Full title: What can be said about risks, vulnerabilities, and adaptation to climate change in Caribbean small island developing states (SIDS)? The case of Dominica. A qualitative study

Short title: Climate change adaptation chalenges in Caribbean SIDS

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Abstract

Introduction

Caribbean Small island developing states (SIDS) are generally qualified as disproportionately vulnerable to climate change, including extreme weather events like hurricanes. While many studies already documented the impacts of climate change on health in the wealthiest countries, there is little knowledge in this field in Caribbean SIDS. Our study aims to discuss health risks and vulnerabilities in a Caribbean context to inform future adaptation measures to climate change.

Methods

Our paper is based on a qualitative study that was conducted in Dominica, a Caribbean SIDS. The data come from semi-structured interviews organized between March 2020 and January 2021 with people internally displaced following an extreme climate event, either tropical storm Erika (2015) or Hurricane Maria (2017), and with some people who migrated to Guadeloupe after Hurricane Maria. Interview guides were based on conceptual frameworks on climate change, migration and health, and vulnerability to climate change. Data were analyzed deductively based on frameworks and inductively to allow new codes to emerge.

Results

Our findings suggest that current knowledge of climate change by those who have been displaced by an extreme climate event varied greatly depending on the education level, class, and socioeconomic condition of the participant. Participants experienced various negative consequences from a storm or hurricane such as increased risk of relocation, lack of access to healthcare, and food, job, and water insecurities – all circumstances know to correlate with mental health issues. Participants suggested stronger dwellings, community preparedness

committees to act sooner, and climate change sensitization and awareness campaigns to foster community unity and solidarity.

Conclusion

These findings contribute to the perspectives and knowledge of climate change, highlighting that existing extreme climate event committees and government officials need to address structural and social barriers that can potentially increase social inequalities and lead to maladaptation to climate change with potential consequences on public health.

Introduction

Anthropogenic or human-induced climate change is due to a mix of greenhouse gas in very high concentrations (C02, CH4, N20) that contribute to global warming (atmosphere, land, sea, and oceans) (1). It has become a pressing global public health emergency whose consequences on human societies and the health of the planet are becoming increasingly severe due to the delayed and inconsistent response from countries worldwide (2). Anthropogenic climate change is already and globally aggravating weather and climate extremes by increasing the frequency and intensity of hot extremes, heatwaves, and heavy precipitations, the frequency of fires, droughts, and flooding in some regions, and, probably, the global proportion of category 3-5 tropical cyclones (1). Climate change, through weather-related events, can result in a multitude of consequences, such as the destruction of homes and infrastructures, aggravation of poverty and social inequities, and human mobility.

These circumstances expose populations to higher vulnerabilities and health risks, as highlighted by various studies (3–5). The intertwining of ecological and social determinants can pose significant health risks, leading to premature deaths, changes in freshwater and food security, alterations in diseases ecology, and the aggravation of some chronic diseases (2,5). Urgent action is required, particularly from the wealthiest countries that contribute the most to carbon dioxide emissions. These countries must take immediate steps to reduce greenhouse gas emissions and eliminate the use of public funds for fossil fuel subsidies (2). Considering this information, it becomes increasingly evident that mitigation and adaptation strategies are essential in addressing the challenges of human-induced climate change.

Caribbean Small Island Developing States (SIDS) are viewed as particularly vulnerable to climate change, resulting in changes in ecosystems and human societies. In particular, those individuals, families, and communities who are already disadvantaged are more vulnerable due to the impact of climate change (6). The Caribbean region has recently experienced a

disproportionate amount of climate-related disasters, with 60% of such events occurring in Caribbean SIDS (7). The Caribbean region is vulnerable to extreme climate events such as sea level rise, Tropical Cyclones (TC), air and sea warming, and changing rainfall patterns that pose multiple social and ecological risks (5,8). The interplay between ecological determinants, like weather-related events, and social circumstances creates potential risks for population health and well-being, such as the spread of infectious diseases, loss of settlements and infrastructure, and decline in ecosystems and biodiversity, impacting economies and livelihoods (5,8). Climate change is viewed as 'the most pressing threat' to the sustainable development of SIDS because of its vulnerabilities to climate-related events, either extreme like Tropical Cyclones (TC) or slow onset events like sea level rise (9).

A decade ago, adaptation to climate change was presented as urgent and a priority for SIDS, and was viewed as inseparable from the challenges posed by socioeconomic development (9). Therefore, adaptation of human systems to climate change includes measures to reduce vulnerabilities and generate benefits, such as food security, livelihood, health and well-being, and biodiversity protection (6). This adaptation process should encompass various aspects of life and society, including raising awareness, reducing social vulnerability to extreme climate events, territorial planning, risk identification, establishing early warning systems, and protecting human populations' health (2). It is crucial to acknowledge the heterogeneity of Caribbean SIDS and their diverse adaptation needs and vulnerabilities (10). General information on vulnerability to climate change may not adequately represent the specific characteristics of small islands, posing significant challenges for adaptation strategies.

