Research for Action on Climate Change and Health in the Caribbean:
A Public, Private, People's and Planetary Agenda

Caroline F. Allen[1], Renée M. West[1], Georgiana Gordon-Strachan[2], Saria Hassan[3], Shelly McFarlane[2], Karen Polson-Edwards[4], Audreyanna Thomas[4], C. James Hospedales[5*], Robert Dubrow[6*]

[1]Blue Sky Development Consulting
[2]Caribbean Institute for Health Research, The University of the West Indies
[3]Rollins School of Public Health, Emory University
[4]Pan American Health Organization
[5]EarthMedic and EarthNurse Foundation for Planetary Health
[6]Yale Center on Climate Change and Health, Yale School of Public Health
[*]Co-chair

Suggested citation: Allen CF, West RM, Gordon-Strachan G, Hassan S, McFarlane S, Polson-Edwards K, Thomas A, Hospedales CJ, Dubrow R. Research for Action on Climate Change and Health in the Caribbean: A Public, Private, People's and Planetary Agenda. Research for Action on Climate Change and Health in the Caribbean Project, 2024.

CONTENTS

ACKNOWLEDGEMENTS

This research for action agenda was made possible by the contributions of literally hundreds of individuals, including presenters and participants at the “Conference on Climate Change and Health in Small Island Developing States: Focus on the Caribbean”, held on 5–8 October 2021; lead authors of conference preparatory documents (members of the Research for Action on Climate Change and Health in the Caribbean Project and Heather Harewood); expert reviewers of conference preparatory documents; participants in stakeholder dialogues/consultations held in 2022-2023 by the Research for Action on Climate Change and Health in the Caribbean Project; and expert reviewers of drafts of the agenda. We thank the National Oceanic and Atmospheric Administration and the Pan American Health Organization for their generous financial support.

LIST OF ABBREVIATIONS

ABBREVIATION	DEFINITION
AAD	average annual displacement
AC	air conditioning
AF	Adaptation Fund
BPOA	Barbados Programme of Action
CAIHR	Caribbean Institute for Health Research
CALGA	Caribbean Association of Local Government Authorities
CANPA	Caribbean Alliance of National Psychological Associations
CAPHCC	Caribbean Action Plan on Health and Climate Change
CARDI	Caribbean Agricultural Research & Development Institute
CariCOF	Caribbean Climate Outlook Forum
CARICOM	Caribbean Community
CARIFORUM	Caribbean Forum
CariSAM	Caribbean Society for Agricultural Meteorology
CARPHA	Caribbean Public Health Agency
CAST	Caribbean Alliance for Sustainable Tourism
CCC	Caribbean Council of Churches
CCCCC	Caribbean Community Climate Change Centre
CCH IV	Caribbean Cooperation in Health IV
CCHSRD	Caribbean Centre for Health Systems Research and Development
CCREEE	Caribbean Centre for Renewable Energy and Energy Efficiency
CDB	Caribbean Development Bank
CDC	Centers for Disease Control and Prevention
CDEMA	Caribbean Disaster Emergency Management Agency
CER	certified emission reduction
CERMES	Centre for Resource Management and Environmental Studies
CHTA	Caribbean Hotel and Tourism Association
CIF	Climate Investment Funds
CIMH	Caribbean Institute for Meteorology and Hydrology
COC	conference organising committee
CRAA	Caribbean Research for Action Agenda
CRCC	Caribbean Regional Climate Centre
CRRP	Climate Resilience and Recovery Plan
CSA	climate-smart agriculture
CSO	civil society organisation
CTO	Caribbean Tourism Organization

CWWA	Caribbean Water and Wastewater Association
EU	European Union
EWS	early warning system
EWISACT	Early Warning Information Systems Across Climate Timescale
FCDO	Foreign, Commonwealth and Development Office of the United Kingdom
FEWER	Fisheries Early Warning and Emergency Response
GA-CDRC	George Alleyne Chronic Disease Research Centre
GCCHE	Global Consortium on Climate and Health Education
GEF	Global Environment Facility
GHG	greenhouse gas
GI	gastrointestinal
GIS	geographic information system
HEAT	Health Economic Assessment Tool
HFC	hydrofluorocarbon
HIVRA	hazard, impact, vulnerability or risk assessment
H-NAP	Health National Adaptation Plan
HSI	Hospital Safety Index
IGDS	Institute for Gender and Development Studies
INSMET	Instituto de Meteorología de la República de Cuba
IRB	institutional review board
IRM	integrated risk management
IVM	integrated vector management
IWRM	integrated water resource management
KABP	knowledge, attitudes, beliefs and practices
KAP	knowledge, attitudes and practice
MGL	Maya Golden Landscape
NCD	noncommunicable disease
n.d.	no date
NDCs	nationally determined contributions
NGO	nongovernmental organisation
NOAA	National Oceanic and Atmospheric Administration
OECS	Organisation of Eastern Caribbean States
PAHO	Pan American Health Organization
PFA	psychological first aid
PICSA	Participatory Integrated Climate Services for Agriculture
PPCR	Pilot Programme for Climate Resilience
PTSD	posttraumatic stress disorder
R4ACCHC	Research for Action on Climate Change and Health in the Caribbean

SDG	Sustainable Development Goal
SHCFC	Smart Health Care Facilities in the Caribbean
SIDS	Small Island Developing States
SLR	sea level rise
SSB	sugar-sweetened beverage
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNGD	United Nations General Debate
UWI	University of the West Indies
VBD	vector-borne disease
WASH	water, sanitation and hygiene
WHO	World Health Organization
WINDREF	Windward Islands Research and Education Foundation
XCD	Eastern Caribbean dollar

INTRODUCTION, METHODOLOGY AND MAIN FINDINGS

The statement by the World Health Organization (WHO) in 2015 that "Climate change is the greatest threat to global health in the 21st century" (WHO, 2015) focused attention on the relationship between climate change and health at the global level. The timing of this statement coincided with the 2015 Paris Agreement, a legally binding international agreement on climate change with the goal to limit "the increase in the global average temperature to well below 2 °C above pre-industrial levels" and to pursue efforts "to limit the temperature increase to 1.5 °C above pre-industrial levels" (UNFCCC, 2019).

