component of budget planning in response to disasters. It aims to protect public finances (provide self-insurance) from the impact of disasters and climate change. The emergency fund has a clearly identified source of income:

1. Rise in standard VAT from 15% to 16% in May 2017 and tourism VAT from 10% to 11%.
2. A tax on tourism: EC\$8 per room night for all visitors to hotels and short-term accommodation.

These measures are estimated to contribute 0.7% of GDP to the fund. However, the supply of these funds may not be sufficient to cover expected needs. Considering a budgetary impact of 1.4% of GDP per year (an estimation based on historical disaster impacts over the past 15 years), the emergency fund could cover half of needs. The other half should be covered by reserves that are not currently included in the budget. To complement the emergency fund, two options are proposed:

- **Expanding insurance coverage.** The current level of coverage of CCRIF is low: insurance pay-out was only EC\$0.8 million (0.03% of GDP) in 2016 based on the level of coverage chosen by the government. As a risk transfer tool, insurance would offer an additional layer of protection against a high-risk disaster. The government's choice was motivated by debt control and fiscal constraint considerations. Nonetheless, this level of contribution does not allow for optimisation of the risk pooling tool.
- **Raising additional reserves to prepare fiscal buffers.** These reserves must be dedicated to floods that are not covered by national contingency funds (this option has not been retained by the authorities,

61 Author interview, Saint Vincent and the Grenadines Red Cross, 2019.

who consider it an additional effort for constituting the reserve not in line with the debt reduction strategy).

To date, the Contingency Fund is not considered fully functional by IMF staff and national authorities. Several critical parameters must be reviewed to enable its operationalisation. This involves embedding the purpose and governance of the fund into legislation. Such legislation must clearly identify reconstruction and possibly prevention as an objective and take floods and landslides into account for the release of funds, based on vulnerability profiles. Integrating flexibility into fiscal law to speed up budget reallocations and disbursements and improve transparency is also critical.

Furthermore, the legislation should: (i) provide clearly the legal form and structure of the fund and its relationship with other state bodies (including the Ministry of Finance); (ii) ensure consistency with the broader public financial management framework governing budgetary processes (in particular, the Contingency Fund's operations should be consolidated with budget reports to allow for a proper assessment of the government's overall fiscal position); (iii) support its effective operation and the achievement of its stated policy objective(s), which should be economic and financial in nature; and (iv) promote effective accountability and transparency (IMF, 2019b). While critical, this legal aspect is complex to implement, and capacity constraints have hindered these legal reforms.

Strengthening longer-term resilience to disasters also requires significant public investment in infrastructure. This is the case with the national airport built in 2008. Domestic investment from public capital is expected to increase in the coming years (9.5% of GDP in 2018). To date, the authorities estimate that one-third of the capital has been allocated to climate change. The 2019 budget includes other investment in DRM, such as allocations to the Natural Disaster Management and Regional Disaster Vulnerability Reduction projects. These two investments are estimated at about 2% of GDP.

The balance between limiting the national debt and investing in resilience (including physical capital and the provision of an emergency fund) remains a complex national issue. The debt reduction goal is critical for Saint Vincent and the Grenadines as an ECCU member.

British Overseas Territories: Montserrat, Anguilla, British Virgin Islands

The British Overseas Territories (OTs) have a specific governance structure. The islands' governments retain decision-making and social and economic planning authority (albeit with budgetary support from the UK), but internal security and defence decision are the central government's responsibility. Therefore, local government is expected to take control of risk reduction management, while the UK government steps in for emergency relief functions if and when local capacity is surpassed (Wilkinson, 2015).

Because of their high-income-country classification, none of the UK OTs is currently eligible for ODA; any grant funding from the UK is thus not considered as ODA. UK schemes for affordable home insurance, such as the Flood Reinsurance or Bellwin scheme, do not extend to the OTs (Wilkinson, 2017). All three OTs are members of the CCRIF, and all three are beneficiaries of the €3 million Technical Assistance Program for Disaster Risk Financing and Insurance in Caribbean Overseas Countries and Territories (OCT). Launched in 2019, this initiative will help OTs understand their financial exposure or liability to disasters and assess the feasibility of participating in insurance mechanisms, while promoting knowledge-sharing between OCTs.

Montserrat is a full OECS member despite its status as a British OT. It enjoyed high levels of autonomy from independence in 1961 until 1995, when it was badly affected by a volcano eruption, which forced the relocation of the capital city and caused 75% of the population to emigrate. Most emergency funding was provided by the UK, and the UK government became progressively more involved in financial governance, with the Secretary of State for International Development supervising the island's finances (Clay et al., 1999). In 1997 financial support shifted from emergency aid to budget support and capital investments, giving the UK government even more say in the island's development. As of 2011, Montserrat's budget is sustained by UK grants covering half of expenditures

(IMF, 2012). This dependence, explained by a weakening economy, a stagnating population of around 5,000 and the island's only export being volcanic sands, shows little sign of easing. Montserrat is not eligible for loans from the World Bank or the IMF, though it has received funds from the EU and the CDB (Wilkinson, 2015). Montserrat is partially integrated into the regional DRM landscape, receiving advice from CDEMA and joining CCRIF in 2018; policies for hurricanes and excess rainfall were taken out in 2019.⁶²

