Climate Change and Health Vulnerability and Adaptation Assessment

Workbook FOR CARIBBEAN SMALL ISLAND DEVELOPING STATES

April 2017

Final DRAFT

# Acknowledgments

This document was prepared by Laura Scheske, Mercator Fellow for International Affairs at the World Meteorological Organization & World Health Organization (WMO & WHO) Joint Office for Climate and Health and Peter Berry, Senior Policy Analyst, Climate Change and Health, Health Canada.

The authors wish to thank Marielle Verret, Independent Consultant, Joy Shumake-Guillemot, head of the WMO/WHO Joint Office for Climate and Health and Sally Edwards, Advisor, Sustainable Development and Environmental Health, Pan American Health Organization (PAHO), Eastern Caribbean Office, for their valuable technical contributions and comments on the workbook.

Special thanks are due to Adrian Trotman and Roché Mahon of the Caribbean Institute for Meteorology & Hydrology (CIMH), for providing regional knowledge, and Maylin Meincke, Advisor, Global Program Adaptation to Climate Change in the Health Sector, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Bonn, Germany, for perspectives from Grenada.

This workbook was supported by the Climate Change and Health department of Health Canada.



# Purpose and Context of an Assessment

Climate change and health vulnerability and adaptation (V&A) assessments provide the necessary information for public health and emergency management officials to plan for the health risks of climate change. They can be conducted at local to national scales. This workbook has been developed to facilitate V&A assessments carried out in Caribbean Small Island Developing States (SIDS), drawing on the experiences from assessments conducted in Dominica and Grenada in 2016. The contents and structure of the workbook are largely based on, and intended to be used as a supplement to the World Health Organization (WHO) Guidance Document – *Protecting Health from Climate Change: Vulnerability and Adaptation Assessment* (WHO, 2013). The WHO Guide can be downloaded at:

<http://www.who.int/globalchange/publications/vulnerability-adaptation/en/>

**Vulnerability and adaptation assessments serve to:**

Improve evidence and understanding of the current associations between weather/climate and health outcomes including the populations most vulnerable to these risks;

Provide health and emergency management officials, stakeholders, and the public with information on the magnitude and pattern of current and future health risks associated with climate variability and change, and identify vulnerabilities in the health system;

Identify opportunities to incorporate climate change concerns into existing policies and programs designed to manage health risks associated with weather and climate, and to develop new programs where necessary to prevent and reduce the severity of future risks;

Serve as a baseline analysis against which future changes in risks and in associated policies and programs can be monitored;

Forge collaborations with sectors such as water and infrastructure to promote activities to improve population health in a changing climate.

Frame and scope the assessment

Describe current health risks

Project future health risks

Identify and prioritize policies and programs

Establish an iterative process

Examine health co-benefits and co-harms

**Figure 1.** The steps of a vulnerability and adaptation assessment form an iterative process

# Table of Contents

**Step 2: Describe current health risks**

**p. 12**

**Step 1: Frame and scope the assessment**

**p. 8**

**Introduction**

**p. 1**

**Step 5: Establish an iterative process**

**p. 23**

**Step 4: Identify policies and programs**

**p. 20**

**Step 3: Project future health risks**

**p. 18**

*Templates*

3b Project Future Health Risks

*Templates*

4a Sources for Identifying Adaptation Options

4b Adaptation Options Inventory

4c Prioritize Options and Identify Resource Needs

4d Possible Constraints

How to use this workbook

Climate change impacts on health in the Caribbean

Climate and climate change in the Caribbean

Understanding and managing the risks of climate change

*Templates*

1a Priority Health Hazards

1b Project Team

1c Work Plan

1d Information Sources

1e Communication Plan

*Templates*

2b Estimating Current Relationships

2d Vulnerability Indicators

2e Effectiveness of Policies and Programs

*Templates*

5a Monitoring Plan

5b Monitoring Indicators

*Templates*

6a Health Benefits and Co-Harms

6b Synergies for Adaptation and Mitigation Options

**Step 6: Examine health benefits & co-harms of other sectors**

**p. 25**

*I – Vulnerable Populations*

*II – Assessment Limitations and SoIutions*

*III – Assessment Checklist*

*IV – Assessment Templates*

6a Health Benefits and Co-Harms

6b Synergies for Adaptation and Mitigation Options

**Annexes**

**p. 38**

# List of Figures

**Figures**

**Figure 1: Primary exposure pathways by which climate change affects health … Page 2**

**Figure B1: Number of reported cases of chikungunya by week in the Caribbean region**

**Figure 2: Determinants of vulnerability**

**Tables**

**Table 1: Potential health risks of a changing climate in the Caribbean … Page 3**

**Table 2: Key sources of information for the Dominica Assessment … Page 11**

**Table 3: General status of climate and weather information relevant for health decision-making Page ..**

**Table 4: Overview of climate sensitive health outcomes examined in the Dominica V&A Assessment … Page 13**

**Boxes**

**Box 1: Caribbean Chikungunya outbreak 2014 … Page 4**

**Box 2: Impacts of Tropical Storm Erika … Page 6**

**Box 3: Stakeholder workshops in Grenada … Page 8**

**Box 4: Launch of the Dominica V&A Assessment … Page 10**

**Box 5: Regional climate risk monitoring and management activities … Page 12**

**Box 6: ‘Smart Hospitals’ Toolkit … Page 15**

**Box 7: Useful resources for the Caribbean context … Page 16**

**Box 8: Caribbean Institute for Meteorology and Hydrology / Centre for Climate and Environment Simulations … Page 19**

**Box 9: Applying a risk matrix exercise to estimate future climate risks to health in Dominica … Page 19**

**Box 10: Adaptation options to reduce risks to health from climate change in Dominica … Page 21**

**Box 11: Examples of indicators for measuring the effectiveness of a heat alert and response system … Page 24**

**Box 12: Measuring the economic cost of climate change on health in the Caribbean … Page 26**

# Acronyms

**BAT** Baseline assessment tool

**CADRIM** Red Cross Caribbean Disaster Risk Management Reference Centre

**CariCOF** Caribbean Climate Outlook Forum

**CCCCC** Caribbean Community Climate Change Centre

**CCCES** Caribbean Center for Climate and Environmental Simulations

**CCORAL** Caribbean Climate Online Risk and Adaptation Tool

**CDC** Center for Disease Control

**CDEMA** Caribbean Disaster Emergency Management Agency

**CIMH** Caribbean Institute for Meteorology & Hydrology

**ENSO** El Niño Southern Oscillation

**EWE** Extreme weather events

**GDP** Gross domestic product

**GIS** Geographic information system

**GIZ** Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH

**IFRC** International Federation of the Red Cross

**IPCC** Intergovernmental Panel on Climate Change

**MoH**  Ministry of Health

**NAH** North Atlantic subtropical high

**NAP**  National adaptation plan

**PAHO** Pan American Health Organization

**SIDS** Small island developing states

**SLR** Sea level rise

**SST**  Sea surface temperature

**V&A**  Vulnerability and adaptation assessment

**WHA** World Health Assembly

**WHO** World Health Organization

**WMO** World Meteorological Organization

# Introduction

**How to use this workbook**

The six steps laid out in the workbook provide a streamlined, rigorous assessment process that can be followed by health officials and key partners from other sectors. The steps can be implemented in full in the order presented, or modified to use selected steps tailored to meet specific research questions or best reflect the population or context under assessment. However, considering all steps will strengthen the relevance and usefulness of the assessment in efforts to raise awareness among decision makers, societal groups and the public of the risks to health from climate change and to inform the development of effective adaptation measures. Due to the inherent nature of climate change and fluctuating vulnerability conditions, performing the assessment constitutes an iterative process that should be repeated.

Most climate change and health vulnerability and adaptation assessments are conducted by a lead organization, a research team and an advisory or stakeholder group. This workbook provides summary information on how to conduct each step that can be shared and used by all of the people involved in the assessment. In order to minimize the need for external support, and to facilitate data collection, organization and analysis, the individual steps have been supplemented with fillable templates (Annex IV). These can either be filled in directly using the PDF file, or used at workshops and assessment meetings to facilitate needed data collection. The templates present a simple structure for data collection; however, the information and indicators listed serve as examples, and do not provide an exhaustive representation of all the factors that affect human health. Specific risk indicators and health determinants that need to be considered in an assessment may differ across national contexts. The six steps in the workbook therefore provide flexible guidance so that the assessment can be tailored to the circumstances, resources, and interests of health units and stakeholders in specific countries.

Sufficient time and effort should be devoted at the start of the assessment to deciding the health outcomes that will be included. Increases in the frequency and intensity of extreme weather and climate events, particularly heat events, droughts, or hurricanes, mean that including the health risks of climate variability may be particularly relevant. There may be pre-existing concerns about vector-borne and waterborne diseases, or other climate-sensitive health outcomes. Priorities will need to be set when there are more concerns than available time and resources. The choice of the health outcome(s) will determine the range of stakeholders and skill sets needed in the project team that will conduct the assessment.

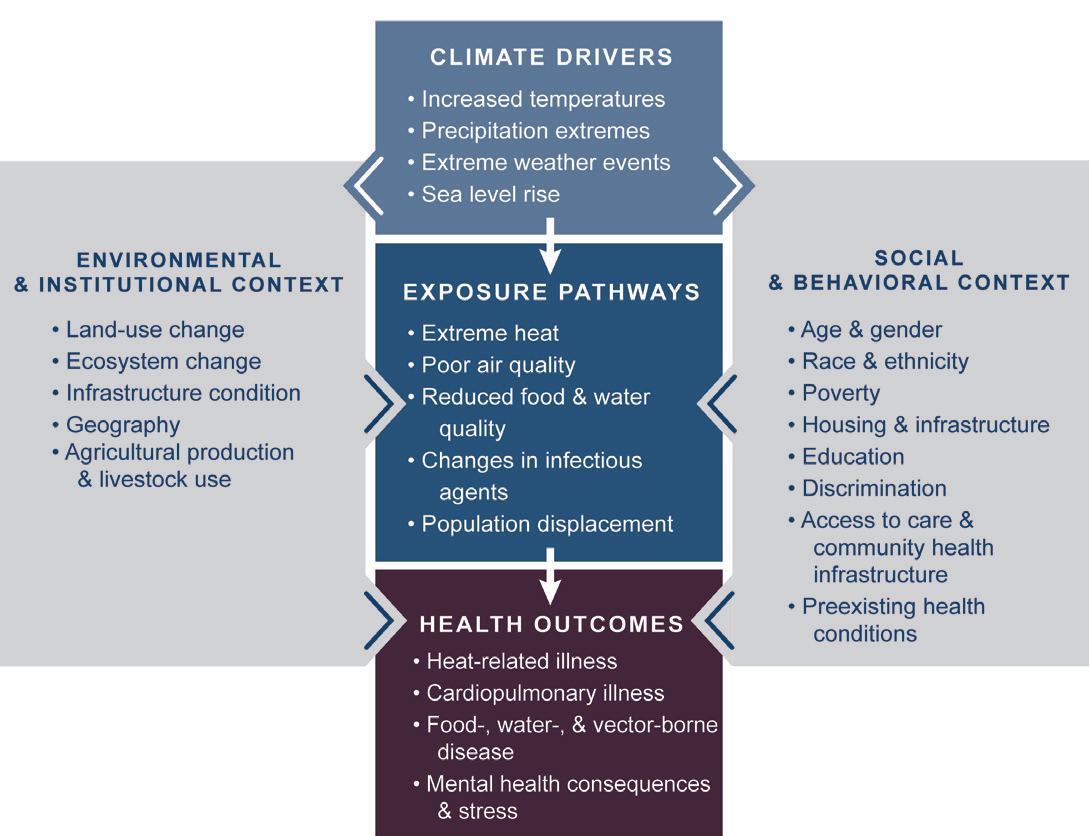
The ultimate aim of performing a V&A assessment is to provide relevant and actionable recommendations for health policymakers on how they can strengthen health systems and increase the resilience of populations vulnerable to the health impacts of climate change. Because an important component of an assessment is informing the public and policymakers of these risks and of actions available to reduce these risks, the assessment should deliver not just a report, but also other communications products with key messages to inform the public and media of the process and outcomes. Communication is generally more effective when it is started at the beginning of the assessment and provides information throughout the process to interested stakeholders and the public.

The six assessment steps are described in the following sections, including the choices that need to be made, the methods and approaches that can be used, and informative case studies from the Caribbean region. Annex II presents challenges encountered while conducting an assessment in Dominica, and tips for overcoming such challenges in other assessments. Annex III provides a summary checklist of the activities and actions required to undertake a climate change and health vulnerability and adaptation assessment that can be used for developing an assessment work plan. Annex IV provides detailed templates for assessment steps 1-6, some of which have been prefilled with indicators relevant to Caribbean SIDS. Boxes in the left margin indicate the templates corresponding to the specific assessment steps.

**Climate change impacts on health in the Caribbean**

Evidence of the health impacts of climate change has been accumulating at an increasing rate, with the World Health Organization (WHO) identifying climate change as the defining issue for public health in this century. Climate variability and change have been associated with a host of both direct and indirect adverse human health impacts. Direct effects from extreme weather events that can be exacerbated by climate change such as heat stress and storms can increase morbidity and mortality, while indirect impacts may be brought about by changing disease ecology and geography, allowing for the proliferation of vector-borne, waterborne, and foodborne diseases. Climate change can also increase the pressures on health systems and infrastructures by testing their resilience and capacity. In essence, climate change acts as a “risk multiplier” by amplifying climate hazards that impact health, and by highlighting the vulnerabilities of communities and critical systems to these hazards (Luber, et al., 2015). The figure below illustrates the exposure pathways by which climate change affects human health, and table 1 indicates the main health risks resulting from climate change in Caribbean SIDS.

Caribbean small island developing states (SIDS) are already suffering the consequences of rising sea levels and dwindling supplies of potable water. Longer dry periods coupled with more intense rainfall may lead to lowered crop yields, impacting food availability and affecting nutrition. Lower socioeconomic groups will be especially affected and may even become displaced. Vector-borne diseases such as dengue, chikungunya, Zika, yellow fever and malaria require particular attention in light of changing geographical distributions and recent outbreaks. These health vulnerabilities must be identified and assessed for countries to be able to create adequate public health responses. WHO recommends the development of national plans of action and/or health national adaptation plans to protect the population’s health against the risks of climate change.



**Figure 1: Primary exposure pathways by which climate change affects health**

(Source: Climate and Health Assessment, <https://health2016.globalchange.gov/downloads>

|  |  |  |
| --- | --- | --- |
| Table 1: Potential health risks of a changing climate in the Caribbean | | |
| Climate drivers | Health risks | Health Impacts |
| *Increased temperatures*   * *Extreme heat* * *Air quality* * *Warmer seas* | * **Excess heat related mortality** * **Heat stress and heat related illnesses** * **Exacerbated cardiovascular and respiratory diseases** * **Algal blooms; ciguatera** | Greater risks of disease and death due to extreme heat and bad air quality |
| *Extreme precipitation*   * *Tropical storms* * *Hurricanes* * *Floods* * *Storm surges* | * **Shifting geographic and seasonal distribution of vector-borne and water-related diseases (e.g. dengue, chikungunya, Zika; leptospirosis)** * **Damage to water and sanitation infrastructure and contamination of water sources leading to diarrheal diseases** * **Loss of livelihoods** * **Stress and damage of health infrastructure** | Greater risks of death and injury due to extreme weather events, increased risks of vector-borne diseases and diarrheal diseases; increasing mental health problems due to trauma and loss of livelihoods |
| Drought & water scarcity | * **Water insecurity** * **Food insecurity** * **Vector-borne diseases (e.g. dengue)** * **Loss of livelihoods** | Nutritional deficiencies and hygiene related issues due to water scarcity and food insecurity, morbidity and mortality due to vector-borne diseases |
| *Sea level rise* | * **Loss of arable land** * **Population displacement** | Risk of psychological illnesses and distress; diminished food production; larger vulnerable population |
| *Source: Modified from Taylor et al., 2009* | | |

In 2008, the Pan American Health Organization (PAHO) proposed a Regional Plan of Action to Protect Health from the Effects of Climate Change – the same year in which the World Health Assembly adopted the first resolution (WHA 61.19) on climate change and health. Three years later, this plan was revised based on experiences at the national, sub regional, and regional levels and on the WHO work plan on climate change and health (WHA62.11). The result was a Strategy and Plan of Action on Climate Change (PAHO CD51.6), which equips and strengthens national and local health systems in dealing with climate risks. It further supports the development and implementation of key actions at local, national, and regional levels to minimize the impacts of climate change on health, and encourages the health sector to adopt energy management measures to mitigate climate change and avoid additional, potentially disastrous impacts on health. The plan of action can be used as a model to develop nationally tailored action plans.