Small island developing states (SIDS) are vulnerable to climate change because of a number of factors, including their small land area and human resource base, remote location, dependence on marine resources, and concentrations of populations and infrastructure near coastlines. These factors also affect health, for example through their impact on the availability of human resources for health; access to medical supplies, water and healthy food; and the vulnerability of key infrastructure, livelihoods and nutrition to the oceanic and meteorological outcomes of climate change, such as sea level rise, ocean acidification and more frequent and severe hurricanes. This is coupled with the fact that Caribbean economies are small and rely heavily on international trade, making them highly vulnerable to climate change-related shocks such as hurricanes (Allen et al., 2021a). International initiatives and agreements have recognised the severity of climate change impacts on health in SIDS, notably the WHO Special Initiative on Climate Change and Health in Small Island Developing States (WHO, 2017, 2018). Governmental and nongovernmental advocates from Caribbean and other SIDS were instrumental in achieving this international recognition (Benjamin and Thomas, 2016). Under the WHO initiative, the "Third Global Conference on Health and Climate Change: Special Focus on SIDS" included a meeting of ministers of health in Grenada, who agreed on a Caribbean Regional Action Plan to address health and climate change priorities in SIDS under the four pillars of the initiative: Empowerment, Evidence, Implementation and Resources (PAHO, 2018).

At the Caribbean regional level, intergovernmental and civil society agencies have increased their focus on climate change and health. A crucial example of this is an initiative, of which this report is a part, entitled "Research for Action on Climate Change and Health in the Caribbean: A Public, Private, People's and Planetary Agenda" (known as R4ACCHC). The broad goal of R4ACCHC is to develop and implement the Caribbean Research for Action Agenda (CRAA) on climate change and health, which aims to accelerate achievement of climate and health goals for the Caribbean. The specific objectives of the CRAA are to:

- Provide an **evidence base** for action by public, private and civil society actors.
- Suggest areas for **advocacy** by actors.
- Identify critical **knowledge gaps** to inform action linking climate and health.
- Provide a basis for further **research and education**.
- Identify needs for building **research capacity**.
- Provide a foundational document for **partnerships** between actors.
- Propose ways of **disseminating information** to different audiences.

The initiative was started in 2020 when representatives from five nongovernmental organisations and academic institutions – EarthMedic/EarthNurse, the University of the West Indies, the Center on Climate Change and Health at Yale School of Public Health, the Emory Rollins School of Public Health and the Pan American Health Organization – came together to form a conference organising committee (COC) for a groundbreaking conference on climate change and health in the Caribbean, as described in the next section.

HOW THE CARIBBEAN RESEARCH FOR ACTION AGENDA WAS DEVELOPED

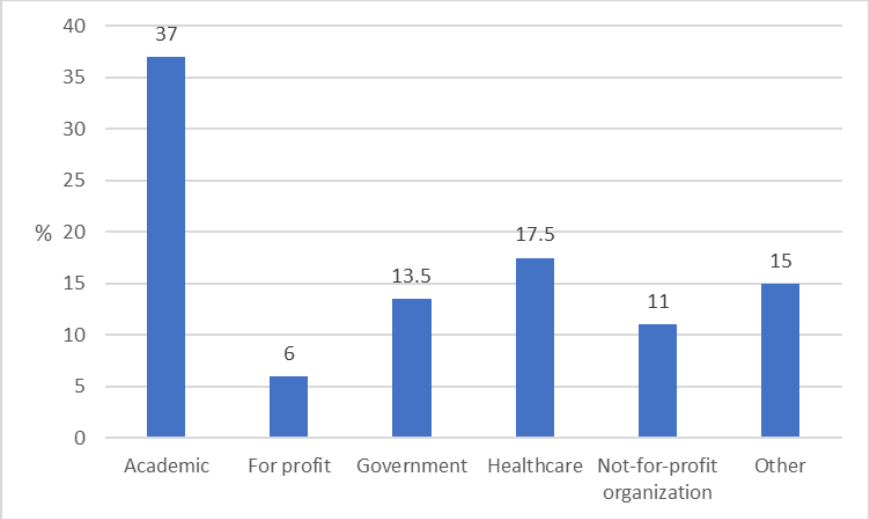
Step 1: Conference on Climate Change and Health in Small Island Developing States: Focus on the Caribbean

The first stage in developing the CRAA was to plan and host the landmark virtual "Conference on Climate Change and Health in Small Island Developing States: Focus on the Caribbean", held on 5–8 October 2021 (henceforth "the Conference"). The COC was supported by over 25 regional and international organisations in sponsoring the Conference. The three objectives of the Conference were to:

- Provide an overview of the health impacts of climate change in the Caribbean, mitigation and adaptation actions to address these impacts, and impediments to these actions.
- Understand and prioritise knowledge gaps that will define an action-oriented research and implementation agenda to reduce the adverse health impacts of climate change.
- Foster multisectoral and regional, North–South and South–South collaboration, innovation and sharing, to facilitate implementation of a research agenda for climate change and health.

The Conference provided a rich source of information for the CRAA by bringing together experts and advocates from the region and around the world to share information about climate change and health in Caribbean SIDS. Conference presentations and lightning talks were delivered by 162 presenters from academic, technical and civil society organisations. The 1057 general registrants were based in more than 80 countries and territories, including 31 SIDS, most of them Caribbean SIDS. Attendees were from various types of organisations (Figure 1).