In terms of internal organisation, the Disaster Office in Montserrat was given access to a reserve fund following the 1995 eruption. However, in the absence of catastrophic disaster, the funds were progressively dispatched for other uses and the reserve no longer exists. Funding for preparatory actions (pre-positioning, moving hospitals, shuttering government buildings) would now come from respective government offices. Met services use forecasts from the US and Antigua.⁶³

Anguilla has received CDB funding in the past, most recently \$5 million to support the national electricity company ANGLEC in restoring its transmission and distribution system following Hurricane Irma. Having joined the CCRIF in 2007, Anguilla has already received pay-outs, notably \$4.2 million in 2010 following Tropical Storm Earl.

The British Virgin Islands joined the CCRIF in 2018, and there are several tools pertaining to disaster financing, the most prevalent of which is the use of ministerial budget reallocations. A reserve fund called the Disaster Management Fund is in place, and rules governing its use are currently under adjustment. The new rules should make access easier, perhaps allowing it to be used for preparatory action, and require services considered 'critical infrastructure' to ensure adequate preparedness. Livelihood Protection Policies are soon to be available, emulating Saint Lucia and Grenada.⁶⁴

French Overseas Territories: Martinique, Guadeloupe and Saint Martin

Martinique and Guadeloupe are not part of the CCRIF, nor are they eligible for concessional loans. Their DRF system is identical to the mainland's. In French law, costs linked to natural disasters are dealt with primarily through the insurance system. This distinguishes two categories: losses linked to storms or wind, and losses linked to other natural disasters. The second category, called 'Catastrophes Naturelles', is most relevant to disasters in the Caribbean. Under this regime, all homeowners who have purchased insurance and reside in a municipality declared to be in a 'state of natural catastrophe' by the mayor (and validated by the state) automatically receive payment on the basis of their contract.

The public and private sector collaborate in a well-defined regulatory environment in the Catastrophes Naturelles regime. Private companies act as field agents and risk professionals; the state reinsurance company is required to reinsure any private insurer who requests it; and the state acts as guarantor (in case of damage exceeding the capacity of the insurance market). Insurance rates are fixed by the state prescriptions; the base rate is currently 12%. Rates on deductibles are contingent on risk reduction actions at municipal level, namely the existence of a Preparedness and Prevention Plan (PPRN) (Feratti, 2015). All cities and towns in Martinique and Guadeloupe possess PPRNs. Although higher than in other Caribbean nations, homeowner insurance rates are much lower than in France, 52% on average (Grislain-Letrémy and Calvet, 2011). A modelling study attributes this to the high proportion of uninsurable homes not complying with legislation, rather than the cost of premiums (Grislain-Letrémy, 2017).

A reserve fund for preparedness and prevention, the 'Barnier fund', was established in 1995. It is replenished through insurance premiums. Originally meant to cover expropriation needs for properties in high-risk zones, it is now used for a variety of preparedness and risk reduction

62 Interview with DMCA, 2019.

63 Interview with government stakeholder, 2019.

64 Focus group discussion in the British Virgin Islands, 2019.

measures. In the French OTs, it can support the elaboration of studies or PPRNs, as well as construction work for compliance or seismic risk installations. The OTs have advocated for a dedicated overseas envelope to be included, as it is currently difficult to unlock funds.⁶⁵ Yearly disbursement for France and the OTs has been capped at €137 million since 2018. The law is under revision as of summer 2019, with a special focus on adjusting construction standards in the OTs.

⁶⁵ www.journaldeenvironnement.net/article/outre-mer-un-rapport-senatorial-imagine-la-prochaine-catastrophe,92986#ftnref1