BOX 1: Caribbean Chikungunya Outbreak 2014



In December 2013 autochthonous transmission (i.e., disease spread from one individual and acquired in another individual in the same place) of chikungunya was first reported on the Caribbean island of Saint Martin (WHO, 2013). Chikungunya is a viral disease endemic to sub-Saharan Africa and South East Asia, and is transmitted by the bite of *Aedes* mosquitoes, which are active during the day. The outbreak in the Caribbean saw over 5294 laboratory confirmed cases, and hundreds of thousands of suspected cases across the region by the end of the summer. As of September 2014, 27 Caribbean countries had reported autochthonous transmission of chikungunya (PAHO, 29 August 2014).

The quick progression of the 2014 outbreak has been associated with the expanding geographic range of the *Aedes* mosquito vector, a phenomenon thought to be a consequence of climate change and globalization (Khan, et al., 2014). While research into the biology of *Aedes* mosquitos and the specific climatic conditions that would support autochthonous transmission is still limited, higher temperatures, such as those experienced under climate change conditions, is thought to shorten the extrinsic incubation period of the mosquitoes (i.e., the time it takes when the vector takes up virus from an infectious patient, and when that vector can transmit the virus to another human host) (Khan, et al., 2014).



Figure B1: Number of reported cases of chikungunya by week in the Caribbean region (Nov 2013-June 2014) (ECDC, 2014)

**Climate and climate change in the Caribbean**

**Current climate of Caribbean SIDS**

Caribbean SIDS experience a Marine Tropical Climate characterized by warm to hot year round temperatures, with dry winters and wet summers. Ocean-atmosphere interactions play a major role in determining the climate of Caribbean SIDS. The dominant synoptic influence arises from the North Atlantic subtropical high (NAH), which is southernmost during the winter and moves north during the summer, giving rise to the dry and wet seasons, respectively (Solomon, et al., 2007). Storms and hurricanes during June to November represent the primary rainfall source for the Caribbean islands and coincide with their main rainy season. Interannual variability of rainfall in the Caribbean is mainly influenced by the El Niño Southern Oscillation (ENSO) and its effect on sea surface temperatures (SST) in the Atlantic and Caribbean Basins. Within the ENSO cycle, El Niño years typically experience a drier rainy season with diminished tropical cyclone activity, while La Niña years result in a wetter rainy season (Solomon, et al., 2007).

**Caribbean climate trends and projections**

*Land and sea temperature*

During 1900-1995, the Caribbean islands experienced an increase in mean annual temperature of more than 0.5°C (IPCC, 2007), compared to pre-industrial period levels. By the end of the century the IPCC (2007) projects temperature increases from 1.4°C to 3.2°C in the Caribbean, with a median of 2.0°C. Similarly, between 1901 and 2012, sea-surface temperatures in the Caribbean warmed by about 0.8°C (IPCC, 2014), with trends showing continued temperature increases. Associated with these changes, the Caribbean region may experience a decrease in mean rainfall by the end of the century, as well as warming seas and ocean acidification.

*Precipitation*

During 1900-1995 the Caribbean islands saw a decrease in mean annual total rainfall by about 250 mm (IPCC, 2007), compared to pre-industrial period levels. Climate models suggest that summer rainfall in the Caribbean is likely to decrease in the vicinity of the Greater Antilles but changes elsewhere and in winter are uncertain (IPCC, 2007). The IPCC (2007) found that most models project decreases in annual precipitation, while a few project increases, with an overall variation from -39 to +11%, with a median of -12%. More confidence exists in Caribbean temperature projections than in rainfall projections under future climate change (Taylor, et al., 2012).

*Sea level rise (SLR)*

Sea levels are likely to continue to rise on average during the century around most SIDS, including those in the Caribbean Sea. The most recent projections (IPCC, 2014) suggest a sea level rise in the region of 0.5 to 0.6m by the year 2100, similar to global SLR projections of 0.41 to 0.71m during this timeframe. Some studies project greater sea-level rise in the Caribbean due to its proximity to the equator.

*Hurricanes*

The north tropical Atlantic is likely to experience more frequent and intense hurricanes with higher wind spends and heavier rainfall (Taylor, et al., 2012). This projection is linked to increases in sea surface temperature (SST) and increased atmospheric water vapor content. There has been a statistically significant increase in the frequency and duration of recent hurricanes in the Caribbean region, and a general increase in the wind speeds and precipitation intensity of major hurricanes in this region over the last 30 years (Simpson, et al., 2012). A recent study found that increased SST in Atlantic and Caribbean oceans will cause increased rainfall and more destructive storm surges within the next 50-100 years (Lau, et al., 2016).

Key risks to small islands from climate change include,

*“Loss of livelihoods, coastal settlements, infrastructure, ecosystem services, and economic stability (high confidence)”*

- IPCC AR5 WGII Ch. 29.6

BOX 2: Impacts of Tropical Storm Erika

Tropical Storm Erika struck a number of Leeward Islands in the Caribbean in August 2015. Several islands experienced heavy rainfall during the passing of Erika, with Dominica being the most affected. Dominica received over 320mm of rainfall within a 12-hour period, causing extensive flooding and landslides. The passing of the storm resulted in local governments issuing tropical storm watches or warnings.

In Dominica alone, the storm affected more than 7200 persons in special disaster areas, leaving 13 dead, 17 missing, and 20 injured. Furthermore, 574 people were rendered homeless by the storm, which damaged or destroyed more than 2500 homes (CDEMA, 28 September 2015). Power outages affected 80% of the island, and many communities were left without potable water. Total damages to Dominica from the storm are estimated at $483 million, or 90% of the country’s gross domestic product (GDP) (IFRC, 21 January 2016).

Tropical Storm Erika significantly affected the health care system in Dominica. Many facilities sustained infrastructure damages, but were able to reopen within two weeks of the storm. The most significant public health challenge arose from the lack of access to clean water, and disruption of solid waste collection, sparking concerns about waterborne diseases. Water supply also remained an urgent need for many health facilities and this became the focus of disaster response efforts to ensure health services for the public were maintained.

In wake of the storm, increased surveillance reported 54 cases of gastroenteritis, 8 cases of acute respiratory illness, and 11 cases of undifferentiated fever (PAHO, 8 September 2015). It is unclear whether these were directly linked to impacts from Tropical Storm Erika.



Image source: Caribbean360/Facebook

**Understanding and managing the risks of climate change**

The magnitude and pattern of climate change risks to health are a function of the (IPCC, 2014):

* **Hazards** resulting from a changing climate, such as changing precipitation patterns, and increases in the frequency, intensity, and duration of heat events;
* **Exposure** of populations to those hazards;
* **Vulnerability** of these exposed populations. Vulnerability is determined by population sensitivity to the exposure due to individual physiological factors, demographic structure, and other factors. It is also determined by the ability of individuals and institutions to prepare for, cope with, respond to, and recover from the exposure

Small island developing states have been identified as particularly vulnerable to the impacts of climate change (Nurse, et al., 2014). Climate change impacts will likely increase the loss of adaptive capacity and ecosystem services that are critical to the lives and livelihoods of people on the islands. They will be exacerbated in countries with resource scarcity, poor infrastructure, higher exposure to extreme weather events (EWE) such as hurricanes, and located significant distances from large market economies (Ebi, et al., 2006).

Climate change risks to health are heightened in the Caribbean as over half of the population (40 million people) lives within 1.5 km of the coastline, resulting in high levels of exposure to EWEs and sea-level rise. Climate-related disasters can have catastrophic impacts on countries in the region (Box 2). Some populations are much more vulnerable to the health impacts of climate change due to existing health status, socioeconomic conditions and related factors. Annex I highlights populations vulnerable to climate change, with examples of factors that increase vulnerability in those groups.

The six steps for comprehensively assessing climate change and health vulnerability in Caribbean SIDS are presented in this workbook and are described further in the WHO technical guidance document <http://www.who.int/globalchange/publications/vulnerability-adaptation/en/>. They include:

1. **Frame and scope the assessment;**
2. **Describe current risks, including vulnerabilities and capacities;**
3. **Project future health risks;**
4. **Identify and prioritize policies and programs to manage the additional health risks associated with a changing climate;**
5. **Establish an iterative process for managing and monitoring health risks;**
6. **Examine the potential health benefits and co-harms of adaptation and mitigation options implemented in other sectors.**

A V&A assessment is not only about understanding the potential implications of future climate change, but assessing vulnerability factors that can interact with climate, and be modified through interventions, or lack thereof, to increase or decrease risks to health. Based upon analysis of risks to health from climate change, it is important to consider the full range of options for mitigating and managing risks, including those that could be taken by other sectors. For example, the health risks of tropical hurricanes and storm surges can be exacerbated by weak sanitation systems; improvements to the infrastructure to make sanitation systems leakage proof and more resilient to damage from heavy rainfall could reduce the risks of waterborne diseases.

# Step 1: Frame and Scope the Assessment

**Step 1: Overview**

Before an assessment is initiated, the assessment needs to be framed and scoped. The project leads should: identify health risks of climate change of most interest, determine how the assessment will be managed, establish a work plan including a timeframe, identify key information sources and adaptation needs to be considered, and outline a communications plan for informing stakeholders.

**Step 1a: Decide Which Health Outcomes to Include**

The first decision to be made is which health outcomes are of greatest importance for including in the assessment. Use the Priority Health Hazards template to compile preliminary information on health outcomes and climate-related hazards to identify which should be a priority for the assessment. In the template, record information on morbidity and mortality in your jurisdiction from extreme weather and climate events (e.g. hurricanes, storms, heat events), changes in air quality arising from changing concentrations of ozone, particulate matter (Saharan dust) or aeroallergens, and water-, food-, and vector-borne diseases that can be made worse by climate change (e.g. gastroenteritis, dengue and chikungunya). When compiling this information, pose the following questions to help prioritize health concerns:

Use Template 1A  
Priority Health Hazards

* What are the priority climate-sensitive health outcomes of concern in the study area?
* Which climate-sensitive health outcomes are of greatest concern for stakeholders and the public?
* Did recent extreme weather and climate events raise concerns about health risks such as hurricanes and storm surges?
* Were recent assessments conducted in the region in other sectors that highlighted issues affecting health?
* Are neighboring health jurisdictions also conducting a health vulnerability and adaptation assessment?

**BOX 3: Stakeholder Workshops in Grenada**

As a first scoping exercise, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), in collaboration with the Grenada Ministry of Health and Social Security (MoH), organized three stakeholder workshops: two on “General awareness of (?) climate change & health in Grenada”, and one on “Development of first ideas for a climate change action plan for the health sector”.

These workshops helped to raise awareness of climate change impacts on health and identify the key health priorities in Grenada. Furthermore, the workshops helped to outline key constraints related to climate change in the health sector, which include: inadequate human and financial capital; limited collaboration and cooperation at both inter- and intra-sectoral levels; and a lack of a functioning monitoring mechanism.

This scoping exercise identified policy and stakeholder processes relevant for a V&A assessment and resulted in the MoH including climate change related indicators and activities in the new National Health Strategy, and the inclusion of health as a relevant sector in the National Adaptation Plan (NAP).

**Step 1b: Identify Project Team**

Once the health outcomes to be considered are identified, a project team with relevant expertise can be created and a work plan developed.

Use the Project Team template to list project team members and other relevant information such as their respective areas of responsibility (e.g. health departments managing the health outcome of interest along with other sectors whose activities can affect the health outcome), their expertise and/or whom they represent (individuals or organizations) and their roles in the assessment.

Use Template 1B  
Project Team

When identifying potential project team members, include the following stakeholders and considerations:

* Officials from local authorities whose activities can affect the burden and pattern of climate-sensitive health outcomes
* Representative health care providers who would diagnose and treat any identified cases
* Core members of the project team who stay for the entire project
* Individuals that are working on issues relevant to the mandate of the assessment in other departments or organizations (e.g. experts in disease transmission, experts on disaster risk management)
* Communication experts to discuss how to present the results to the public in ways that empower appropriate behavioral adaptation actions
* Ensuring a high degree of stakeholder inclusivity while having a small enough team to direct the study most effectively
* Additional resource persons with targeted expertise on specific topics

**Step 1c: Develop a Vulnerability and Adaptation Assessment Work Plan**

The work plan needs to consider the extent to which steps in a vulnerability and adaptation assessment are necessary to achieve the desired results. Time and financial resources may call for a delay in the implementation or removal of a particular step; this should be noted in the work plan. For example, the examination of potential health benefits and co-harms of adaptation and mitigation options implemented in other sectors might be omitted or could be undertaken when the next assessment is carried out. Reasons for not undertaking a certain step should be included in the final report to inform the framing and scoping of subsequent assessments.

The work plan should specify the management plan, key responsibilities, activities, time line and resources needed for the assessment.

Use Template 1C  
Work Plan

**Step 1d: Identify Qualitative and Quantitative Information to Inform the Assessment**

Another activity to undertake during the scoping phase is to identify available and relevant information for the assessment. Sources of relevant information could include:

* Peer-reviewed literature – There are many publications on potential changes in health risks to vulnerable populations from climate hazards. Some of these include projections of changes in precipitation and temperature in the coming decades and maps on the current and projected ranges of the vectors that cause malaria, dengue, or Zika.
* Grey literature – Grey literature may describe the current burden of climate-sensitive diseases and management approaches for the health outcomes of concern. Regional level assessments that have been done for other sectors could provide valuable insights into climate exposures that impact health.
* Climate and weather data – This data may be obtained from environment agencies and can include, for example, changes in precipitation patterns, extreme heat events and occurrences of drought.
* Community reports – These reports can provide information on a range of key vulnerability factors (e.g. relevant health reports and associated datasets).

Use Template 1D  
Information Sources

Key sources of information that were used during the Dominica assessment are presented in Table 2.

**Step 1e: Develop a Communication Plan**

Developing a communication plan early in the process is important to ensure that the assessment is structured from the beginning to communicate identified risks effectively to policy and decision-makers responsible for managing the risks, as well as to those who could be affected. The plan should specify the primary assessment output (e.g. report), to whom it will be communicated, mechanisms for sharing the results (e.g. launch events, webinars, workshops), and whether outreach materials will be developed to communicate the results.

Use Template 1E  
Communication Plan

**BOX 4: Launch of the Dominica V&A Assessment**

The Dominica V&A assessment was launched during the Caribbean Regional Climate Outlook Forum (CariCOF) held in Dominica in May 2016. Organized by the Caribbean Institute for Meteorology and Hydrology (CIMH), this CariCOF had a special focus on health topics and brought together participants from health authorities and National Meteorological and Hydrological Service in the region. The main outcomes of the report were presented by a member of the project team and distributed to policy makers in the form of an executive summary.