Figure 1: Organisation types represented by the 2021 Conference's general registrants



Following the Conference, the COC collaborated closely with Blue Sky Development Consulting, a small consultancy company specialising in climate change and health research based in Trinidad and Tobago, under the umbrella of R4ACCHC, to develop the CRAA presented in this publication. This involved the methodological steps outlined below.

Step 2: Development of the conceptual framework

To develop the CRAA, a conceptual and organisational framework was created, taking into account the wide range of pathways linking climate change and health. Existing frameworks on climate change and health were reviewed, including the WHO's operational framework for building climate resilient health systems (Shumake-Guillemot et al., 2015), the United States Global Change Research Program's primary exposure pathways by

which climate change affects health (USGCRP, 2016) and the Lancet Countdown's monitoring framework on health impacts of climate change (Romanello et al., 2021).

In preparation for the Conference, members of R4ACCHC and another colleague wrote documents on the following topics, which were thought to be key to the eventual content of the CRAA, and provided Caribbean examples for each topic:

- Leadership, governance and financing;
- Research on impact of climate on health;
- Climate-resilient health systems;
- Emergency preparedness and management;
- Management of environmental determinants of health;
- Health co-benefits of mitigation and adaptation.

These documents were presented to conference participants for feedback. We analysed the content of and feedback on these documents to assess their coherence with the three main frameworks under consideration. We also mapped the main topics covered at the Conference against the domains covered by the frameworks.

The findings of the mapping and analysis process determined that the *Lancet* Countdown framework was the framework that was most consistent with the subject matter of preparatory documents for, and main topics covered at, the Conference (Table 1). The *Lancet* Countdown framework was also found to be consistent with the topics covered in the most comprehensive review of Caribbean evidence on climate change and health to date: the report "State of public health in the Caribbean 2017–2018 – climate and health: averting and responding to an unfolding health crisis" by the Caribbean Public Health Agency (CARPHA, 2018). The *Lancet* Countdown uses a broad ecological framework that considers social and environmental determinants of health, which include characteristics of healthcare systems. A broad framework is appropriate since pathways between climate change and health are mediated by actions in non-health sectors such as energy, water, sanitation and transport. The *Lancet* Countdown framework offers a relatively simple way to organise information about the health impacts of climate change, actions in various sectors relating to climate change mitigation and adaptation that can impact on health, and the economic and political context (Table 1).

Table 1: Comparison of the domains of the *Lancet* Countdown framework with the main topics of the Conference

The Lancet Countdown domains	Conference main topics
1. **Health** impacts, exposures and vulnerability	• Day 1: The Varied Effects of Climate Change on Health
2. **Adaptation**, planning and resilience for health	• Day 2: Immediate Health Benefits of Climate Change Mitigation and Adaptation
3. **Mitigation** actions and health co-benefits	• Day 3: The Health Sector and its Role in Addressing Climate Change and Health
4. **Economics and finance**	• Day 4: Participation, Representation, and Collaboration to Implement the Research Agenda
5. Public and political **engagement**	

Further analysis of information presented at the Conference and in the CARPHA report on the state of public health in the Caribbean in relation to climate and health led to the adaptation of the *Lancet* Countdown framework for the purposes of the CRAA. *Lancet* Countdown Domains 4 ("Economics and finance") and 5 ("Public and political engagement") were merged into a domain we call "Resources and engagement for climate change and health action".

Thus, the final framework for organising evidence relating to climate change and health in the Caribbean consisted of the following four domains:

1. Climate change **health** impacts, exposures and vulnerability;
2. **Adaptation**, planning and resilience for health;
3. **Mitigation** actions and health co-benefits;
4. **Resources and engagement** for climate change and health action.

Step 3: Methodology for choosing Priority Areas for the Caribbean Research for Action Agenda

The CRAA should correspond with the issues that are the most pressing and the most important for preserving and promoting health in the context of climate change in Caribbean SIDS. Establishing a method to determine issues of importance in Caribbean SIDS was therefore necessary.

The *Lancet* Countdown monitoring framework is based on tracking indicators, which are grouped into one of the five *Lancet* Countdown domains shown in Table 1. In 2020–21, the *Lancet* Countdown conducted qualitative research with expert stakeholders in Caribbean and Pacific SIDS. The 24 participants, including 17 from the Caribbean, were asked during online interviews to provide a constructive critique of the indicator areas included in the *Lancet* Countdown monitoring framework in terms of their relevance to SIDS. Participants recommended 24 areas, some of which were based on the *Lancet* Countdown indicator areas, as relevant for the development of indicators, research and action on climate change and health in SIDS. At a subsequent workshop where findings of the assessment were presented, stakeholders engaged in a prioritisation exercise, which narrowed down the number of recommended areas to eight Priority Areas, as follows (Allen et al., 2021a, b):

1. Injury and long-term impacts of severe weather events;
2. Vulnerability to vector-borne diseases (VBDs);
3. Water, sanitation and hygiene;
4. Noncommunicable diseases (NCDs) and risk factors;
5. Collaboration between agencies;
6. Research and surveillance systems;
7. Investment in climate and health surveillance and research;
8. Government engagement in health and climate change.

Including these 8 areas in the CRAA was considered highly important, and the remaining 16 of the 24 areas identified by participants in the *Lancet* Countdown research were also considered for inclusion.

As the largest gathering of experts and advocates on climate change and health in Caribbean SIDS to date, the Conference was a critical resource in determining which issues were priorities for the region. The Conference session topics and presentations, and the lightning talk titles, were therefore also reviewed. In addition, previously published reviews of Caribbean research and action on climate change and health were analysed (CARPHA, 2018; Rise et al., 2022; Taylor et al., 2010).