Table A1 Published disaster management plans

Country	National disaster management plan and legislation	Disaster management plans	
		Hazard-specific plan	Sector-specific plan
Sovereign states			
Antigua and Barbuda	Disaster Management Act 2002. There is reference to a review of disaster legislation in 2009 and a local consultant began work on a National Comprehensive Disaster Management (CDM) Policy and Strategy.	Hurricane preparedness bulletins.	
Dominica	The Commonwealth of Dominica National Disaster Plan 2001 (issued in 1996, updated in 2001); a new Comprehensive Disaster Management Bill exists.		
Grenada	National Disaster Plan (V 3.1 7 September 2005).	In the National Disaster Plan there is reference to hurricanes, floods, earthquakes and man-made disasters	
Montserrat	Disaster Preparedness and Response Act (in force 17 January 2000. Revised 1 January 2002).	National Hurricane Plan (2013).	
Saint Kitts and Nevis	Saint Kitts and Nevis National Disaster Plan Part 1 V 3.0 27 September 2013; Part 2: Terms of Reference; Part 3: Hurricane Action Plan.	Tsunami Warning Information Dissemination Protocol & SOP for Saint Kitts and Nevis (2016); Hurricane Action Plan (2013) (eight priority hazards were identified – wind, drought, storm surge, volcano, floods, ground shaking, coastal erosion, inland erosion.	
Saint Lucia	National Emergency Management Plan (NEMP) (Rev. 29 June 2011); Disaster Management Act No. 30 of 2006 (est. of NEMO); Comprehensive Disaster Management Strategy and Programme Framework (27 February 2009); Hazard Mitigation Policy and Plan (2006).	Response Plan for Extreme Heat (2006); Volcanic Eruption Response Plan (2009); Earthquake Plan (2011) based on the CDEMA DRAFT MODEL Earthquake Contingency Plan – 2010; Saint Lucia National Flood Plan; Floodplain Management and Flood Response (2006) based on the CDERA Model Flood Plan – 2003; Wildfire Management Plan (2008); Water Management Plan for Drought (2006); Hurricane Response Plan (2002).	Emergency Telecommunications Procedures Manual (1996); Strategy on the Management of Used Oil (October 2006); Post- Disaster Food Protection Guidelines (2009) (http://nemo.gov.lc/Disaster-Management/National-Emergency-Management-Plan/National-Plans).
Saint Vincent and the Grenadine	Saint Vincent and the Grenadines National Disaster Plan (31 July 2005); Comprehensive Disaster Management Policy (2014); Saint Vincent and the Grenadines National Emergency and Disaster Management Act, 2006.	Saint Vincent and the Grenadines National Emergency Management Plan Annex 4 Draft; Saint Vincent and the Grenadines National Volcano Emergency Plan October 2014.	

Table A1 Published disaster management plans (continued)

Country	National disaster management plan and legislation	Disaster management plans	
		Hazard-specific plan	Sector-specific plan
Overseas territories			
Anguilla	Anguilla National Disaster Plan 17 February 2012 Part 1; Part 2 Section A National Response Plan 2012; Govt. of Anguilla Comprehensive Disaster Management Policy (2013); Disaster Management Act 2007	Tsunami Warning Protocols for Anguilla (adapted from CDEMA Model Protocols) Draft v2.6 6 October 2011); Disaster Plan Part IV – Hurricane Plan, Oil Spill Plan, Health Sector Mass Casualty Plans, Airport and Aviation Plan, Emergency Services Major Incident Plan; Land-based Search and Rescue; Ferryboat and Waterborne Incident Plan	
British Virgin Islands	Virgin Islands National Disaster Management Plan 2008 Base Plan Revised May 2009 (this was being reviewed in 2018); Virgin Islands Comprehensive Disaster Management Strategy and Programming Framework III 2014–2018; Virgin Islands (UK) Comprehensive Disaster Management Policy (2009); Comprehensive Disaster Management Strategy and Programming Framework (2009–2013)	Hazard Incident Annexes (HI) mentioned in Disaster Management Plan: 1. Bomb threats 2. Drought 3. Earthquake 4. Epidemics 5. Fires 6. Floods 7. Hazardous substances 8. Hurricane/Tropical Storms 9. Landslides 10. Oil spill 11. Terrorist Act 12. Transport Air 13. Transport Sea 14. Tsunamis 15. Transport Land	
Martinique, Guadeloupe and Saint Martin	French territories have mandatory plans for risk prevention (PPR), according to the law of 2 February 1995. The prefectures issue progressive early action orders in accordance with colour-coded stages of alert: green = no significant danger, yellow = watch, orange = prepare, red = protect violet = lockdown, grey = all clear/stay prudent. Actions include raising public awareness and inviting the population to follow regular Météo-France bulletins and heed instructions issued by the prefecture. NHC tropical storm and hurricane watches and alerts are issued by Météo-France at 48- and 36-hour early warnings, according to the ORSEC cyclone plan (PSUC); each island has its own PSUC and broadcasts every six hours (every three hours when approaching inhabited areas). Météo-France informs the Prefect of watches and warnings that include preventive and preparedness action advice according to the level of colour-coded alert, for heavy rain, heavy seas and coastal storm surge; in the case of hurricanes the Prefecture also monitors the SXM Cyclone network and NHC, and coordinates all actors in preparedness and response actions.	National and departmental plans validated in 2011 are administered by the Prefecture with local community support, to cover the risks of flooding by marina submersion, flash flood, runoff and dike failure, based on adaptation of buildings, improving vigilance and alerts, structures and protection systems and resilience of the population. The Prevention of Natural Risks Plan (NRPP) approved by the Prefect is annexed to the Local Urban Planning law (PLU). The Barnier law aims to strengthen risk prevention action approved by Prefects (scope of risk defined by article R111-3 of the planning code (PSS for flood, PZIF for forest fire))	Risks are taken into account in urban planning and public financing is an obligation for application of the EU flood directive, captured in French law through the 2010 LENE Act and the 2011 Decree 2011-227 resulting in the national flood risk management strategy (SNGRI) and a 2014 joint decree by the ministers of environment, housing, interior and agriculture. Local action is supported through the Fund for the Prevention of Major Natural Hazards.



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