The CariCOF offered an excellent platform to communicate results and share assessment experiences with countries from the region. These included: Antigua, Bahamas, Barbados, Belize, Cayman Islands, Cuba, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, Montserrat, Panama, St. Vincent & Grenadines, St. Lucia, St. Kitts, Suriname and Trinidad & Tobago.

The executive summary of the Dominica V&A assessment report can be accessed at: here.

|  |  |  |
| --- | --- | --- |
| Table 2: Key sources of information for the Dominica Assessment | | |
| Data source | | **Types of information collected during the Dominica V&A** |
| *Qualitative* | **Interviews** | * Key informant interviews were held to gather targeted and in-depth information on priority health risks and capacity issues |
| **Focus groups** | * A focus group with the Environmental Health Department was organized to discuss risk prevention activities and existing barriers * A focus group on adaptation was held to gather adaptation options from local stakeholders |
| **Workshops** | * An assessment launch event was organized to build enthusiasm by sharing findings of an initial desk review report with local stakeholders * National stakeholder workshops were held to increase awareness and solidify political will for the V&A assessment in Dominica |
| **Surveys** | * Surveys to collect information on vulnerability were administered during a workshop * A survey to gather information on adaptive capacity was distributed during workshops and digitally   *[To increase response rates, surveys should be sent electronically to all participants, and administered in person to key stakeholders such as during workshops or meetings]* |
| **Risk Matrix** | * Risk matrix exercises were used to provide qualitative assessments of future risks   *[To improve outcomes, high sample sizes should be sought and exercises administered in person such as during workshops to offer opportunities for explanation and questions.]* |
| *Quantitative* | **Environmental Health Department** | * Mosquito indices, water quality data, as well as reports on vector control, water quality and food safety |
| **Ministry of Health (Health Information Unit)** | * Health data from official government reports |
| **Dominica Meteorological Service** | * National climate data |
| **Health Centers** | * Paper-based health information on indigenous communities (Kalinago hamlets) |
| **Discover Dominica Authority** | * Tourism information |
| **Food and Agriculture Organization** | * Food security indicators |
| **CARIBSAVE** | * National climate change risk profiles from the Caribbean Climate Change Risk Atlas |
| **Data Modeling** | * A data modeling expert quantified the relationship between climate and disease patterns |
| **National Water Authority (DOWASCO)** | * Data on water quality [requested] |
| **Ministry of Finance** | * Demographic data [requested] |

# Step 2: Describe Current Risks - Exposures, Vulnerabilities and Capacities

**Step 2: Overview**

This step is undertaken to describe current climate related health risks. This involves documenting exposure to climate hazards and vulnerabilities, and individual and community level capacities to cope or adapt. This will provide the context for understanding where modifications to current programs could help protect health as the climate continues to change.

**Step 2a: Review Qualitative and Quantitative Information**

The datasets, departmental documents, peer-reviewed publications, and internet sources identified during Step 1 should be reviewed for relevant information on the priority health hazards and to provide a vulnerability baseline that describes the current distribution and burden of climate-sensitive health outcomes, and vulnerability to these outcomes. Gaps in knowledge can be filled, to some extent, by interviewing subject matter experts to describe current exposures and vulnerabilities. Keep track of the information collected in order to quickly reference and analyze the data and to inform the assessment report.

Box 5 includes resources on general climate exposure, as well as on disaster management capacities in the Caribbean region.

**Box 5: Regional CLIMATE Risk Monitoring and Management Activities**

**Caribbean Centre for Climate and Environmental Simulations (CIMH/CCCES)** is part of the region’s strategy to build and sustain regional resilience to the risks posed by climate change, increasing climate variability, extreme weather and increasing environmental degradation and change. The CCCES addresses resilience in these areas by providing Caribbean Community (CARICOM) scientists, engineers and researchers with state-of-the-art computation resources to conduct complex simulations and analyses within and across disciplines on a range of scenarios (various spatial and temporal scales) to adequately identify, bound and mitigate the drivers of risk to the social and economic development of the Caribbean.

Access: <http://www.cimh.edu.bb/?p=ccces>

**The Caribbean Disaster Risk Management Reference Centre (CADRIM)** is a tool of the International Federation of the Red Cross (IFRC) and hosted by the Barbados Red Cross National Society. This Reference Centre was established in 2010 and aims to reduce risk, especially to the most vulnerable in the Caribbean region, through innovative and relevant activities and actions at the community and institutional levels.

Access: <http://www.cadrim.org/>

**Caribbean Disaster Emergency Management Agency (CDEMA)** is a regional inter-governmental agency for disaster management in the Caribbean Community (CARICOM). The Agency was established in 1991 as CDERA (Caribbean Disaster Emergency Response Agency) with primary responsibility for the coordination of emergency response and relief efforts to Participating States that require such assistance. It transitioned to CDEMA in 2009 to fully embrace the principles and practice of Comprehensive Disaster Management (CDM). Access: <http://www.cdema.org/>

|  |  |  |
| --- | --- | --- |
| **Table 3: General status of climate and weather information relevant for health decision-making** | | |
| **Timescale** | **Example of climate information products available in the Caribbean** | **Example of health-decision applications** |
| Historic record of climate observations | Historic time series data, summary statistics and other information products | Epidemiological trend and regression analysis to understand associations of climate and health; develop disease forecasting from current and recent observation data, particularly for infectious diseases with time lags between observed ambient conditions and disease onset |
| Weather information  (hourly, daily, weekly, 30 days) | Real-time monitoring of daily weather: temperature, precipitation, humidity, etc.  0-14 day probabilistic outlooks  Extended range forecasts from 10-30 days  Tercile forecasts (above normal, normal, below normal) probabilistic prediction of rainfall and temperature  Extreme weather probability prediction | Short-term operational decisions such as public weather advisories, and thresholds that trigger action plans for staff deployment, delivery of supplies, and public protection |
| Short-term climate information  (1 – 12 months) | Risk indices of hurricanes, floods, dust storms, wind storms, extreme temperature, fire  Long-range forecasts of average, maximum and minimum temperature and precipitation conditions 1 - 2 months ahead (e.g. sub-seasonal forecasts and trends)  Status of El Niño Southern Oscillation (ENSO) conditions  Tercile forecasts (above normal, normal, below normal) probabilistic prediction of rainfall and temperature | Short-term operational investment in preparedness, outbreak prevention, identification of resource needs |
| Mid-term climate information  (annual to multi-year) | Annual to interannual projections (several years ahead) describing large scale state of the climate for regional applications  Downscaled regional climate models | 1-5 year policy decisions for disease control, research, health systems planning |
| Long-range climate information  (decades) | 10-30 year decadal projections of surface temperature, precipitation, and sea surface temperature, etc  Climate change scenarios, dynamic climate models, global circulation models | Long-term health infrastructure investments, research, demographic and population models, health system planning  Increase understanding of disease trends, epidemic behavior on a regional scale and future health risks |

**Step 2b: Describe Historical Trends in the Environmental Hazards of Interest and Establish Baseline Conditions**

Collect data and maps on recent weather and climatic trends of interest. Data can be obtained from international, national and regional agencies, such as CIMH (<http://www.cimh.edu.bb/?p=home>), IPCC reports (**http://www.ipcc.ch/publications\_and\_data/publications\_and\_data\_reports.shtml)**, the scientific literature, or through online portals (see Box 7 below). If relevant to important health outcomes, document how the geographic range, intensity, and duration of particular weather events have changed over recent decades. Consulting a meteorologist or climatologist can be helpful to ensure the right sources of information have been selected, and data are interpreted appropriately.

**Step 2c: Analyze Current Relationships between Climate and Weather Patterns and Climate-Sensitive Health Outcomes**

Determine the associations (if any) between the exposures and the incidence, seasonality, and geographic range of the climate-sensitive health outcomes under consideration.

Graphing the data may prove useful for identifying patterns, particularly with limited time series. It is important to consider factors that could influence any observed trends such as changes in disease control programs and changes in land use. There will be more confidence in analyses conducted using longer and larger health data sets.

Illustrating risk distribution using spatial mapping can be a valuable approach for communicating and explaining assessment results. The use of geographical information systems (GIS) such as R- software, WHO’s HealthMapper or CDC’s EpiInfo **(https://www.cdc.gov/epiinfo/index.html)** can offer opportunities to input health data to show the distributions of important variables of interest to public health officials, such as health facilities or disease incidence. These data can be overlaid or combined with environmental or climate information to identify vulnerabilities and possible interventions.

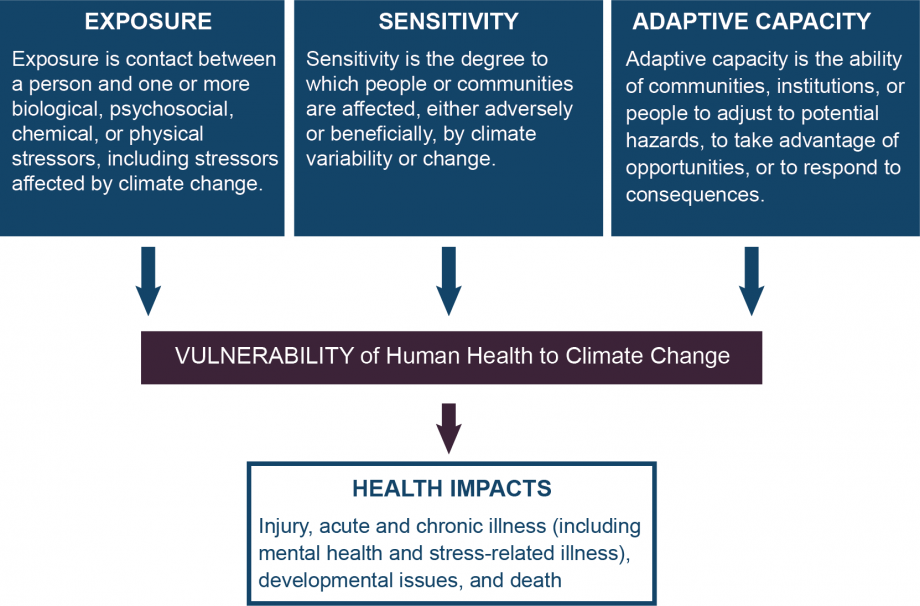
When sufficient data are not available, estimates of the strength of associations can be gathered from the published literature or from interviews with subject matter experts. This information can be used to describe exposure-response relationships. Survey questionnaires may be useful for obtaining this type of information. Table 3 below shows examples of health outcomes examined during the V&A assessment in Dominica.

Use Template 2C  
Estimating Current Relationships

|  |  |  |
| --- | --- | --- |
| Table 4: Overview of climate sensitive health outcomes examined in the Dominica V&A Assessment | | |
| Health hazard | **Exposure** | **Sensitivity** |
| *Vector-borne diseases* | Abundance and distribution of vectors | Dengue, Chikungunya |
| *Waterborne and water-related diseases* | Drinking and recreational water quality  Abundance and distribution of rodents | Water quality, Leptospirosis, Typhoid fever |
| *Foodborne diseases* | Flooding and service interruptions  Food handlers and special events | Gastroenteritis, Ciguatera |
| *Food security* | Extreme weather events including: drought, excessive rainfall, hurricanes | Undernourishment, Underweight children, |
|  |  | Source: Verret et al. 2016 |

**Step 2d: Characterize the Vulnerability of Exposed Individuals and Communities, Including Sensitivity and Ability to Cope**

The extent to which a particular group is vulnerable to a specific health outcome reflects the balance between factors that increase sensitivity and the ability to cope with exposure risks.

[](https://www.google.at/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&ved=0ahUKEwj04JjImanTAhWD0xoKHa3UCykQjRwIBw&url=https://health2016.globalchange.gov/populations-concern&bvm=bv.152479541,bs.1,d.ZGg&psig=AFQjCNGC5R83vefdJMPxNwkjQp5mVmIq7w&ust=1492439731958178)

**Figure 2: Determinants of vulnerability** (Source: Climate and Health Assessment, https://health2016.globalchange.gov/populations-concern)

Use vulnerability indicators for each climate hazard and pose questions to obtain indicator data. When collecting data, consider those individuals and communities that are most vulnerable. These may include vulnerable urban and rural populations, indigenous groups, but also populations living in coastal and low-lying areas.

Use Template 2D  
Vulnerability Indicators

An analysis of how key social and environmental determinants of health could be affected by climate change in the study region should also be considered in this step. These include projections of changes in economic and employment conditions, the health system, social networks and aspects of the physical environment including water availability, food security, and the occurrence of heat waves, droughts, floods and other EWEs.

**Step 2e: Describe and Assess the Effectiveness of Policies and Programs to Manage Current Vulnerabilities and Health Burdens**

Generate a list of all existing policies and programs (within and external to the health sector) that affect the climate-sensitive health outcomes considered in the assessment. Using evaluations or expert judgement, determine how well policies and programs are protecting individuals and communities against climate-related hazards. Consider the effectiveness of current programs/systems in reducing morbidity and mortality, the quality of program management and delivery, (e.g. infectious disease monitoring and surveillance) and whether existing measures are sufficient for reducing risks.

Use Template 2E Effectiveness of Policies and Programs

**Step 2f: Evaluate Disaster and Emergency Preparedness of the Health System, and Consider Health Infrastructure Adaptive Capacity and Resilience**

Evaluate health system climate resilience and the current capacity of health sector-related facilities to anticipate and cope with emergencies related to extreme weather events and outbreaks by using existing tools (Box 6). Information should be gathered on the state of current health sector infrastructure, and show their ability to cope in major emergencies. These kinds of assessments have often been done by the disaster risk reduction community and reports may already be available. Consulting members of the disaster risk reduction community or the responsible ministry at the national level can help identify existing information and facilitate understanding of health sector vulnerability to climate hazards.

**Step 2g: Develop a Baseline of Information for Monitoring Future Vulnerability and Evaluating Adaptation Options**

Synthesize information collected into a baseline of information that can be used as a first comparison and as a future reference to determine the success (or failure) of future adaptation policies and programs. The baseline should use key metrics to describe current morbidity and mortality of the climate-sensitive health outcomes of concern, including recent trends and information on associated underlying risk factors and determinants. It should also examine the policies and programs in place to manage those outcomes, including measures of their effectiveness. Drivers that affect the health outcome and risk level should be documented and monitored over time (e.g. policies and programs).

**BOX 6: SMART HOSPITALS TOOLKIT**

Climate change poses significant risks to health systems, including health facilities in the Caribbean. To increase the resilience of small to medium sized health facilities and their capacity to respond to health emergencies and disasters, the Pan American Health Organization and the World Health Organization developed the SMART Hospitals Toolkit. The toolkit is a practical guide for hospital administrators, health disaster coordinators, health facility designers, engineers and maintenance staff to achieve Smart Health Facilities by conserving resources, cutting costs, increasing efficiency in operations and reducing carbon emissions. It includes several toolkits and instruments (below) for establishing disaster-resilient health facilities.

(http://www.paho.org/disasters)

* **PAHO Hospital Safety Index** **– Safe Hospitals Checklist**: The Hospital Safety Index provides a snapshot of the probability that a hospital or health facility will continue to function in emergency situations, based on structural, non-structural and functional factors, including the environment and the health services network to which it belongs. By determining a hospital’s safety index or score, countries and decision makers will have an overall idea of its ability to respond to major emergencies and disasters.