To help ensure that the Priority Areas chosen for the CRAA were in line with the experiences and views of stakeholders, R4ACCHC presented a tentative list of priorities in a series of stakeholder meetings in 2022 and 2023 with the following organisations:

- Healthy Caribbean Coalition;
- Caribbean Hotel and Tourism Association;
- Faculty of Medical Sciences, University of the West Indies (UWI), Mona, Jamaica;
- School of Clinical Medicine and Research, UWI, the Bahamas;
- Caribbean Alliance of National Psychological Associations;

- Caribbean College of Family Physicians;
- Caribbean Broadcasting Union;
- Caribbean Association of Local Government Authorities;
- Sir Arthur Lewis Community College, Saint Lucia;
- Ministry of Health and Wellness, Saint Lucia;
- Health and Social Cluster, Organisation of Eastern Caribbean States Commission.

Step 4: Priority Areas for research and action on climate change and health in the Caribbean

Resulting from the Step 3 review, analysis and consultation process, 18 Priority Areas for research and action on climate change and health in the Caribbean were chosen (Table 2).

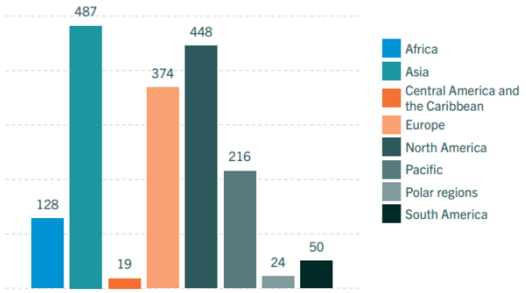
Table 2: 18 Priority Areas

Domain 1: Climate change health impacts, exposures and vulnerability
1. Health impacts of extreme weather events
2. Vulnerability to vector-borne diseases
3. Water, sanitation and hygiene
4. Noncommunicable diseases and risk factors
5. Air quality
6. Heat-related illness
7. Mental health
8. Population displacement and migration
9. Distribution, equity and justice in climate change and health
Domain 2: Adaptation, planning and resilience for health
10. Collaboration between agencies
11. Research and surveillance on climate change and health
12. Agriculture, food safety and security
13. Awareness- and skills-building
Domain 3: Mitigation actions and health co-benefits
14. Marine resources and health
15. Climate-friendly health-promoting infrastructure
16. Smart health facilities
Domain 4: Resources and engagement for climate change and health action
17. Funding streams for climate and health action
18. Government engagement in health and climate change

Step 5: How the evidence on each Priority Area was gathered

A key rationale for developing the CRAA was the observation that the evidence base on climate change and health in the Caribbean is weak. For example, a WHO (2021) review found only 19 peer-reviewed journal articles on climate change and health in Central America and the Caribbean for the whole period 2008–2019 – the lowest number of all global regions included in the review (Figure 2). A more recent review focusing on original research on climate change and health in the Caribbean covering the period 2006–2021 found a greater number of pieces of research (27), but nevertheless concurred with the WHO review in concluding that the Caribbean is the subject of fewer peer-reviewed publications related to climate and health than other regions (Rise et al., 2022).

Figure 2: Geographical distribution of articles reviewed, by region, in the WHO review of climate change and health research 2008–2019



Source: WHO (2021), licensed under CC BY-NC-SA 3.0 IGO.

The publications identified in the WHO and Rise et al. reviews were included in the evidence used for reporting on the Priority Areas. The authors also included literature referred to in CARPHA's (2018) report on climate and health and the state of public health in the Caribbean and the *Lancet* Countdown report on climate change and health in SIDS (Allen et al., 2021a). Using the PubMed database, further searches for peer-reviewed journal articles were conducted for the period 2018–2022. Titles and abstracts were searched, combining "climate" and "health" with "Caribbean" or individual names of countries or territories in the region as follows:

("climat*") AND ("health") AND ("Caribbean") OR ("Anguilla") OR ("Antigua") OR ("Aruba") etc.

A total of 147 articles were initially judged to be relevant based on their titles, including articles containing empirical research; commentaries; and reviews covering human, animal and environmental health (in line with the One Health approach). It should be noted that the scope of the search was wider than the searches conducted by WHO and Rise et al., which included only empirical research. Abstracts and papers were then reviewed for relevance to the 18 Priority Areas. Further targeted searches were conducted on PubMed for evidence from the Caribbean for each of the 18 areas. It was acknowledged, based on experience of the Caribbean research landscape, that many pieces of research in the region are not submitted to peer-reviewed journals. Many are presented at conferences and meetings of academic institutions or technical agencies, and are thus subjected to expert review. Some are published in books and technical reports, with those published by regional publishers often not appearing in global online searches. An important reason behind the low rate of publication in international peer-reviewed literature is that Caribbean researchers have many professional responsibilities in addition to publishing in peer-reviewed journals, given the scarcity of their expertise in the SIDS context. A further line of enquiry was therefore to review the websites of reputable academic and technical agencies and contact researchers to obtain their publications.

Major sources of evidence for the 18 Priority Areas were the Conference and notes from the meetings with stakeholders conducted by R4ACCHC sources were particularly important as, for some of the Priority Areas, little

or no formal empirical evidence was available for the Caribbean. Presenters at the Conference and participants in the meetings with R4ACCHC drew on their own expertise to reflect on the issues of most relevance to the region and how to address them. At the Conference, some speakers presented empirical findings from elsewhere in the world and reflected on how they may be relevant to the Caribbean, with recommendations based on their experience. For instance, Dr John Kotcher presented results of a multinational survey on the views of health professionals on climate change and health. While very few of the survey participants were from the Caribbean, the findings were useful in pointing to issues that must be addressed to build skills among health professionals and enable them to apply these skills in addressing climate change and health challenges (Kotcher, 2021; Kotcher et al., 2021). Some Caribbean researchers at the Conference had not yet conducted empirical research combining climate change and health but presented examples of relevant work. For example, Renelle Sarjeant, an urban planner, presented work on the development of "blue" and "green" infrastructure in the Caribbean. These infrastructure types mitigate climate change by reducing greenhouse gas emissions while also having health co-benefits by reducing urban heat island effects and providing pleasant environments for physical exercise (Sarjeant, 2021).

It should be noted that the initial online literature search was restricted to articles in English, thus could have missed some research from non-English-speaking countries and territories of the Caribbean. However, this limitation was to some extent compensated for by including presentations and lightning talks from the Conference in the review. Presenters included participants from Spanish-, Dutch- and French-speaking Caribbean countries and territories. In addition to reviewing the presentations of these speakers, the authors sought out their other publications. For instance, several publications from the Cuban Institute for Meteorology were included in the review.

Step 6: Reporting on the 18 Priority Areas

For each of the Priority Areas, two documents were developed:

1. A situational analysis (what is happening?);
2. Recommended actions arising from the situational analysis (what should be done?).

The situational analysis documents summarised empirical evidence on what is happening in the Caribbean and relevant evidence from elsewhere. They presented gaps in the evidence from research and surveillance in the Caribbean.

The recommended actions documents were informed by an ecological approach to health determinants, looking first at what individuals and communities can do, and second at structural determinants and what governments, the private sector and other organizations can do to address the challenges identified in the situational analyses. Each action document was divided into sections with the following headings:

- Individual and community actions and how to support them;
- Structural/governmental and private sector actions;
- Research gaps and how to address them;
- Surveillance gaps and how to address them;
- Research and surveillance capacity-strengthening needs.

First drafts of the documents were reviewed by members of R4ACCHC and by Caribbean experts selected according to the Priority Area under review.

An online "stakeholder dialogue" was held on 9–10 May 2023 to present the findings to stakeholders and gather their feedback. Invitees included participants of the Conference, attendees of previous stakeholder meetings with individual organizations, other selected experts, policymakers and civil society advocates. Seventy-eight

people participated. For each Priority Area, a breakout room was provided, where the findings were presented and participants were invited to provide their feedback and make additional recommendations for action and research if applicable. The feedback and recommendations from participants in the stakeholder dialogue were included in the final version of the documents.

CROSS-CUTTING THEMES EMERGING FROM THE ANALYSES OF THE 18 PRIORITY AREAS

Most published research and data collected relevant to climate change and health in the Caribbean relate to Domain 1 of the conceptual framework: climate change health impacts, exposures and vulnerability. There is relatively little primary research or surveillance data relating to Domains 2–4, on adaptation, mitigation, and resources and engagement.

Domain 1: Climate change health impacts, exposures and vulnerability

Some Priority Areas within Domain 1 have received more attention from Caribbean researchers than others. The Caribbean has been conducting groundbreaking work on arbovirology since the 1950s. Research on the links between climate change and VBDs has been conducted since the early 2000s, and, recently, work has concentrated on the development and adoption of early warning systems (EWSs) for VBDs. A growing body of research focuses on understanding the health outcomes of extreme weather events, increasing the resilience of health systems to severe tropical storms and hurricanes, and developing models of multisectoral action to address the health consequences of extreme events. A further rapidly emerging area of research is the impact of climate change on the incidence of NCDs and on health outcomes for people living with NCDs. Most Caribbean studies on climate change and air quality concentrate on the impact of Saharan dust on respiratory disease. Saharan dust is only one of the air quality drivers of ill health associated with climate change.

For the other Priority Areas under Domain 1, there is only a handful of Caribbean empirical studies. There is a dearth of studies on mental health, heat-related illness, population displacement and migration, and water, sanitation and hygiene (WASH). Only one Caribbean empirical study on heat-related illness was identified. Caribbean studies on mental health, population displacement and migration, and WASH do not generally consider how these issues are affected by climate change.

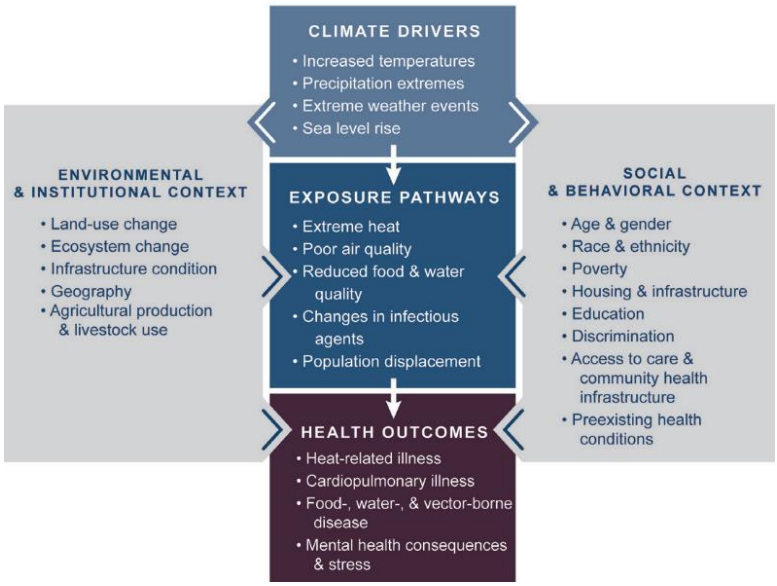
Surveillance data on climate change health impacts and exposures in the Caribbean are weak. Some mosquito-borne diseases are reportable by Caribbean Member States of CARPHA, and confirmatory testing is available for these diseases from CARPHA and in selected countries. Some food- and waterborne diseases that may be associated with WASH status are reportable to and monitored by CARPHA. CARPHA also conducts syndromic surveillance of fever and gastrointestinal illness to enable responses to infectious disease outbreaks in general. Some countries are developing registries for selected NCDs. COVID-19 cases are reportable, and syndromic surveillance includes cases of fever and cough, but little other systematic reporting of respiratory diseases takes place. Scarcely any data are systematically collected on mental health conditions or heat-related illnesses. No system is in place to monitor population displacement within countries, and migration data do not systematically include indications of reasons for migration. The few data systematically collected on health outcomes of severe weather events are usually restricted to mortality during or in the immediate aftermath of the event. However, since the 2017 hurricanes, studies in several countries have compared mortality during a period of several months post hurricane with mortality during the same period in previous years, showing substantial increases in deaths during the post-hurricane months.