<http://www1.paho.org/english/DD/PED/SafeHospitalsChecklist.htm> The Hospital Safety Index has been applied to 45 hospitals and 59 small facilities in in the Caribbean (e.g. St. Kitts and Nevis, Grenada, Montserrat, Saint Vincent and the Grenadines, Anguilla, Dominica and Barbados)

* **Baseline Assessment Tool (BAT)** - assesses factors related to structural (age, physical condition, and quality of construction of the building) and non-structural (mechanical, fire and electrical codes, health and safety, and accessibility) integrity of health facility buildings
* **Green Checklist** – a green building rating system
* **Cost-benefit Analysis** – helps determine the financial feasibility of investing in “smart” health facility improvements or upgrades

In 2008, the project “Strengthening Communities through Safer Health Care Facilities”, implemented by PAHO/WHO, was launched with a workshop based on the newly developed Hospital Safety Index. People were trained to apply the index in eight hospitals in Grenada, St. Kitts and Nevis, St. Vincent and the Grenadines, Dominica, Montserrat, Anguilla, and Barbados. Using the Hospital Safety Index each facility was provided with information needed to evaluate its location, construction, condition, support system, and disaster preparedness and response plans. The general hospital of Grenada, St. George’s, participated in the project. The results of the first evaluation highlighted the need to take action in nearly all areas.

Beginning of 2015, PAHO/WHO launched another project in Grenada, “SMART Health Care Facilities in the Eastern Caribbean”. The aim of this project is to support Grenada and other vulnerable Caribbean countries to assess and prioritize vulnerability reduction investments of their health facilities. The health facilities are being assessed for disaster safety, water and energy improvements, providing needed information to direct upgrade investments. Results are incorporated within the national risk exposure database.

Three health facilities in Grenada will be retrofitted to help reduce the downtime and potential damage in the event of a disaster, reduce operational expenditures by improving water and energy management, and ensure energy auto-sufficiency to support continuity of healthcare delivery in the event of a major disaster. This project will also use the Hospital Safety Index to evaluate the selected facilities.

Source: Meincke et al. 2015 (Unpublished)

**BOX 7: Useful Resources For the Caribbean Context**

**Caribbean Resources**

* **CARIBSAVE** - The INTASAVE-CARIBSAVE Group is a global not-for-profit and environmental enterprise that innovates, connects and implements practical solutions for sustainable development and climate change.

CARIBSAVE Climate Change Risk Atlas:

<http://www.caribbeanclimate.bz/closed-projects/2009-2011-the-caribsave-climate-change-risk-atlas-cccra.html>

* **CIMH** – The Caribbean Institute for Meteorology and Hydrology is an Institution of the Caribbean Community (CARICOM) and the technical organ of the Caribbean Meteorological Organization (CMO). The mandate of the CIMH is to assist in improving and developing meteorological and hydrological services, as well as, providing awareness of the benefits of meteorology, hydrology and climatology for the economic well-being of the 16 CMO Member States. This is achieved through training, research, investigations, and the provision of related specialized services and advice.

<http://www.cimh.edu.bb/>

* **CCORAL** - The Caribbean Climate Online Risk and Adaptation Tool - is an online support system for climate resilient decision making. It helps users undertake quick screening, understand climate influence, apply climate risk management process and find tools in CCORAL toolbox.

<http://ccoral.caribbeanclimate.bz/about>

* **CCCCC** **(5 C’s)**: The Caribbean Community Climate Change Centre coordinates the Caribbean region’s response to climate change, working on effective solutions and projects to combat the environmental impacts of climate change and global warming. It provides climate change-related policy advice and guidelines to the Caribbean Community (CARICOM) Member States through the CARICOM Secretariat and to the UK Caribbean Overseas Territories and is an archive and clearing house for regional climate change data and documentation.

<http://www.caribbeanclimate.bz/>

<http://clearinghouse.caribbeanclimate.bz/>

**Other Useful Tools and Technical Guidance**

* **WHO Technical Guidelines in Emergencies:** This section of the Health Action in Crises web pages contains technical information for crises and crises management, useful templates and training information, as well as tools to facilitate work in the field.

<http://www.who.int/hac/techguidance/en/>

* **US Climate Resilience Toolkit – Human Health:** The U.S. Climate Resilience Toolkit provides scientific tools, information, and expertise to help people manage their climate-related risks and opportunities, and improve their resilience to extreme events. The site is designed to serve interested citizens, communities, businesses, resource managers, planners, and policy leaders at all levels of government.

<https://toolkit.climate.gov/>

* **US Climate and Health Assessment - The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment:** This assessment provides ‘a comprehensive, evidence-based, and, where possible, quantitative estimation of observed and projected climate change related health impacts in the United States. The Assessment has been developed to inform public health officials, urban and disaster response planners, decision makers, and other stakeholders within and outside of government who are interested in better understanding the risks climate change presents to human health.’ Its methodology is comprehensively described and can be used as guidance in conducting a new assessment.

<https://health2016.globalchange.gov/>

**BOX 7: Useful Resources (continued)**

* **GIS Climate Change Scenarios – Climate Inspector:** The Climate Inspector is an interactive web application which expands GIS mapping and graphing capabilities to visualize possible temperature and precipitation changes throughout the 21st century. The maps and graphs are generated from a large dataset of climate simulations by the NCAR Community Climate System Model (CCSM4). These simulations were prepared for the 5th Assessment Report of the Intergovernmental Panel on Climate Change.

<https://gisclimatechange.ucar.edu/inspector>

* **CanVis:**This software gives users an opportunity to modify maps and photos of a campus or facility to visualize impacts of projected sea level rise. This downloadable photo-editing program gives users the power to generate “after” pictures illustrating possible futures.

<http://toolkit.climate.gov/tool/canvis>

<https://coast.noaa.gov/digitalcoast/tools/canvis>

* **Checklists for Sustainable and Climate-Resilient Health Facilities:** This Toolkit contains a set of introductory checklists for each of the five elements of climate resilience. These checklists can assist health care organizations in assessing climate-related infrastructure and care-delivery vulnerabilities at both a system and facility level.

<https://toolkit.climate.gov/topics/human-health/building-climate-resilience-health-sector>

# Step 3: Project Future Health Risks

**Step 3: Overview**

This step requires consideration of how the current magnitude and pattern of climate-sensitive health burdens could change in a changing climate. For this step, build on information that was collected in Step 2c (refer to the Estimating Current Relationships template).

**Step 3a: Review Qualitative and Quantitative Information**

Explore datasets, department documents, peer-reviewed publications, and internet sources to identify relevant information. Collect information to answer questions about future health burdens from climate change such as: how could climate change affect the spread of vector-borne diseases or the frequency, intensity, and duration of future heat events? When information from the aforementioned sources is unavailable, seek insight from experts.

**Step 3b: Describe Current Health Risks and How They are Expected to Change Without Climate Change**

Explore datasets to determine current health hazards irrespective of climate change. Social determinants of health that may also have an influence on climate-sensitive health outcomes, such as changes in demographics, socio-economic development, poverty, or urbanization should be analyzed to be able to avoid bias and better estimate the impact of climate change on health risks against a backdrop of other risk drivers.

**Step 3c: Describe How Current Risks Could Change Under Different Weather and Development Patterns**

Determine the time frame for projecting future health risks. Confidence in climate projections over the next few decades (up to 2040’s) is greatest.

To project future health risks, a common approach is to multiply current exposure-response relationships by the projected change in the relevant weather variable(s) over the time periods of interest. This approach assumes that current vulnerability will remain the same over the coming decade, which is unlikely. Vulnerability is expected to change as socio-economic and environmental factors change over time. Consider also how weather affects how climate-sensitive health risks evolve. Aim to estimate how morbidity and mortality of health outcomes could be altered by: (1) development patterns alone, (2) climate change alone, and (3) climate and development.

Use the following approaches to obtain relevant information:

* Work with modeling experts to obtain quantitative projections of health risks. Experience has shown that these experts should be included early on in the assessment process to be able to outline data needs.
* Host an expert meeting with the goal of describing several possible development pathways over the next few decades, taking into consideration planned changes in policies and programs.
* Use local and regional climate projections from available sources. Scenarios can be created that combine development pathways with climate change projections to facilitate projections that cover a wider range of possible futures.
* Use a qualitative approach, through expert interviews and facilitated discussions, to estimate health risks in the next few decades.

Use Template 3C  
Project Future Health Risks

The projected risks will have several sources of uncertainty. Describe climate uncertainties in the assessment report and the extent to which they could influence projected health risks.

**BOX 8: Caribbean Institute for Meteorology and Hydrology - The WMO Caribbean Regional Climate Centre**

As the World Meteorological Organization (WMO) Regional Climate Centre (RCC) for the Caribbean, the CIMH produces regional climate products and services, including long-range (seasonal) forecasts in support of regional and national climate information needs. As of 2015, the Institute is actively working on an emerging health and climate portfolio in collaboration with regional health partners such as the Caribbean Public Health Agency (CARPHA) and the Pan-American Health Organization (PAHO). Recent efforts include: (1) fundamental research towards the development of a heat early warning product, (2) applied research towards the development of a modelling framework to provide spatio-temporal probabilistic forecasts of *Aedes aegypti* proliferation, and (3) the development of a new quarterly Caribbean Health-Climatic Bulletin.

*Heat extremes research*

Extreme heat has been recognised as a serious public health hazard in many parts of the world. In the Caribbean, motivation exists to implement preparedness measures in order to reduce the public health impact of heat waves. However, there are significant gaps in knowledge about the occurrence and impacts of heat waves needed to underpin such policy measures. Ongoing work is investigating the climatology and variability of heat wave indicators; developing a seasonal forecasting model for extreme heat; and validating seasonal forecasts of heat wave indicators for the region.

*Vector proliferation research*

Seasonal climate forecasts provide an opportunity to anticipate climate conditions conducive to yellow fever, dengue fever, chikungunya and Zika epidemics several months in advance. The CIMH in collaboration with regional health organisations and international research institutions are working towards developing and/or modifying statistical models for describing, simulating and predicting spatial patterns of *Aedes aegypti* populations associated with climate variability patterns. At a given point in time, the statistical models should provide an outlook of the spatial and temporal distributions of populations of *Aedes aegypti* for up to three months with a zero month lead time, using information on the climatic conditions for the Caribbean. The outputs of the models are expected to provide user-friendly maps that can be used for vector surveillance and control.

*Caribbean Health-Climatic Bulletin*

The new Caribbean Health-Climatic Bulletin is a joint effort with regional health partners CARPHA and PAHO. The Bulletin seeks to provide a broad overview of climate conditions and communicate health-climatic implications up to 6 months in advance. A prototype of the Bulletin was first developed in April 2016 and has undergone extensive testing with regional and national level health stakeholders. The official launch of the operational Bulletin is scheduled for June 2017.

For more information see[http://rcc.cimh.edu.bb](http://www.cimh.edu.bb/?p=home)

**BOX 9: Applying a risk matrix exercise to estimate future climate risks to health in Dominica**

When modeling results are not complete or lacking information, a qualitative risk analysis using a risk matrix with stakeholders may provide valuable local information to estimate future climate risks to health. The information presented here provides a simplified example of a risk matrix exercise that was undertaken during the Dominica V&A Assessment:

1. **Projection**: **A 2**°**C increase in temperature coupled with a decrease in precipitation by 40% by the year 2100.**
2. **Question**: Considering the above climate projection, what is the ***strength of link*** between [climate linked health hazard] and climate change in Dominica? What is the ***severity of impacts*** from [climate linked health hazard] to Dominican society under the presented climate projection?
3. **Instructions:** Please mark your answer with an “**X**” in the risk matrix below

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Strength of Link to Climate Change in Dominica | **Extreme** |  |  |  |  |
| **High** |  |  |  |  |
| **Medium** |  |  |  |  |
| **Low** |  |  |  |  |
|  | **Low** | **Medium** | **High** | **Extreme** |
| Severity of Impacts to Dominican Society | | | | |

*Note: response rates may be low when the exercise is distributed via mail. In-person administration in addition to electronic distribution may increase response rates*.

Source: Verret et al. 2016

# Step 4: Identify and Prioritize Policies and Programs to Manage the Additional Health Risks Associated with a Changing Climate

**Step 4: Overview**

The purpose of this step is to identify and recommend options to modify current policies and programs. It involves prioritizing options and developing timelines for implementation. Examples of adaptation options include:

* Strengthening primary health care services and environmental health services
* Strengthening early warning systems, disaster risk management and integrated disease surveillance programs
* Mainstreaming climate change into health policies and programs
* Improving infrastructure and including climate change and health considerations into built environment initiatives

**Step 4a: Review Qualitative and Quantitative Information**

Build on step 2e (and the Effectiveness of Policies and Programs template) by collecting information that can be used to identify needed modifications to current policies and programs and new actions to manage climate related health risks. Build on current policies and programs to prepare for future or emerging risks. Collect information by:

Use Template 4A Sources for Identifying Adaptation Options

* Holding discussions through workshops, interviews, or community meetings with health authorities, scientists, practitioners, and stakeholders and officials outside the health sector about the adaptations they have implemented, their effectiveness and possible new actions.
* Conducting a literature review (e.g. peer-reviewed publications, grey literature and other sources) to identify promising adaptation options.

**Step 4b: Inventory Options to Improve the Effectiveness of Current Policies and Programs or to Implement New Ones to Manage the Health Risks of Climate Variability and Change**

Use the information collected from Step 4a to develop an adaptation inventory listing all options regardless of the resource (cost, staff, time) requirements. Include potential adaptations within and outside the health sector.

Use Template 4B Adaptation Options Inventory

When developing the list, include key stakeholders that need to be engaged. For example, when considering strategies to reduce risks from frequent heavy precipitation events, representatives from the environment agency should be involved.

**BOX 10: ADAPTATION OPTIONS TO REDUCE RISKS TO HEALTH FROM CLIMATE CHANGE IN DOMINICA**

The assessment report "Assessment of Climate Change and Health Vulnerability and Adaptation in Dominica" (2016) identified a number of potential adaptation options to protect people from the health risks of concern (e.g. infectious diseases, waterborne diseases, extreme weather events, food safety and security). Examples included:

**Near-term Options**

* Strengthen solid waste management services across the island
* Enhance enforcement of existing legislation on waste management, vector control and food safety
* Increase public awareness of health risks associated with climate change and encourage public involvement in adaptation efforts, with a particular focus on the engagement of unemployed youth
* Provide training to health sector staff on the health impacts from climate change and how to reduce risks
* Improve the reliability and safety of water storage practices at community and household levels
* Improve data collection methods and enhance environmental monitoring
* Enhance the integration of climate services into health decision-making
* Strengthen the organizational structure of emergency response and ensure workers are familiar with emergency plans

**Long-term Options**

* Develop early warning systems for climate-sensitive health risks utilizing forecast information from the Caribbean Institute for Meteorology and Hydrology
* Develop a national electronic database for health, vector, water, weather and climate data that is accessible by all relevant stakeholders
* Conduct routine analyses of weather, vector and epidemiologic data and distribute findings in a bulletin to relevant stakeholders
* Hold community meetings to increase awareness of protective behaviors through coordination among village councils, the EHD and health centers
* Convert current paper-based data collection systems to electronic systems
* Increase the capacity of laboratory facilities to detect disease-causing pathogens in humans, animals and plants
* Increase the climate-resiliency of health facilities and farm infrastructure

Source: Verret et al. 2016

**Step 4c: Prioritize Short and Long-Term Options and Develop Resource Needs**

Identify which policies and programs are possible to implement now and in the future, based on existing resource constraints (technological, human, and financial). Generate a priority list of options from which policymakers can choose.

Use one or more prioritization approaches to identify when options should be implemented. Ensure that criteria used to identify the priorities are explicitly described. Examples of criteria for prioritizing options include:

Use Template 4C Prioritize Options and Develop Resource Needs

1. Is the option technically feasible?
2. Is the option effective in reducing health risks?
3. Does the option have positive or negative consequences? If so, consider how best to monitor consequences and potential corrective actions. The best options reduce negative health outcomes and improve the natural and built environment.
4. Are adequate financial resources available for implementing and sustaining the option?
5. Is the option socially acceptable?
6. Does the option contribute to the reduction of greenhouse gases?
7. Does the option focus on impacts associated with a narrow range of future scenarios, or does it allow for flexibility in response?