There is also a lack of disaggregated data that enable the analysis of the distribution of health effects of climate change. Some data are disaggregated by sex and age group, but this is not universal. Often the implications of differences found between the sexes are not analysed from a gender perspective, so opportunities to redress gender inequities are missed. Similarly, data disaggregated by age are not usually analysed to develop appropriate strategies for each age category across the life course. Data on the distribution of climate-sensitive health conditions by other indicators of vulnerability such as income, race, ethnicity and disability are generally unavailable. There is limited use of geographic information systems (GISs), with such systems mostly used for the development of VBD and air quality EWSs. GISs have not been used to map climate-sensitive health conditions against indicators of social and economic deprivation. Studies of the health status of indigenous

people are rare, and their health is not systematically monitored alongside data on the environmental hazards they face, some of which are related to climate change. In sum, there is a shortage of data to inform the channelling of interventions to vulnerable groups and people.

Very few Caribbean studies demonstrate mediating factors on the pathways between climate drivers such as precipitation extremes and health outcomes such as food-, water- and vector-borne diseases. The United States Global Change Research Program's conceptual framework shows that environmental, institutional, social and behavioural contextual factors mediate the impact of climate change on health (Figure 3) (USGCRP, 2016). Studies have looked at climate drivers and health outcomes without considering the contextual factors that may be subject to human intervention and thus provide the potential for preventing and reducing adverse climate change impacts. Some studies look at individual contextual factors such as infrastructure condition. Such studies do not generally measure the health outcomes of different types of intervention, such as different infrastructural designs. This lack of an integrated approach means that there are very few Caribbean evidence-based interventions to reduce the negative impacts of climate change on health or to demonstrate the health co-benefits of climate change mitigation or adaptation measures.

Figure 3: Primary exposure pathways by which climate change affects health



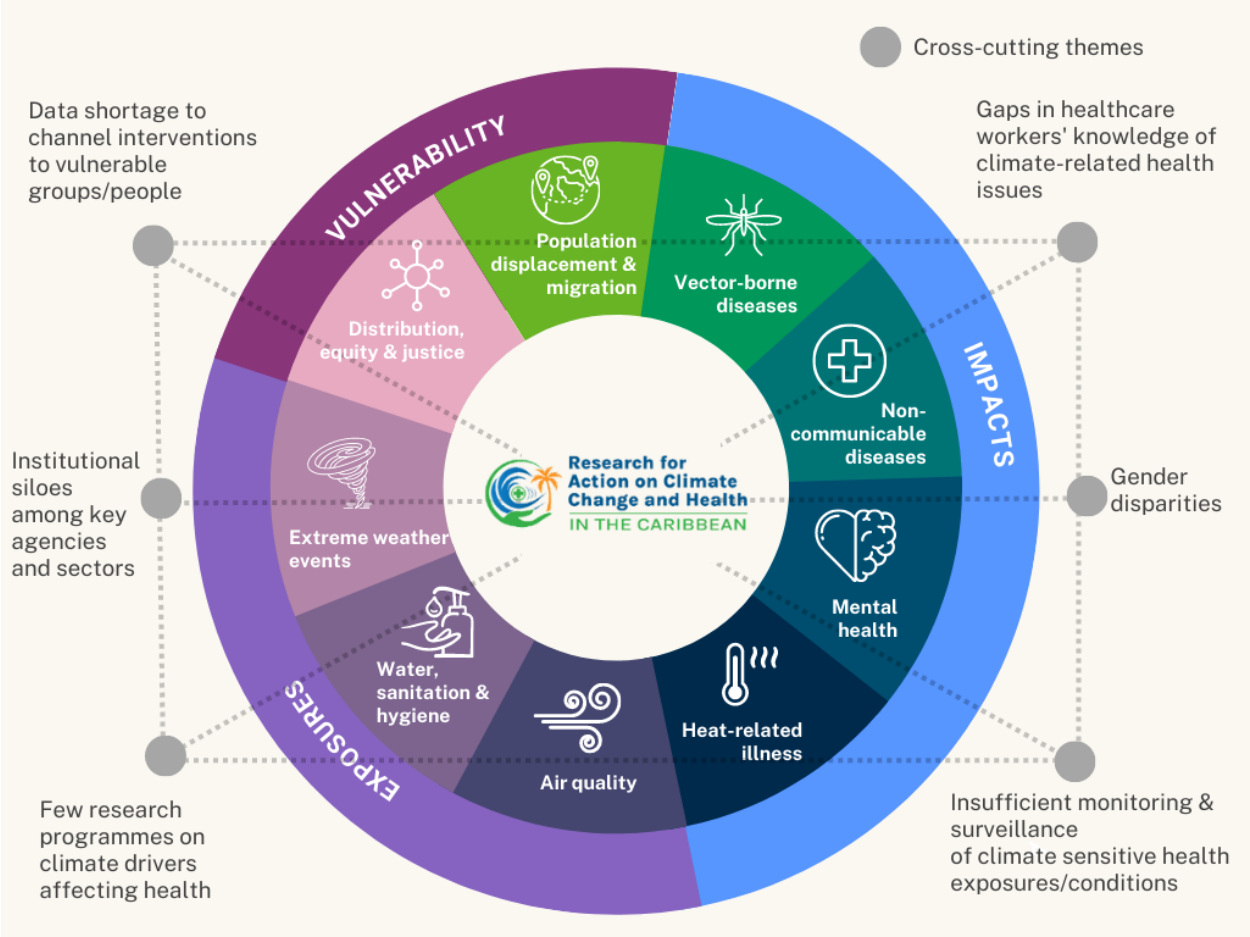
Source: USGCRP (2016).

Meteorological data are increasingly being used in research projects on health, especially in air quality and VBD research in the Caribbean. The Caribbean Institute for Meteorology and Hydrology and CARPHA are collaborating to integrate data and provide health forecasts based on weather forecasting. However, integration of data is hampered by the fact that reporting periods for health data are generally much longer (e.g. yearly or monthly) than for meteorological data (e.g. daily).

There is also very little information on what health professionals know about the impacts of climate change on health and the extent to which they use this knowledge in their professional practice. Gathering such information will be important for informing awareness and skills development.

Figure 4 presents the health impacts, exposures and vulnerability Priority Areas considered under Domain 1 of the CRAA, along with the cross-cutting themes that emerged from the analysis and have been presented in this section.

Figure 4: Priority Areas and cross-cutting themes on climate change health impacts, exposures and vulnerability



Domains 2–4: Adaptation, mitigation, and resources and engagement

Very few research projects have assessed adaptation, mitigation and other policy measures to address climate change in terms of their impacts on health outcomes. Most adaptation and mitigation projects in the Caribbean, with the exception of the Smart Health Facilities initiative, are not specifically designed with health outcomes in mind. The evidence for the Priority Areas under Domains 2–4 came mostly from the Conference, the stakeholder meetings hosted by R4ACCHC and the final stakeholder dialogue. Experts and stakeholders presented the work they do in various sectors and discussed how it could be leveraged and adapted to improve climate change-related health outcomes. Because of a lack of empirical research and surveillance systems, the most likely health outcomes of adaptation and mitigation measures are difficult to predict.

As indicated above, surveillance of climate-sensitive health outcomes must be strengthened. There is also a need for far more extensive documentation and monitoring and evaluation of policies, projects and social/behavioural interventions aimed at addressing climate change. Stronger research designs are needed, including stronger experimental designs comparing innovative interventions with the status quo or other interventions. Data-sharing practices and protocols, and ethics review mechanisms, are needed to overcome the limitations of individual SIDS and to benefit from shared expertise and economies of scale.

Participants in the Conference and in other aspects of the CRAA development process shared their expertise and experiences to share recommendations presented in the following paragraphs. These were only sometimes backed up with empirical evidence from the Caribbean, so strengthening the evidence base is paramount.

Increased funding must be provided for climate change and health research and action in Caribbean SIDS. This is a matter of justice, since SIDS are very minimally responsible for greenhouse gas emissions and other human activities that exacerbate climate change and its impacts. While funding related to climate change and designed for developing countries and SIDS has increased, it has not generally included research funding. Caribbean research is limited by the allocation of research funding according to country income classification, which is used by some donors. With the exception of Haiti, Caribbean countries and territories are classed as high income or upper-middle income. This makes research funding less likely, especially for the high-income countries and territories, and prevents collaborations between countries/territories at different income levels that nevertheless share climate change-related vulnerabilities.

Analyses of the Priority Areas under Domains 2–4 show that collaborative mechanisms must be actively established and maintained between countries, agencies and sectors. The health sector cannot go it alone in addressing the climate change-related determinants of health. Institutional siloes are difficult to overcome, and leadership is needed at every level to reach out and involve others in a spirit of partnership. Legal and institutional agreements between partners are needed for sustainability.

There is a need for increased knowledge, awareness and skills across society to effect the necessary cultural and political shifts towards climate change resilience and environmental sustainability. Communities of all types must be increasingly engaged. Leaders of all types of organisations should inform and empower people to become involved and take the necessary steps. Media and educational institutions must be involved.

Young people play a particularly important role in helping to determine health outcomes for future generations and can leverage their communications skills, especially if empowered by scientific information communicated in appropriate ways. To reduce the adverse health outcomes of climate change in vulnerable populations, it is critical to involve these populations in climate change and health decision-making and action. Involving vulnerable populations can also help in developing viable solutions for all of society, since others can benefit from their experiences and adaptive strategies. The resilience of communities must be built through education, active involvement and access to financial and other resources. National and regional initiatives will not be successful without the collaboration and cooperation of people “on the ground” in local communities and agencies.

Figure 5 presents the Priority Areas considered under Domains 2–4 of the CRAA, along with the cross-cutting themes that emerged from the analysis and that have been presented in this section.

Figure 5: Priority Areas and cross-cutting themes on adaptation, mitigation, and resources and engagement

CONCLUSION

The CRAA presents the existing evidence for the Caribbean and draws on the expertise of Caribbean and other stakeholders to make recommendations for research and action in the 18 Priority Areas. It is based on a broad ecological approach to health, considering multiple determinants across different sectors affected by climate change.

Empirical evidence for the Caribbean was found to be lacking, and what is known is not readily available to those who need to act. For all Priority Areas, there is a need for further research and much stronger surveillance systems. Evidence on what works is also sorely lacking. Attention must be paid to strengthening operational and policy research and assessing the effectiveness of interventions. Scientific information must be communicated in accessible ways to a variety of audiences. To implement all of this, funding must be provided for research, surveillance and communication.