Key considerations when prioritizing options are the current morbidity and mortality from the health outcome of concern, projections of future health impacts and how well risks are managed with current policies and programs.

**Step 4d: Assess Possible Constraints to Implementing Options and How to Overcome Them**

For each priority adaptation option, list possible constraints or barriers to implementing it by considering the following:

* Technological, human, and financial resources required for implementation
* Expected time frame for implementation
* Other possible implementation requirements

Differentiate constraints (i.e. those which can be overcome) from limits (i.e. no adaptation option is possible or available options are too difficult or expensive to implement). Working with officials from other sectors can help overcome adaptation barriers. Include these officials in discussions about adaptation constraints to identify non-health sector opportunities to move forward with the priority adaptation options, thereby reducing risks from climate change.

Use Template 4D Possible Constraints

**Step 4e: Develop an Adaptation Plan that Integrates Climate Change Adaptation into Existing Health-Related Planning Processes**

The information generated in previous steps should be synthesized to develop a climate change and health adaptation plan that considers shorter and longer time scales, and that facilitates coordination and collaboration with other sectors to promote resilience and reduces risks to health. The adaptation plan does not have to be extensive, but should provide sufficient information so that those not involved in its development can understand it and use it to implement the recommended actions.

The plan should link with initiatives to address the risks of climate change in other sectors, and include specific goals and the time frame over which key actions will be accomplished. Depending on the context, the plan may include:

* Objectives
* Expected results
* Milestones
* Sequencing of activities based on priorities and timescale of potential impacts
* Clear responsibilities for implementation
* Required human and financial resources
* Costs and benefits of interventions
* Financing options

The plan should promote coordination and synergies with city and regional goals and actions, particularly those presented in other climate change adaptation plans. Including someone with knowledge of such plans or actions on the project team would be an effective approach to making these linkages. Emphasis should be placed on outlining what is needed to implement priority short-term adaptation options. The PAHO Strategy and Plan of Action on Climate Change may be consulted as a model, but should be altered to take into account local needs.

# Step 5: Establish an Iterative Process for Managing and Monitoring Health Risks

**Step 5: Overview**

As the climate continues to change, it is important to proactively manage and monitor changes in risks to health. Develop an iterative process for managing and monitoring health risks from climate change which involves:

* Identifying a lead agency to coordinate monitor reporting
* Recommending when the V&A assessment should be reviewed or repeated to examine how risks are changing or to identify new ones
* Monitoring changes in the geographic range of health outcomes
* Consulting with partners and stakeholders
* Advising and communicating changing risks to policy and decision-makers

**Step 5a: Develop a Monitoring Plan**

Develop a plan for monitoring the burden of health outcomes, changing exposures, and the effectiveness of implemented adaptation options. Public health resilience should increase with effective adaptation. However, health burdens could increase if climate conditions create new or exacerbate existing risks, or if implemented adaptation measures are not balanced against the severity and magnitude of these risks. Therefore, it is essential to create a plan for monitoring changing risks and exposures that affect public health. A monitoring plan should include:

Use Template 5A Monitoring Plan

* What will be monitored (e.g. changing risks or changing exposures to climate conditions)
* Frequency of monitoring
* Methods of data analysis and collection
* Milestones for evaluation
* Recommended adaptation modifications
* Communication protocol to ensure appropriate and timely adjustments to the adaptation options

When completed, insert the monitoring plan into the adaptation plan (Step 4e). This step aligns with the baseline developed in Step 2g for comparing how morbidity and mortality of climate-sensitive health outcomes change over time.

**Step 5b: Develop Indicators for Monitoring**

A set of minimum indicators related to the health impacts of concern should be agreed upon. These indicators must be appropriate and effective for measuring changes in vulnerability and exposures, as well as the degree of success of health adaptation activities. Work with stakeholders to select appropriate indicators. Select indicators that enable the quantification of health burdens over time and space and that include qualitative metrics of the effectiveness of adaptation processes. Categorize indicators into themes if helpful, for example, by health hazard or by key characteristics of vulnerability. Steps 1a (Priority Health Hazards template), 1d (Information Sources template) and 2d (Vulnerability Indicators template) provide examples of indicators that can be used for monitoring adaptation effectiveness. Refer to the Monitoring Indicators template which compiles these indicators. When indicators for monitoring are decided upon, include them in the monitoring plan. Box 11 shows example indicators for measuring the effectiveness of a heat alert system.

Use Template 5B Monitoring Indicators

**Step 5c: Identify and Share Lessons Learned and Best Practices**

Establish a communications strategy to continually inform policy and decision-makers on the results of the monitoring and evaluation work, and flag rising vulnerabilities or changes in exposures. Inform policymakers of study limitations and uncertainties (such as lack of specific data, or difficulties in involving stakeholders from different sectors). Document lessons learned from implementing adaptations and monitoring adaptation success or shortcomings. Share information to support health authorities as they build adaptive capacity at national levels. The strategy could include the creation of a key climate and health working group or sounding board that includes technical experts as well as policy level actors.

**BOX 11: EXAMPLES OF INDICATORS FOR MEASURING THE EFFECTIVENESS OF A HEAT ALERT AND RESPONSE SYSTEMS**

The effectiveness of Heat Alert and Response Systems (HARS) in reducing risks from extreme heat events relies on regular evaluation of the systems. The Health Canada report "Heat Alert and Response Systems to Protect Health: Best Practices Guidebook" (2012) presents the following HARS evaluation questions and potential indicators that can be used by public health officials.



Source: Health Canada, 2012

# Step 6: Examine the Potential Health Benefits and Co-Harms of Adaptation and Mitigation Options Implemented in Other Sectors

**Step 6: Overview**

Policy and management decisions, including adaptation and mitigation efforts in other health determining sectors, such as water and agriculture, can have cascading impacts on health that are sometimes unintended but may be significant. It is important that public health officials engage with other sectors to identify intentional and unintentional health consequences, and work together to minimize risks and maximize possible health gains.

**Step 6a: Review Adaptation and Mitigation Options Proposed or Implemented in Other Sectors**

Climate change adaptation and greenhouse gas mitigation options implemented in other sectors can affect public health. Collaborative efforts to address vulnerabilities to a changing climate can promote resilience in health and other sectors simultaneously. Identify proposed and/or implemented adaptation and mitigation strategies and policies in other sectors that may affect health by:

* Engaging with other sectors
* Engaging with local or regional climate change programs
* Arranging for an expert evaluation of the human health implications of policies and programs proposed or implemented in other sectors
* Identify possible adjustments in these strategies that could promote health

Health effects from adaptation and mitigation efforts in other sectors are generally unintended and can range from non-existent to highly significant. For example, changes to industrial processes to reduce carbon dioxide emissions have the potential for human exposures to potentially hazardous materials depending on the technology, the chemicals or other agents involved, and how they are implemented. Changes in water conservation practices can potentially cause resurgence of diseases or create vector breeding sites. It is therefore imperative that other sectors take into consideration potential health impacts.

Use Template 6A Health Benefits and Co-Harms of Adaptation and Mitigation Options

**Step 6b: Identify Synergies for Adaptation and Greenhouse Gas Mitigation Options**

Greenhouse gas mitigation is a primary prevention health measure that is required and advocated by public health officials to reduce climate change and health risks. There are many examples of actions that mitigate GHG emissions and that also increase resilience to future climate-related health risks, such as, planting trees, buying local food, and installing green roofs. Health co-benefits can be achieved by green roofing which has multiple environmental benefits, such as cooling indoor and ambient environments and storm water management. As well, pedestrian injuries and deaths and traffic accidents can be reduced through efforts to reduce GHGs by implementation of active transportation measures (e.g., walking and bicycle paths).

Use Template 6B Synergies for Adaptation and Mitigation Options

Refer to the Synergies for Adaptation and Mitigation Options template to document relevant information.

**BOX 12: MEASURING THE ECONOMIC COST OF CLIMATE CHANGE ON HEALTH IN THE CARIBBEAN**

Taking action to reduce risks to health from climate change not only benefits human well-being, but also improves a country's economy. Governments should take into account the costs associated with treatment or prevention of emerging diseases, as well as the additional costs brought about by changing disease incidences under different climate change scenarios. Such costs include the cost of human suffering, as well as the productivity losses associated with the number of cases of ill health or the number of deaths.

A thorough vulnerability and adaptation assessment should aim to quantify the direct and indirect costs associated with diseases of high priority, which would allow for the ranking of adaptation strategies according to affordability and urgency. For example, a study by the United Nations Economic Commission for Latin America and the Caribbean (UNECLAC, 2013) used decadal disease forecasts to estimate treatment and prevention costs for diseases in the Caribbean. They included costs associated with treating or preventing the number of forecast cases, but not the costs of practical, technical and managerial resources that would be required to implement these measures.

The estimated direct and indirect costs of climate change to the Caribbean health sector under A2 and B2 climate scenarios are presented in the figure below. This study offers a good example of how cost-benefit analyses can be performed in the context of climate change and health, however the authors warn that policy makers should also take into account adaptation activities taking place in other sectors that may positively or negatively impact health.



Source: UNECLAC, 2013

# Bibliography

**CDC** Chikungunya in the Caribbean [Online] // Center for Disease Control and Prevention. - http://wwwnc.cdc.gov/travel/notices/watch/chikungunya-caribbean.

**CDEMA** Tropical Storm Erika - Situation Report No. 12 [Report]. - 28 September 2015.

**Ebi KL, Lewis ND and Corvalan C** Climate variability and change and their potential health effects in small island states: information for adaptation planning in the health sector [Journal] // Environmental Health Perspectives. - 2006. - pp. 1957-1963.

**ECDC** Rapid Risk Assessment: Chikungunya outbreak in Caribbean region [Report]. - Stockholm : ECDC, 2014.

**IFRC** Operations Update No. 2 Dominica Tropical Storm Erika [Report]. - 21 January 2016.

**IPCC** IPCC Fourth Assessment Report: Climate Change [Journal]. - 2007.

**IPCC** Summary for Policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability [Report]. - Cambridge, UK and New York, NY USA : Cambridge University Press, 2014.

**Khan K [et al.]** Assessing the Origin of and Potential for International Spread of Chikungunya Virus from the Caribbean [Report]. - [s.l.] : PLOS Current Outbreaks, 2014.

**Lau W K M [et al.]** What would happen to Superstorm Sandy under the influence of a substantially warmer Atlantic Ocean? [Journal] // Geophysical Research Letters. - [s.l.] : Geophysical Research, 2016. - Vol. 43.

**Luber G and Lemery J** Global Climate Change and Human Health - From Science to Practice [Book]. - San Francisco : Jossey Bass, 2015.

**Nurse LA [et al.]** Small islands. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. [Report]. - Cambridge, UK and New York, NY USA : Cambridge University Press, 2014. - pp. 1613-1654.

**PAHO** Epidemiological Alert Chikungunya and dengue feverin the Americas [Report]. - 29 August 2014.

**PAHO** Health Response Dominica - Tropical Storm Erika - Situation Report No. 6 [Report]. - [s.l.] : PAHO/WHO, 8 September 2015.

**Simpson MC [et al.]** CARIBSAVE Climate Change Risk Atlas (CCCRA) [Report]. - Barbados, West Indies : DFID, AusAID and The CARIBSAVE Parntership, 2012.

**Solomon S [et al.]** Climate Change 2007: The Physical Science Basis Contribution of WGI to AR4 Report of the IPCC [Report]. - Cambridge, UK and New York, NY USA : Cambridge University Press, 2007. - https://www.ipcc.ch/publications\_and\_data/ar4/wg1/en/ch11s11-9-1.html.

**Taylor M A [et al.]** Climate Change and the Caribbean: Review and Response [Journal] // Caribbean Studies. - 2012. - 2 : Vol. 40. - pp. 169-200.

**UNECLAC** An assessment of the economic and social impacts of climate change on the health sector in the Caribbean [Report]. - [s.l.] : United Nations Economic Commission for Latin America and the Caribbean, 2013.

**Verret M [et al.]** Assessment of Climate Change and Health Vulnerability and Adaptation in Dominica [Report]. -Dominica, East Indies: Government of the Commonwealth of Dominica, 2016.

**WHO** Chikungunya in the French part of the Caribbean isle of Saint Martin [Online] // Emergencies preparedness, response. - December 10, 2013. - April 20, 2016. - http://www.who.int/csr/don/2013\_12\_10a/en/.

**WHO** Protecting health from climate change: Vulnerability and adaptation assessment [Report]. - Geneva : World Health Organization, 2013.

# ANNEX I: Vulnerable Populations

|  |  |  |
| --- | --- | --- |
| Populations vulnerable to the health impacts of climate change in the Caribbean | | |
| Vulnerability due to: | **Vulnerable groups:** | **Vulnerability factors (examples):** |
| Demographic factors | * Proportion of children * Proportion of women * Proportion of elderly people * Population density | * Children (<5 years old) are disproportionately affected by foodborne diseases * Women at increased exposure to foodborne diseases (e.g. food preparation) * Elderly are more sensitive to diseases and may suffer increased morbidity and mortality |
| Health status | * Immunocompromised populations (e.g. those who are HIV positive) * Undernourished or malnourished populations * Populations with infectious disease burden * Populations with chronic disease burden * Mentally or physically disabled people | * Immunocompromised populations at higher risk of developing more severe disease leading to increased morbidity and mortality * Malnourished groups more sensitive to foodborne diseases which can worsen state of malnourishment * Persons with chronic diseases may be more sensitive to extreme temperatures, or susceptible to new infections * Mentally or physically disabled persons may be unable to care for themselves during extreme events and have less adaptive capacity |
| Culture or life condition | * Impoverished and those of low socio-economic standing * Squatters and migrants living in “Shanty Towns” * Ethnic minorities and indigenous communities (e.g. Kalinago in Dominica) * Subsistence farmers and fisher folk * Indentured laborers * Homebound individuals | * Impoverished have limited purchasing power to access imported food; are more likely to store water incorrectly, increasing breeding sites for disease vectors, raising the risk for waterborne diseases; lack of access to improved sanitation * “Shanty Town” residents living in poor housing conditions have increased exposure to vectors; diseases linked to sanitation * Ethnic minorities in the Caribbean generally have a higher poverty rate, increasing their exposure risk to climate hazards * Farmers may have increased risk to vector-borne diseases due to agricultural water storage practices; and their existence heavily depends on rainfall and other climatic factors |
| Limited access to adequate resources and services | * Unplanned urban housing * Flood risk zones * Drought risk zones * Coastal storm and hurricane risk zones * Water-stressed zones * Food-insecure zones * Urban, remote, rural areas | * Populations living in urban areas that are unplanned may be more at risk of property loss due to hurricanes; exposed during heat waves * Populations living in natural hazard risk zones are more likely to suffer direct injury or suffer property loss and damages |
| Limited access to adequate | * Health care * Potable water * Sanitation * Education * Shelter * Economic opportunities | * Limited access to healthcare can exacerbate existing disease burdens; climate related health hazards may put increased stress on weakened health systems * Limited access to clean water and sanitation can increase the risk of waterborne diseases * Persons living in inadequate shelter are directly exposed to climate hazards and have decreased adaptive capacity * Uneducated individuals may have decreased awareness of health protection measures (in the context of climate change) |
| Sociopolitical conditions | * Political stability * Existence of complex emergencies or conflict * Freedom of speech and information * Types of civil rights and civil society | * Sociopolitical conditions may hamper preparedness measures for populations to protect themselves from climate related health hazards * Conflict may result in decreased food security, increased poverty, infrastructure loss |