Addressing the health challenges that Caribbean SIDS face as a result of climate change will take a huge collaborative effort. By assembling available evidence and presenting recommendations, the CRAA aims to assist in the development of community-level and multi-agency, multi-country and multisectoral approaches and to contribute to North–South and South–South cooperation, to overcome these challenges in the interest of a sustainable future.

Cross-cutting research questions arising from this process for the four domains of the CRAA are as follows.

Domain 1: Climate change health impacts, exposures and vulnerability

- What are the impacts of climate change on health? What contextual factors mediate the impact of climate change on health?
- Who are the vulnerable populations and how are they affected?

Domain 2: Adaptation, planning and resilience for health

- How effective are adaptation measures in protecting health?

Domain 3: Mitigation actions and health co-benefits

- What are the health co-benefits of climate change mitigation?

Domain 4: Resources and engagement for climate change and health action

- What are the costs of climate and health research/action?
- How can financial resources be mobilised?
- How do we join up silos between communities, researchers, health professionals, government agencies, businesses, advocates and other stakeholders?

REFERENCES

Allen, C. F., West, R. M., Beagley, J., McGushin, A. (2021a). Climate change and health in small island developing states. London: The *Lancet* Countdown on Health and Climate Change, University College London. Available from: https://www.lancetcountdown.org/resources.

Allen, C. F., West, R. M., Gordon-Strachan, G., Beagley, J., McGushin, A. (2021b). Developing indicators of climate change and health linkages in Caribbean and Pacific small island developing states: priority issues and measurement capacities (O-17). *West Indian Med J.* 69 (Supplement 2):26.

Benjamin, L., Thomas, A. (2016). 1.5°C to stay alive? AOSIS and the long term temperature goal in the Paris Agreement. *IUCN Acad Environ Law e-J.* 7:122–129.

CARPHA (Caribbean Public Health Agency) (2018). State of public health in the Caribbean 2017–2018 – climate and health: averting and responding to an unfolding health crisis. Port of Spain: CARPHA. Available from: https://carpha.org/What-We-Do/Health-Information/State-of-Public-Health.

Kotcher, J. (2021). Views of health professionals on climate change and health. Conference on Climate Change and Health in Small Island Developing States: Focus on the Caribbean (A Virtual Conference); 5–8 October. Available from: https://www.youtube.com/watch?v=f1XuSXafPng&list=PLZKElzrIqp1XeKknw_exYgzkGu9aan2Ju&index=3&t=1665s.

Kotcher, J., Maibach, E., Miller, J., Campbell, E., Alqodmani, L., Maiero, M., et al. (2021). Views of health professionals on climate change and health: a multinational survey study. *Lancet Planet Health.* 5(5):e316–e323. Available from: https://doi.org/10.1016/S2542-5196(21)00053-X.

PAHO (Pan American Health Organization) (2018). *Climate change and health in small island developing states: SIDS in the Caribbean Region*. Washington, D.C.: PAHO. Available from: https://reliefweb.int/sites/reliefweb.int/files/resources/Climate-change-health-Small-islands-Caribbean-SIDS-Sep-2018%20%281%29.pdf.

Rise, N., Oura, C., Drewry, J. (2022). Climate change and health in the Caribbean: a review highlighting research gaps and priorities. *J Clim Change Health*. 8:100126. Available from: https://doi.org/10.1016/j.joclim.2022.100126.

Romanello, M., McGushin, A., Di Napoli, C., Drummond, P., Hughes, N., Jamart, L., et al. (2021). The 2021 report of the *Lancet* Countdown on health and climate change: code red for a healthy future. *Lancet.* 398(10311):1619–1662. Available from: https://doi.org/10.1016/S0140-6736(21)01787-6.

Sarjeant, R. (2021). Greening the public realm: greener spaces and greener mobility. Conference on Climate Change and Health in Small Island Developing States: Focus on the Caribbean (A Virtual Conference); 5–8 October. Available from: https://www.youtube.com/watch?v=T8ho09eX6O4&list=PLZKElzrIqp1X9JSj3LmnwQe_zbznIkWaw&index=2.

Shumake-Guillemot, J., Villalobos-Prats, E., Campbell-Lendrum, D. (2015). Operational framework for building climate resilient health systems. Geneva: World Health Organization.

Taylor, M. A., Chen, A. A., Bailey, W. (2010). Review of health effects of climate variability and climate change in the Caribbean. Belmopan: Caribbean Community Climate Change Centre.

UNFCCC (United Nations Framework Convention on Climate Change) (2019). The Paris Agreement. Bonn: UNFCCC. Available from: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement.

USGCRP (United States Global Change Research Program) (2016). The impacts of climate change on human health in the United States: a scientific assessment. Washington, D.C.: USGCRP. Available from: https://health2016.globalchange.gov/.

WHO (World Health Organization) (2015). WHO calls for urgent action to protect health from climate change – sign the call. Geneva: WHO. Available from https://www.who.int/news/item/06-10-2015-who-calls-for-urgent-action-to-protect-health-from-climate-change-sign-the-call.

WHO (World Health Organization) (2017). Special initiative on climate change and health in small island developing states. Geneva: WHO. Available from https://www.who.int/news/item/06-11-2017-special-initiative-on-climate-change-and-health-in-small-island-developing-states.

WHO (World Health Organization) (2018). Climate change and health in small island developing states. A WHO special initiative. Geneva: World Health Organization. Geneva: WHO.

WHO (World Health Organization) (2021). Climate change and health research: current trends, gaps and perspectives for the future. Geneva: WHO. Available from https://www.who.int/publications/m/item/climate-change-and-health-research-current-trends-gaps-and-perspectives-for-the-future.