*Table adapted from WHO, 2013 and Verret et al., 2016*

# ANNEX II: Assessment Limitations & Solutions

**Common challenges and possible solutions in conducting an assessment – experiences from Dominica**

|  |
| --- |
| Limitations |
| Resources may be limited to model all priority health areas, even though data may be available.  Solution: budget in modeling consultant during project design |
| Poor response rate for adaptive capacity survey and risk matrix exercise  Solution: send these electronically before being in-country, and then administer them in person until desired sample sizes are reached |
| Adaptation options may not be ranked according to criteria during focus groups  Solution: use a developed PowerPoint tool to organize and rank adaptation options |
| Difficulties |
| Data: Existence of paper-based data in Dominica presented a challenge (e.g. food safety surveillance data, health facility data, etc. Anticipate this when conducting assessments and plan for computerization of data or, more likely, how to address gap through qualitative research). |
| Data: Limited time periods (not all data available for long time periods, limiting potential for modeling work and historical analysis). |
| Data: Formal requests required to access some sources. (Suggest that researcher establishes preliminary list of required data sets early on in assessment so that in-country lead submits required formal request before researcher arrives in-country. Can then plan to address anticipated quantitative data gaps with qualitative research in-country). |
| Research Team (Resources permitting, it may be advantageous to have at least two consultants travel in-country to coordinate and lead activities. Guiding discussions and collecting data simultaneously may be challenging). - |
| Workshop: consider using research assistants. (Assistants to take notes, record and guide discussions during breakout sessions may be useful in preventing the loss of valuable information). |
| Report Development: Preferred a single comprehensive report (depending on modes of data collection, different reporting structures may be used, e.g. breaking up a longer report into several shorter reports). |
| Successes |
| Desk review (very useful in guiding assessment. In-country officials enjoyed listening to findings during assessment launch). |
| Assessment Launch (good for building local enthusiasm and providing a positive start to the assessment). |
| Expert advisory group (allows for strong expertise provision by members throughout assessment process. |
| Enthusiasm and Availability of In-Country Lead (Main lead was available to coordinate and attend interviews and in-country activities with consultant which was essential). |
| Involvement of Modelers (Pro bono modeling work was completed for the Dominica V&A, during the second half of the assessment. Resources permitting, modeling experts should be included early on in assessment to guide data collection). |
| Workshop (Useful for informing local officials, raise awareness and gather important qualitative data). |

# ANNEX III: Assessment Checklist

**Step 1: Frame and Scope the Assessment**

* Specify timeframe and resources
* Identify priority climate risks and health outcomes and decide which to include in the study
* Specify which future time period to assess for associated risks and adaptation needs
* Identify a project team that will manage the entire process
  + Create a project team with relevant expertise, preferably from both, the climate, and health sectors
* Identify available information to inform the assessment
* Identify additional resource persons with targeted expertise on specific topics
* Conduct interviews with stakeholders to obtain information as needed on specific topics
* Develop a communication plan for informing stakeholders of results and progress
* Consult with communication experts to discuss how to present the results to the public
* Develop a work plan

**Step 2: Describe Current Risks – Exposures, Vulnerabilities and Capacities**

* Compile available qualitative & quantitative information, including available tools for monitoring and evaluation
* Describe historical trends for environmental hazards of interest and establish baseline conditions
* Analyze current relationships between weather patterns and climate-sensitive health outcomes
* Characterize current vulnerability of exposed individuals and communities
* Describe and assess effectiveness of policies & programs
* Evaluate Disaster and Emergency Preparedness of the Health System, and Consider Health Infrastructure Adaptive Capacity and Resilience
* Develop an explicit baseline for use in monitoring future vulnerability and for evaluating adaptation options

**Step 3: Project Future Health Risks**

* Define time frame for projecting future risks (2020’s, 2050’s, 2080’s)
* Describe current health risks and how they are expected to change without climate change
* Consider how weather and development patterns could affect future climate-sensitive health risk

**Step 4: Identify and Prioritize Policies and Programs to Manage the Additional Health Risks Associated with a Changing Climate**

* Create an inventory of the policies and programs and identify options for possible modification
* Recommend options to be implemented to help manage the health risks of climate change:
  + Improving climate and health data collection
  + Strengthening integrated disease surveillance programs
  + Strengthening environmental health services
  + Strengthening early warning and disaster risk management
  + Mainstreaming climate change into public health policy
  + Strengthening primary health care service
  + Improving infrastructure
  + Improving built environment (e.g. plant trees, improve urban landscape)
* Prioritize options to identify time scale for implementation (short and long term)
* Identify possible new efforts to manage additional health risks from climate variability and change
* Consult with health authorities in other jurisdictions, sectors, scientists, practitioners and other stakeholders within and outside the health sector
* Identify all possible measures that could be implemented regardless of technical feasibility, cost, or other limiting criteria
* Identify possible policies and programs to implement over a particular time period, within existing technological, human and financial resource constraints. Screening criteria could include:
  + Whether the option is technically feasible
  + The degree of effectiveness of the proposed measure in reducing morbidity and mortality
  + What consequences might be associated with the option
  + Whether there is the financial capacity to implement and maintain option
  + Whether the proposed option is socially acceptable
* Prioritize which options to implement over the short and medium term
* Create two sets of priorities: critical policies and programs that should be implemented now; and those that are important but can wait a few years before implementation
* Assess possible constraints to implementing options and how to overcome them
* Develop a climate change and health adaptation plan that:
  + Defines action that will be taken in shorter and longer time scales
  + Facilitates coordination and collaboration with other sectors to promote resilience
  + Specifies overarching strategies (e.g. climate change strategies in other sectors)
  + Specifies goals and the timeframe of accomplishments
  + Outlines expected results, milestones, sequencing of activities
  + Outlines roles and responsibilities for implementation
  + Outlines required human and financial resources required to implement plan
  + Provides analysis of costs and benefits of interventions and financing options
  + Promotes coordination and synergies between the implementation plan and city and provincial goals

**Step 5: Establish an Iterative Process for Managing and Monitoring Health Risks**

* Develop a plan for monitoring the burden of health outcomes and effectiveness of adaptations with robust indicators
* Identify an agreed set of minimum indicators to track health outcomes and adaptation progress
* Identify what will be monitored, how frequently and how data will be analyzed and communicated
* Indicate when the V&A assessment should be repeated to identify new risks
* Specify milestones for evaluation
* Document lessons learned and share these with partners and stakeholders and more broadly

**Step 6: Examine the Potential Health Benefits and Co-Harms of Adaptation and Mitigation Options Implemented in Other Sectors**

* Review Adaptation and Mitigation Options Implemented/Proposed in Other Sectors
* Identify Synergies for Adaptation and Mitigation Options

# ANNEX IV: Assessment Templates

Templates to help organize and structure the assessment process, as well as gather data and information can be found in the following pages. Each template corresponds to one of the six assessment steps. It is not necessary to use the templates in sequential order, even though that is how they are presented here. Furthermore, not all assessment steps have templates for each sub-step. The indicators and categories that are pre-filled into the template worksheets serve as examples and can be altered according to national contexts.

**Step 1 Templates:** Step 1a: Priority Health Hazards

Step 1b: Project Team

Step 1c: Work Plan

Step 1d: Information Sources

Step 1e: Communication Plan

**Step 2 Templates:** Step 2b: Estimating Current Relationships between Weather Patterns and Climate-Sensitive Health Outcomes

Step 2d: Vulnerability Indicators

Step 2e: Effectiveness of Policies and Programs

**Step 3 Templates:** Step 3b: Project Future Health Risks

**Step 4 Templates:** Step 4a: Sources for Identifying Adaptation Options

Step 4b: Adaptation Options Inventory

Step 4c: Prioritize Options and Develop Resource Needs

Step 4d: Possible Constraints

**Step 5 Templates:** Step 5a: Monitoring Plan

Step 5b: Monitoring Indicators

**Step 6 Templates:** Step 6a: Health Benefits and Co-Harms

Step 6b: Synergies for Adaptation and Mitigation Options

## Step 1a: Priority Health Hazards

Use this template to compile preliminary information on climate change health outcomes and climate-related hazards in order to identify which should be a priority for the assessment. The template lists examples of climate and health outcome indicators to assist you in this step. You may have more or different hazards and indicators to include. Use the template to document data and information related to each health outcome and knowledge gaps of interest to help in prioritization. Provide information on morbidity and mortality in your jurisdiction from climate hazards. When compiling this information, pose the following questions to help prioritize health concerns:

* What are the priority climate-sensitive health outcomes of concern in the study area?
* Which climate-sensitive health outcomes are of greatest concern for stakeholders and the public?
* Did recent extreme weather and climate events raise concerns about health risks such as heat events or floods?
* Were recent assessments conducted in the region in other sectors that highlight issues affecting health?
* Are neighboring health jurisdictions also conducting a health vulnerability and adaptation assessment?

|  |  |  |  |
| --- | --- | --- | --- |
| **Health Hazard Examples** | **Indicator Examples** | **Data and Information** | **Knowledge Gaps** |
| Extreme precipitation (e.g., storms, hurricanes, floods) | Heat-related morbidity and mortality  Cold-related morbidity and mortality |  |  |
| Other extreme weather events (e.g. extreme heat, droughts) | Morbidity and mortality from extreme weather events (e.g. injuries, infections, mental health outcomes) |  |  |
| Air quality (aero-allergens, air pollution, Saharan dust, particulate matter and/or wildfire smoke) | Cardiovascular or respiratory health outcomes from aeroallergens or poor air quality |  |  |
| Food- and water-borne diseases | Illnesses or outbreaks due to food-, or water-borne diseases |  |  |
| Vector-borne diseases (Dengue, chikungunya, Zika, malaria)) | Dengue Virus incidence  Chikungunya incidence  Other vector-borne disease incidence |  |  |
| UV Exposure | Cases of sunburns, skin cancers, cataracts and eye damage |  |  |

## Step 1b: Project Team

Use this template to list project team members and other relevant information such as their area of responsibility (e.g. health departments managing the health outcome of interest, other sectors whose activities can affect the health outcome), expertise and/or whom they represent (individuals or organizations) and roles in the assessment.

When identifying potential project team members, include the following stakeholders, member types and considerations:

* Officials from local authorities whose activities can affect the burden and pattern of climate-sensitive health outcomes
* Representatives of health care providers who would diagnose and treat any identified cases
* Core members of the project team who stay for the entire project
* Ensure a high degree of stakeholder inclusivity while having a small enough team to direct the study most effectively
* Individuals that are working on issues relevant to the mandate of the assessment in other departments or organizations (e.g. experts in disease transmission, epidemiologists, vector control specialists, climate scientists, environmental officers)
* Communication experts to discuss how to present the results to the public in ways that empower appropriate behavioral adaptation actions
* Additional resource persons with targeted expertise on specific topics

|  |  |  |  |
| --- | --- | --- | --- |
| Project Team Member | Contact Information | Area of Expertise (e.g. health specialty, non-health specialty) | Roles and Responsibilities  (E.g. write report, conduct literature review, conduct statistical analysis, organize meetings and stakeholder workshops etc.) |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

## Step 1c: Work Plan

The work plan should specify the management plan, key responsibilities, activities, time line and resources needed for the assessment. Use this template to document key milestones or deliverables, deadlines, resources and key contacts for undertaking the assessment. The work plan also needs to consider the extent to which all steps in a vulnerability and adaptation assessment are necessary to achieve the desired results. Time and financial resources may call for a delay in implementing or removal of a particular step; this should be noted in the work plan. Adapt the work plan template to suit the specific information needs of the assessment.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Assessment Step | Milestone or Deliverable | Deadline | Resources | Lead or Key Contact |
| 1. Frame and Scope the Assessment |  |  |  |  |
| 1. Describe Current Risks Including Vulnerabilities and Capacities |  |  |  |  |
| 1. Project Future Health Risks |  |  |  |  |
| 1. Identify and Prioritize Policies and Programs to Manage the Additional Health Risks Associated with a Changing Climate |  |  |  |  |
| 1. Establish an Iterative Process for Managing and Monitoring Health Risks |  |  |  |  |
| 1. Examine Potential Health Benefits and Co-Harms of Adaptation and Mitigation Options Implemented in Other Sectors |  |  |  |  |



## Step 1d: Information Sources

Another activity to undertake during the scoping phase is to identify available and relevant information for the assessment. Sources of relevant information could include:

* Peer-reviewed literature – There are many publications on potential changes in health risks to vulnerable populations from climate hazards. Some of these include projections of changes in precipitation and temperature in the coming decades and maps on the current and projected ranges of the vectors that cause malaria, dengue, or Zika.
* Grey literature – Grey literature may describe the current burden of climate-sensitive diseases and management approaches for the health outcomes of concern. Regional level assessments that have been done for other sectors could provide valuable insight into climate exposures that impact health.
* Climate and weather data – This data may be obtained from environment agencies and can include changes in precipitation patterns and occurrences of drought.
* Community reports – These reports can provide information on a range of key vulnerability factors (e.g. relevant health reports and associated datasets).

Compile data sources into the Information Sources template.

|  |  |  |
| --- | --- | --- |
| **Health Hazard Examples** | **Indicators of Risk** | **Source** |
| **Extreme precipitation (e.g., storms, hurricanes, floods)** | * Maximum and minimum temperatures, heat index * Increase in heat alerts/warnings * Projected hot days and warm nights * Projected cold days * Excess mortality due to extreme heat * Excess morbidity due to extreme heat * Daily all-cause mortality (trends associated with heat) * Percent households without any air conditioning * Access to cooling centers * Percent households with central air conditioning * Number of heat wave early warning systems * Number of municipal heat island mitigation plans |  |
| **Other extreme weather events (e.g. extreme heat, droughts)** | * Historical precipitation intensity, duration and frequency patterns * Projected changes in precipitation * Historical frequency, severity, distribution, and duration of wildfires, flooding, droughts and tornadoes * Projected frequency, severity, distribution, and duration of wildfires, flooding, droughts and tornadoes * Incidence of injury/death from extreme events and diseases |  |
| **Air quality (aero-allergens, air pollution, Saharan dust, particulate matter and/or wildfire smoke)** | * Stagnation air mass events * Ground-level ozone estimates due to climate change * Saharan dust concentrations * Ozone and particulate matter concentrations and exceedance * Number of vehicle miles travelled/ Automobile use * Respiratory/allergic disease and mortality related to increased air pollution and pollens (ground-level ozone, fine particulate matter (PM2.5)). * Daily all-cause mortality (trends associated with air pollution) * Daily non-accidental mortality (trends associated with heat and air pollution) * Air quality monitoring capabilities * Government regulations aimed at improving air quality |  |
| **Food- and water-borne diseases** | * Food-borne diseases or outbreaks * Water-related diseases and infections (drinking and recreational water) * Food safety surveillance and control programs |  |
| **Vector-borne diseases (Dengue, chikungunya, Zika, malaria)** | * Dengue disease incidence in humans * Chikungunya incidence in humans * Zika incidence in humans * Malaria incidence in humans * Number of positive test results in reservoirs/sentinels/vectors * Vector-borne disease surveillance and control programs * Projected expansion of disease vectors * Number of vector management activities |  |
| **UV Exposure** | * Preventable deaths from skin cancer * Estimated number of excess hospital admissions due to climate hazard exposure |  |
| **Vulnerable populations** | * ≥ 65 years of age * ≥ 65 years of age living alone * Infants and young children * People with chronic illness/physically impaired (e.g. diabetes, cardiovascular or renal disease, nervous system disorders) * Socially disadvantaged individuals and communities * Newcomers * Relevant occupational groups (e.g. outdoor workers for heat-exposure sensitivity) * Physically active individuals * Smoking population * People suffering from food insecurities * Vulnerable populations (above) living in 100-and 500- year flood zones * Population by country within 5km of coast with “very high” vulnerability to sea level rise * Employment and unemployment rates * Below poverty line |  |

## Step 1e: Communication Plan

Developing a communication plan early in the process is important to ensure that the assessment is structured, from the beginning, to communicate identified risks effectively to those who will manage the risks and to those who could be affected. Use this template to specify the primary assessment output (e.g. report), to whom it will be communicated, mechanisms for sharing the results (e.g. webinars, workshops), and if outreach materials will be developed to communicate results.

|  |  |  |  |
| --- | --- | --- | --- |
| **Assessment Milestone or Event** | **Output / Outcome** | **Target Audience**  **(e.g. decision-makers, public)** | **Communication Mechanism**  **(e.g. webinar, outreach materials)** |
| 1. **Assessment Launch** |  |  |  |
| 1. **Assessment Awareness and Engagement** |  |  |  |
| 1. **Draft Report Release for Review** |  |  |  |
| 1. **Final Report Release** |  |  |  |
| 1. **Post Assessment Engagement** |  |  |  |



## Step 2c: Estimating Current Relationships between Weather Patterns and Climate-Sensitive Health Outcomes

Determine the associations (if any) between the exposures and the incidence, seasonality, and geographic range of the climate-sensitive health outcomes under consideration. The template below includes guiding questions and examples of key relationships that could be examined. In the last column of the template, indicate if the information is available and accessible. If it is not readily available or accessible, indicate how the data could be obtained (e.g. conduct a literature search, conduct interviews with subject matter experts). Experts can provide estimates of the impacts of extreme heat events on excess mortality or of heavy precipitation events on episodes of gastrointestinal diseases which can be used to describe exposure-response relationships. If interviews with experts will be conducted, identify key respondents who have carried out other assessments. Create survey questionnaires and keep track of the information collected in order to quickly reference and analyze the data.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Examples of Health Hazards** | **Examples of Guiding Questions** | **Indicators of Duration, Intensity, Frequency, Seasonality and Geographic Range for Hazard of Interest** | **Indicators of Mortality or Morbidity** | **Is this Information Available / Accessible? If so record this information. If not, how can it be obtained?** |
| Extreme precipitation (e.g., storms, hurricanes, floods) | * Is the population widely exposed to extreme heat or cold? If so which populations are exposed? * What is the incidence of heat- or cold-related illnesses or deaths? * Is there a particular seasonality that characterizes the heat- or cold related health outcomes? * What is the geographic range within which heat- or cold related health hazards pose health risks to individuals? * What is the current impact of \_\_\_\_\_\_\_ on morbidity and/or mortality? How does this vary with changes in duration, intensity and frequency of the hazard? | * Number of extreme heat and/or cold days * Number of extreme heat and/or cold events * Number of heat alerts called | * Number of heat or cold related hospital visits * Number of deaths attributable to heat or cold * Number of heat or cold-related illnesses |  |
| Air quality (aero-allergens, air pollution, Saharan dust, particulate matter and/or wildfire smoke) | * Is the population exposed to air pollution, aeroallergens or wildfire smoke? If so which populations are exposed? * What is the incidence of respiratory conditions attributable to air pollution, aeroallergens or wildfire smoke? * Are there certain times of the year when air pollution, aeroallergens and wildfire smoke pose the greatest human health risks? * What is the geographic range within which air pollution, aeroallergens and Saharan dust poses health risks to individuals? * What is the current impact of \_\_\_\_\_\_\_ on morbidity and/or mortality? How does this vary with changes in duration, intensity and frequency? | * Number of smog days * Number of high allergen days * Number of poor air quality days due to Saharan dust * Geographic range of poor air quality | * Number of hospital visits attributable to smog * Number of hospital visits due to exposure to wildfire smoke * Number of hospital visits attributable to allergies * Number of deaths attributable to poor air quality |  |

## Step 2d: Vulnerability Indicators

Use the template below to document information on the sensitivity and adaptive capacity of individuals and the community to climate-related health hazards. Many sensitivity and adaptive capacity indicators are relevant for all climate-related health hazards (i.e. provide an indication of vulnerability for all), while others are specific to one or more. Examples of indicators are provided in the template to help guide data collection. Data from these indicators will also be useful for monitoring adaptation success. See Step 5b: Monitoring Indicators Template.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Health Hazards** | **Elements of vulnerability** | **Examples of Indicators** | **Data Source** | **Method(s) of Verifying Efficacy and Appropriateness of Indicators** |
| **Extreme precipitation (e.g., storms, hurricanes, floods)** | Exposure | * Maximum and minimum temperatures, heat index * Increase in heat alerts/warnings * Projected hot days and warm nights * Projected cold days * Projected air temperature seasonal changes and extremes * Proportion of the population living in an urban heat island |  |  |
| Sensitivity | * Socially and economically disadvantaged populations * Number of people with conditions that inhibit temperature regulation * Number of seniors * Number of children * Heat-related morbidity and mortality * Cold-related morbidity and mortality |  |  |
| Adaptive Capacity | * Health and social services * Proportion of the population without air conditioning * Access to cooling centers * Availability (number) of forecasts and early warning systems |  |  |
| **Other extreme weather events (e.g. extreme heat, droughts)drought)** | Exposure | * Historical precipitation intensity, duration and frequency patterns * Projected precipitation intensity, duration and frequency patterns * Historical frequency, severity, distribution, and duration of wildfires, flooding, droughts and other extremes * Projected frequency, severity, distribution, and duration of wildfires, flooding, droughts and other extremes * Proportion of the population living on or near flood plains |  |  |
| Sensitivity | * Socially and economically disadvantaged populations * Number of people with mobility limitations * Number of seniors * Number of pregnant women * Number of children * Number of people who drink alcohol, use illicit substances or take medication * Morbidity and mortality from extreme weather events (e.g. injuries, infections, mental health outcomes) |  |  |
| Adaptive Capacity | * Health and social services * Emergency management programs * Mental health programs focused on reducing mental health outcomes from floods, droughts and other extremes * Availability (number) of forecasts and early warning systems |  |  |
| **UV Exposure** | Exposure | * Proportion of the population that does not take protective measures during sunniest parts of the day * Extension of warm season due to climate change |  |  |
| Sensitivity | * Number of children * Number of persons working outdoors * Number of persons with skin conditions that increase sun damage risks |  |  |
| Adaptive Capacity | * Health and social services * Health promotion activities on sun safety / sun damage prevention / cancer prevention * Urban greening / shade policies * Availability (number) of forecasts and early warning systems |  |  |
| **Air quality (aero-allergens, air pollution, particulate matter, Saharan dust, and/or wildfire smoke)** | Exposure | * Stagnation air mass events * Projected ground-level ozone and particulate matter estimates due to climate change * Pollen counts, ragweed presence * Number and duration of smog advisories * Ground-level ozone and particulate matter concentrations and exceedance |  |  |
| Sensitivity | * Socially and economically disadvantaged populations * Number of seniors * Number of children * Number of people with chronic diseases and who smoke tobacco * Cardiovascular or respiratory health outcomes from aeroallergens or poor air quality (ground-level ozone, particulate matter) * Number of persons working outdoors * Daily all-cause mortality (trends associated with air pollution) * Daily non-accidental mortality (trends associated with air pollution) |  |  |
| Adaptive Capacity | * Health and social services * Health promotion activities on air pollution prevention and protection from air pollutants, aeroallergens or wildfire smoke * Air quality regulations * Proportion of people who use public transportation / active transportation * Air quality monitoring capabilities/ forecasts and early warning systems |  |  |
| **Food- and water-borne illnesses and food-security issues** | Exposure | * Number of people on small water systems * Number of people using natural outdoor recreational facilities (e.g., beaches) * Number of people on flood plains * Harmful algal blooms * Number of outdoor events (e.g., farmers markets) during warm weather) |  |  |
| Sensitivity | * Socially and economically disadvantaged populations * First Nations and Inuit populations relying on traditional foods * People with suppressed or developing immune systems * Food-borne diseases or outbreaks * Water-related diseases and infections (drinking and recreational water) |  |  |
| Adaptive Capacity | * Health and social services * Food safety regulations for food processing activities and food premises * Drinking and recreational water quality guidelines and regulations * Water quality advisories and programs * Number of meal programs and food banks * Surveillance of water- and food-borne diseases * Availability (number) of forecasts and early warning systems * Health promotion activities on food safety and drinking water safety * Local community ability to grow food |  |  |
| **Vector-borne diseases (Dengue, chikungunya, Zika, malaria)** | Exposure | * Dengue incidence * Chikungunya incidence * Other vector-borne disease incidence * No. of positive test results in reservoirs/sentinels/vectors |  |  |
| Sensitivity | * Number of seniors * Number of children * People with suppressed or developing immune systems * Number of persons spending greater time outdoors for recreation * Number of persons working outdoors * Number of persons travelling to other parts of the world where other vector-borne diseases may be endemic |  |  |
| Adaptive Capacity | * Health and social services * Vector-borne diseases programs (e.g. surveillance and monitoring, larviciding, adulticiding, public awareness campaigns) * Availability (number) of forecasts and early warning systems |  |  |

## Step 2e: Effectiveness of Policies and Programs

Use the Table 1 in this template to generate a list of all existing policies and programs that affect the climate-sensitive health outcomes considered in the assessment. Keep track of data sources that can be used to undertake the evaluation. Use Table 2 to record evaluation information for each policy and program under evaluation. Using existing evaluations and/or expert judgement, evaluate the effectiveness of each policy and program in reducing the relevant climate-related health risks. Two main categories of investigation should be considered when conducting an evaluation. Refer to Text Box 1 in this template for a description of process and outcome evaluations and examples of data sources.

**Table 1. Template for Generating a List of Existing Policies or Programs that Affect Climate-Sensitive Health Outcomes**

|  |  |  |
| --- | --- | --- |
| **Examples of Health Hazards** | **Policies or Programs** | **Evaluation Data Sources** |
| General | 1. |  |
| 2. |  |
| 3. |  |
| 4. |  |
| 5. |  |
| Extreme precipitation (e.g., storms, hurricanes, floods) | 1. |  |
| 2. |  |
| 3. |  |
| 4. |  |
| 5. |  |
| Other extreme weather and climate events (e.g. extreme heat, droughts) | 1. |  |
| 2. |  |
| 3. |  |
| 4. |  |
| 5. |  |
| Mental health, social protection and support programming | 1. |  |
| 2. |  |
| 3. |  |
| 4. |  |
| 5. |  |
| Air quality (aero-allergens, air pollution, Saharan dust, particulate matter and/or wildfire smoke) | 1. |  |
| 2. |  |
| 3. |  |
| 4. |  |
| 5. |  |
| Food- and water-borne illnesses and food-security issues | 1. |  |
| 2. |  |
| 3. |  |
| 4. |  |
| 5. |  |
| Vector-borne diseases (Dengue, chikungunya, Zika, malaria) | 1. |  |
| 2. |  |
| 3. |  |
| 4. |  |
| 5. |  |

**Table 2. Template for Conducting a Process and/or Outcome Evaluation of a Climate Change and Health Policy or Program**

**Policy or Program Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Date Template Completed: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Completed By: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

\*1=Highly effective, 2=Somewhat effective, 3=Not effective, 4=Unknown

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Evaluation Type** | **Guiding Questions** | **Indicator Examples** | **Evaluation Data** | **Evaluation Result** |
| Process | **Operational Costs** | | | |
| * Has the policy or program been carried out as planned? * Has each component of the policy or program been operating effectively? * What are the operational costs (resources used)? * Were processes involved in implementing the policy / program efficient? | * Resources used by each partner to implement program * Resources required for collecting and monitoring surveillance data * Staff time spent on the implementing the policy or program at various stages * Costs to communicate messages to stakeholders and the public * Costs of maintaining the policy or program |  |  |
| **Protocols / Processes** | | | |
| * Was information provided to stakeholders accurate? * Were relevant stakeholders engaged? * Did stakeholders find the process useful and helpful? * Are intended responses being followed through by the public or other stakeholders? | * Frequency of partner notification and public alerts * Timeliness of alert information received * Timeliness and efficiency of message delivery to the public * Quality of surveillance data * Frequency of warnings and alerts issued in relation to actual weather conditions occurring * Capacity of participating agencies to monitor and deliver surveillance and weather data |  |  |
| **Stakeholder Engagement** | | | |
| * Were relevant and key messages being provided to the public in a timely manner? * Is the target population aware of the policy / program and do they comprehend the messages? | * Level of participation of agencies and other community groups in education activities * Number and types of response measures delivered by stakeholders * Number and diversity of engaged stakeholders and meeting frequency * Partners’ views on the degree of coordination of activities * Stakeholders’ views on the adequacy of support offered * Level of stakeholder satisfaction * Number of at-risk people who took preventive actions * Number of people, their demographic makeup, and degree of compliance with intended responses * Number of people and their demographic makeup who took advantage of other response measures |  |  |
| **Communication** | | | |
| * Was communication effective? | * Number of planned communication elements delivered * Vulnerable and general populations reached by each communication element * Number and types of inquiries received * Number and types of resources distributed * Promotion and publicity received through media activities * Number of media and information sources engaged as part of the outreach campaign * Reach of key messages into media * Accessibility of information to the public * Number of at-risk people who perceive hazard to be a health risk * Number of at-risk people who can identify preventive measures * Capacity of targeted population to recall accurate messaging |  |  |
| Outcome | * Has progress been made towards achieving intermediate objectives and ultimate policy or program goals? * Has the policy or program been effective in reducing health risks or negative health outcomes as intended? * Has morbidity or mortality decreased due to the public health intervention? * Has the public health intervention lead to a desired change in awareness, knowledge, understanding and behavioral change? | * Number of daily deaths relative to historical baseline * Number of daily emergency calls attributable to the hazard * Number of daily emergency room visits and hospitalizations attributable to the hazard * Changes in health protective behaviors of at-risk population * Changes in public awareness, knowledge and beliefs an changes in service utilization |  |  |

**Text Box 1. Information on Conducting Evaluations of Policies and Programs for Reducing Health Risks from Climate Change Hazards**

|  |
| --- |
| **Information Sources for Evaluations of Policies or Programs**  Formal evaluations are most credible and useful when information is gathered using a mix of qualitative (e.g. focus groups, in-depth interviews, open-ended survey questions) and quantitative methods (e.g. surveys, process tracking forms and records, large data sets). Informal feedback from stakeholders and target audiences, as well as observations about the performance of the policy or program from lead agencies, may be used for the evaluation; however, this type of data is often incomplete and may be biased. The most appropriate indicators and methodologies for data collection can be identified when the evaluation design addresses the following: evaluation goals, data availability, types of tools and measures needed for data collection, frequency of data collection and optimal time frame to collect the data, and organizations responsible for data collection and analysis. A collaborative approach to the evaluation process, including identifying the core objectives, is essential. Using this approach, partners and stakeholders contribute to the evaluation through their knowledge of individual and community-level vulnerabilities, target audiences for outreach activities, and existing information gaps. It is important to identify core elements of the program or policy and its ultimate goal. A schematic can guide the evaluation process by highlighting how the policy or program operates and by identifying leads with their roles and responsibilities.  **Process and Outcome Evaluations**   * Process evaluation determines if the policy or program has been carried out as planned and whether each component of the policy or program has been operating effectively. It involves gathering data during implementation to assess program-specific issues of relevance and performance as well as design and delivery. The evaluation should address pre-identified questions using a set of indicators. Data sources could include: financial reporting information, interviews, meeting summaries, website usage statistics and other inquiries received and table-top exercises. * Outcome evaluation focusses on the impact of the policy or program based upon the policy or program goals and objectives. An evaluation should be focused on issues of greatest concern to partners and stakeholders, while being as simple and cost-effective as possible. It is most appropriate for well-developed policies or programs that have made progress towards achieving intermediate objectives and ultimate goals. This type of evaluation should focus on policy or program effectiveness by measuring changes in morbidity and mortality and the impact of the public health interventions on awareness, knowledge, understanding and behavioral change. Outcome evaluations may need more resources because they require several years of observation, the establishment of baseline data, access to hospitalization and annual mortality data, and the expertise of an epidemiologist to conduct the analysis. A detailed analysis of health outcomes based on only a few years of implementation of the program or policy will likely convey a limited understanding of program impact and effectiveness.   Adapted from Heat Alert and Response Systems to Protect Health: Best Practices Guidebook. Health Canada. Ottawa, Ontario: Her Majesty the Queen in Right of Canada represented by the Minister of Health.- <http://www.hc-sc.gc.ca/ewh-semt/alt_formats/pdf/pubs/climat/response-intervention/response-intervention-eng.pdf> |

## Step 3c: Project Future Health Risks

Use the template below to document projections of future climate change risks to health. To project future health risks, a common approach is to multiply current exposure-response relationships by the projected change in the relevant weather variable(s) over the time periods of interest. Keep in mind that vulnerability and adaptive capacity will also evolve over time. For each climate health hazard of interest, use the guiding questions to collect and document information. Add to the list of questions to focus inquiries and to obtain relevant information for the assessment. To obtain data, employ literature searches, expert interviews, facilitated discussions at a workshop, consultations with modelling experts and other approaches. Document uncertainties and how they could affect projected health risks in the template.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Health Hazard Examples** | **Guiding Questions** | **Time period** | **Projected Changes** | **Baseline Health Risks** | **Projected changes to health risks** | **Uncertainties** |
| **Extreme precipitation (e.g., storms, hurricanes, floods)** | How is climate change expected to affect the hazard? |  |  |  |  |  |
| How are vulnerability and adaptive capacity expected to change? |  |  |  |  |  |
| **Other extreme weather and climate events (e.g. extreme heat, droughts)** | How is climate change expected to affect the hazard? |  |  |  |  |  |
| How are vulnerability and adaptive capacity expected to change? |  |  |  |  |  |
| **Disease vectors (e.g. vectors for Chikungunya, Dengue)** | How is climate change expected to affect the hazard? |  |  |  |  |  |
| How are vulnerability and adaptive capacity expected to change? |  |  |  |  |  |
| **Food- and water-borne contamination** | How is climate change expected to affect the hazard? |  |  |  |  |  |
| How are vulnerability and adaptive capacity expected to change? |  |  |  |  |  |
| **Air quality (aeroallergens, particulate matter, Saharan dust, and/or wildfire smoke)** | How is climate change expected to affect the hazard? |  |  |  |  |  |
| How are vulnerability and adaptive capacity expected to change? |  |  |  |  |  |
| **Mental health and social protection** | How is climate change expected to affect the hazard? |  |  |  |  |  |
| How are vulnerability and adaptive capacity expected to change? |  |  |  |  |  |

## Step 4a: Sources for Identifying Adaptation Options

Use the template below to identify sources of information to help identify potential modifications to policies and programs to reduce current and future health risks from climate change. A range of information sources can be used to identify and collect relevant information (e.g. interviews, literature reviews, workshops).

|  |  |  |  |
| --- | --- | --- | --- |
| **Health Hazard Examples[[1]](#footnote-1)** | **Guiding Questions** | **Key Experts, Literature, Data Collection Opportunities** | **Stakeholders to Engage** |
| **Extreme precipitation (e.g., storms, hurricanes, floods)** | 1. Who is aware of or has implemented (possible) adaptations (e.g. scientists, government health agencies, staff within your organization or other public health agencies)?    1. Have other health jurisdictions implemented adaptations that your agency can learn from?    2. Could your agency learn from work being done in other provinces/territories or internationally? 2. What peer-reviewed or grey literature can you draw on to identify possible adaptations? 3. What are some ways this information can be collected from partners and stakeholders (e.g. workshop, webinar, teleconference and facilitated discussions)? |  |  |
| **Other extreme weather and climate events (e.g. extreme heat, droughts)** |
| **Air quality (aero-allergens, air pollution, Saharan dust, particulate matter and/or wildfire smoke)** |
| **Food- and water-borne diseases** |  |  |
| **Vector-borne diseases (Dengue, chikungunya, Zika, malaria)** |

## Step 4b: Adaptation Options Inventory

Use the template below to develop a list of adaptation options. Refer to the information collected in Step 4a (and documented in the Sources for Identifying Adaptation Options template) to develop the inventory of potential adaptation options. Include in the template any key stakeholders that may need to be engaged when prioritizing potential options.

|  |  |
| --- | --- |
| **Health Hazard Examples** | **Potential Adaptation Options** |
| Extreme precipitation (e.g., storms, hurricanes, floods) |  |
| Other extreme weather and climate events (e.g. extreme heat, droughts) |  |
| Air quality (aero-allergens, air pollution, Saharan dust, particulate matter and/or wildfire smoke) |  |
| Food- and water-borne diseases |  |
| Vector-borne diseases (Dengue, chikungunya, Zika, malaria) |  |

## Step 4c: Prioritize Options and Develop Resource Needs

Use the template below to prioritize the adaptation options.

|  |  |  |  |
| --- | --- | --- | --- |
| **Health Hazard Examples** | **Adaptation Option** | **Prioritization Criteria Examples** | **Outcome of Prioritization Process**  **(e.g. Score / Ranking)** |
| **Extreme precipitation (e.g., storms, hurricanes, floods)** | A. | 1. Feasibility 2. Effectiveness in reducing health risks 3. Positive / Negative consequences 4. Adequate financial resources 5. Social acceptability 6. Health System and Infrastructure Resilience 7. Does the option contribute to the reduction of greenhouse gases? 8. Does the option focus on impacts associated with a narrow range of future scenarios, or does it allow for flexibility in response? |  |
| B. |  |
| **Other extreme weather and climate events (e.g. extreme heat, droughts)** | A. |  |
| B. |  |
| **Mental health and social protection issues** | A |  |
| B. |  |
| **Air quality (aero-allergens, air pollution, Saharan dust, particulate matter and/or wildfire smoke)** | A. |  |
| B. |  |
| **Food- and water-borne diseases** | A. |  |
| B. |  |
| **Vector-borne diseases (Dengue, chikungunya, Zika, malaria)** | A |  |
| B. |  |

## Step 4d: Possible Constraints

Use the template below to list possible constraints or barriers that need to be overcome when implementing the identified adaptation options. Differentiate constraints from limits (i.e. no adaptation option is possible or available options are too difficult or expensive to implement). Include possible ways to overcome barriers in the last column.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Health Hazard Examples** | **Adaptation Options** | **Guiding Questions** | **Possible Constraints or Barriers** | **Possible Ways to Overcome Barriers** |
| **Extreme precipitation (e.g., storms, hurricanes, floods)** | A. | 1. What are the possible constraints or barriers needing to be overcome when implementing options? 2. What are possible limits, which cannot be overcome? 3. What are the technological, human and financial resources required for implementation? 4. What is the expected time-frame for implementation? 5. What are other possible implementation requirements? 6. Can other sectors be involved in helping overcome adaptation barriers? 7. Are there opportunities to engage other sectors to discuss adaptation constraints and to identify non-health sector opportunities to advance adaptations and promote health? |  |  |
| B. |  |  |
| **Other extreme weather and climate events (e.g. extreme heat, droughts)** | A. |  |  |
| B. |  |  |
| **Mental health and social protection issues** | A. |  |  |
| B. |  |  |
| **Air quality (aero-allergens, air pollution, Saharan dust, particulate matter and/or wildfire smoke)** | A. |  |  |
| B. |  |  |
| **Food- and water-borne diseases** | A. |  |  |
| B. |  |  |
| **Vector-borne diseases (Dengue, chikungunya, Zika, malaria)** | A. |  |  |
| B. |  |  |

## Step 5a: Monitoring Plan

Use the template below to develop the monitoring plan. Insert the completed monitoring plan into the adaptation plan (Step 4e).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Health Hazard Examples** | **Indicator to be Monitored\*** | **Frequency of Monitoring** | **Methods of Data Analysis and Collection** | **Recommended Adaptation Modifications** | **Communications Activities** |
| **Extreme precipitation (e.g., storms, hurricanes, floods)** |  |  |  |  |  |
| **Other extreme weather and climate events (e.g. extreme heat, droughts)** |  |  |  |  |  |
| **Mental health and social protection issues** |  |  |  |  |  |
| **Air quality (aero-allergens, air pollution, Saharan dust, particulate matter and/or wildfire smoke)** |  |  |  |  |  |
| **Food- and water-borne diseases** |  |  |  |  |  |
| **Vector-borne diseases (Dengue, chikungunya, Zika, malaria)** |  |  |  |  |  |

\*Use the Monitoring Indicators template (step 5b) for ideas on what could be monitored.

## Step 5b: Monitoring Indicators

This template provides indicators that can be used to monitor adaptation success. Select from this list, or identify new indicators and include them in the monitoring plan.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Health Hazards** | **Elements of vulnerability** | **Examples of Indicators** | **Data Source** | **Method(s) of Verifying Efficacy and Appropriateness of Indicators** |
| **Extreme precipitation (e.g., storms, hurricanes, floods)** | Exposure | * Maximum and minimum temperatures, heat index * Increase in heat alerts/warnings * Projected hot days and warm nights * Projected cold days * Projected air temperature seasonal changes and extremes * Proportion of the population living in an urban heat island |  |  |
| Sensitivity | * Socially and economically disadvantaged populations * Number of people with conditions that inhibit temperature regulation * Number of seniors * Number of children * Heat-related morbidity and mortality * Cold-related morbidity and mortality |  |  |
| Adaptive Capacity | * Health and social services * Proportion of the population without air conditioning * Access to cooling centers * No. of heat wave early warning systems * No. of municipal heat island mitigation plans |  |  |
| **Other extreme weather and climate events (e.g. extreme heat, droughts)** | Exposure | * Historical precipitation intensity, duration and frequency patterns * Projected precipitation intensity, duration and frequency patterns * Historical frequency, severity, distribution, and duration of wildfires, flooding, droughts and other extremes * Projected frequency, severity, distribution, and duration of wildfires, flooding, droughts and other extremes * Proportion of the population living on or near flood plains |  |  |
| Sensitivity | * Socially and economically disadvantaged populations * Number of people with mobility limitations * Number of seniors * Number of pregnant women * Number of children * Number of people who drink alcohol, use illicit substances or take medication * Morbidity and mortality from extreme weather events (e.g. injuries, infections, mental health outcomes) |  |  |
| Adaptive Capacity | * Health and social services * Emergency management programs * Mental health programs focused on reducing mental health outcomes from floods, droughts and other extremes |  |  |
| **UV Exposure** | Exposure | * Proportion of the population that does not take protective measures during sunniest parts of the day * Extension of warm season due to climate change |  |  |
| Sensitivity | * Number of children * Number of persons working outdoors * Number of persons with skin conditions that increase sun damage risks |  |  |
| Adaptive Capacity | * Health and social services * Health promotion activities on sun safety / sun damage prevention / cancer prevention * Urban greening / shade policies |  |  |
| **Air quality (aero-allergens, air pollution, Saharan dust, particulate matter and/or wildfire smoke)** | Exposure | * Stagnation air mass events * Projected ground-level ozone and particulate matter estimates due to climate change * Pollen counts, ragweed presence * Number and duration of smog advisories * Ground-level ozone and particulate matter concentrations and excess |  |  |
| Sensitivity | * Socially and economically disadvantaged populations * Number of seniors * Number of children * Number of people with chronic diseases and who smoke tobacco * Cardiovascular or respiratory health outcomes from aeroallergens or poor air quality * Number of persons working outdoors * Daily all-cause mortality (trends associated with air pollution) * Daily non-accidental mortality (trends associated with air pollution) |  |  |
| Adaptive Capacity | * Health and social services * Health promotion activities on air pollution prevention and protection from air pollutants, aeroallergens or wildfire smoke * Air quality regulations * Proportion of people who use public transportation / active transportation * Air quality monitoring capabilities |  |  |
| **Food- and water-borne illnesses and food-security issues** | Exposure | * Number of people on small water systems * Number of people using natural outdoor recreational facilities (e.g., beaches) * Number of people on flood plains * Harmful algal blooms * Number of outdoor events (e.g., farmers markets) during warm weather) |  |  |
| Sensitivity | * Socially and economically disadvantaged populations * First Nations and Inuit populations relying on traditional foods * People with suppressed or developing immune systems * Food-borne diseases or outbreaks * Water-related diseases and infections (drinking and recreational water) |  |  |
| Adaptive Capacity | * Health and social services * Food safety regulations for food processing activities and food premises * Drinking and recreational water quality guidelines and regulations * Water quality advisories and programs * Number of meal programs and food banks * Surveillance of water- and food-borne diseases * Health promotion activities on food safety and drinking water safety * Local community ability to grow food |  |  |
| **Vector-borne diseases (Dengue, chikungunya, Zika, malaria)** | Exposure | * Other vector-borne disease incidence * Dengue disease incidence in humans * Chikungunya incidence in humans * No. of positive test results in reservoirs/sentinels/vectors |  |  |
| Sensitivity | * Number of seniors * Number of children * People with suppressed or developing immune systems * Number of persons spending greater time outdoors for recreation * Number of persons working outdoors * Number of persons travelling to other parts of the world where other vector-borne diseases may be endemic |  |  |
| Adaptive Capacity | * Health and social services * Vector-borne diseases programs (e.g. surveillance and monitoring, larviciding, adulticiding, public awareness campaigns) |  |  |

## Step 6a: Health Benefits and Co-Harms

Use the template below to document proposed and/or implemented adaptation and mitigation strategies in other sectors that may affect health and recommendations to minimize risks and maximize potential health gains. For example, planting trees, buying local food and installing green roofs might both mitigate greenhouse gas emissions and increase resilience to future climate-related health risks.

|  |  |  |  |
| --- | --- | --- | --- |
| **Examples of Sectors** | **Adaptation and Mitigation Strategies That Can Affect Health** | **Health Implications (Synergies / Impacts), If Any** | **Recommendations to Reduce Risks / Maximize Health Benefits** |
| **Planning (e.g. Urban)** |  |  |  |
| **Emergency Management** |  |  |  |
| **Water and Waste-Water / Public Works** |  |  |  |
| **Conservation and Environmental Management** |  |  |  |
| **Transportation** |  |  |  |
| **Natural Resources and Land Use** |  |  |  |
| **Parks and Recreation** |  |  |  |
| **Infrastructure (e.g. roads, sewers, sidewalks)** |  |  |  |
| **Social Services** |  |  |  |
| **Tourism / Arts / Entertainment** |  |  |  |
| **Waste Management** |  |  |  |

## Step 6b: Synergies for Adaptation and Mitigation Options

Use the template below to document actions that aim to mitigate greenhouse gas emissions and also increase resilience to future climate-related health risks. Examples include: planting trees, buying local food, and installing green roofs. When identifying synergies, ask the question: what is the likelihood / certainty that the program, policy or initiative decreases greenhouse gas emissions as well as reduces current and future health risks from a changing climate? Recommend options that are of high probability and/or certainty.

|  |  |
| --- | --- |
| **Examples of Sectors** | **Recommendations for Options to Maximize Adaptation and Mitigation Synergies** |
| **Planning**  **(e.g. Urban)** |  |
| **Emergency Management** |  |
| **Water and Waste-Water / Public Works** |  |
| **Conservation and Environmental Management** |  |
| **Transportation** |  |
| **Natural Resources and Land Use** |  |
| **Parks and Recreation** |  |
| **Infrastructure (e.g. roads, sewers, sidewalks)** |  |
| **Social Services** |  |
| **Tourism / Arts / Entertainment** |  |
| **Waste Management** |  |

1. Draw on results from the “Project Future Health Risks Template” in Step 3 to select climate change-related health hazards which are most relevant to your community. [↑](#footnote-ref-1)