Incorporating community perspectives into climate change adaptation efforts is crucial, particularly for vulnerable communities, to ensure effective and equitable strategies (10,11). Incorporating community members' perceptions of climate change is vital in informing policies and risk communication strategies and developing climate change adaptation plans and

120 responses (12,13). Adaptation to climate change should reflect on issues like colonialism and
121 capitalism, whose practices and legacies continue to broadly impact developmental injustice and
122 related vulnerabilities to climate change (14).

123 In the context of small islands, there is a significant research gap regarding the direct and
124 indirect impacts of climate change on human well-being (8). In Caribbean SIDS, there is a paucity
125 of research regarding climate change and health (15). Moreover, some authors highlighted the
126 need in Caribbean SIDS for more information on linkages between climate and local health data
127 to develop health adaptation measures (16). Cloos et al. (2023) conducted a study in Dominica,
128 a Caribbean SIDS, and they suggest that among those who were internally displaced or migrated
129 to Guadeloupe following a storm or a hurricane, daily life was rife with uncertainties and
130 insecurities (17). Similarly, a study in The Bahamas revealed a lack of action and recognition of
131 potential migration-related risks despite high awareness of climate change (80%) among the
132 young population (13). This paper represents one of the few attempts to contribute to the
133 discussion on adaptation and vulnerabilities in the specific context of the Caribbean SIDS, based
134 on local data. We draw from a qualitative study that explores climate change perspectives,
135 climate-related risks and vulnerabilities, and adaptation measures among individuals displaced
136 by extreme climate events that struck the Caribbean Island of Dominica. We hope our findings
137 can support and provide relevant insights to policymakers.

138

139 **Materials and methods**

140 *Study context*

141 This article is based on data from a larger study in Dominica conducted by PC and colleagues,
142 entitled “Climate, Migration, and Health in the Caribbean (*CliMiHealth*)”. This interdisciplinary,
143 cross-sectoral, and mixed-methods research project seeks to gain a better understanding of: 1)

the experiences of environmental change, 2) climate-related migration, 3) the impacts on the health of the population, and 4) issues regarding adaptation to climate change in Caribbean small islands. Dominica is located in the Eastern Caribbean region and is recognized as vulnerable to climate change impacts due to its mountainous terrain, changing wind patterns, and increased rainfall from July to December. Dominica is particularly exposed to environmental challenges such as sea-level rise, earthquakes, and volcanic eruptions (18). Dominica's economy also relies on sectors such as social services, agriculture, financial intermediation, transportation, trade, construction, electricity, gas, and water supply (19). Dominica has experienced extreme climate events in recent years, including Tropical Storm Erika in August 2015, which caused extensive damage to infrastructure, loss of lives, and mass displacement of families and communities due to heavy rainfall, mudslides, and flooding (20). Subsequently, Hurricane Maria struck in September 2017, damaging over 80% of the country's infrastructure, severe social, financial, and economic repercussions and thousands of internal displacements (21).

Conceptual Framework

CliMiHealth's research strategy aims to explore the interconnections between climate change, human migration, and health through the lens of vulnerability. It was inspired by a transdisciplinary approach to studying health related to human mobility in a climate change context, combining theoretical frameworks on the health impacts of climate migration and adaptive capacity. The project was guided by two frameworks: Wilhelmi et Hayden (2010) vulnerability and Schwerdtle et al. (2017)'s mobility, health, and climate change frameworks.

Wilhelmi et Hayden (2010) view vulnerability to extreme climate events (more specifically heat waves) as comprising exposure (comprising extreme climate event and land use component), sensitivity (depending on medical, demographic, and socioeconomic components), and adaptive capacity (i.e., knowledge, social networks and access to resources) that are determined by political, social, ecological policies and programs. Adaptive capacity is critical to

understanding vulnerability, as it involves a community's ability to adjust to and cope with changes and stressors. Building resilience and implementing strategies to adapt to climate change require well-informed policies and programs. Different communities may have different levels of adaptive capacity (22). Schwerdtle et al. (2017) propose a framework for understanding the health impacts of climate-related mobility. The framework identifies three pathways: direct exposure, displacement and migration, and adaptation and coping. Climate-related mobility can exacerbate the direct impacts of climate change on health. Displacement and migration can disrupt social networks and support systems, increase exposure to health risks, and result in poor living conditions and inadequate access to healthcare (3). Both frameworks underline that vulnerabilities and mobility are influenced by ecological determinants and shaped by political and social forces.

Study design, sampling, and data collection

Inspired by these frameworks, a semi-structured interview guide was constructed collaboratively for the data collection on issues related to experiences of mobility, knowledge, and observations on climate change, health issues, access to healthcare and other resources, impacts of climate change on living conditions, adaptive capacity, and recommendations regarding climate change adaptation (Appendix A). The sampling strategy was guided by diversification (23) and by the empirical field. Data was collected in Dominica and the neighboring island of Guadeloupe, where displaced individuals from Dominica relocated following an extreme climate event. Qualitative interviews began in Dominica in March 2020 and ended in January 2021. Data collection was suspended from April until July 2020 due to lockdowns brought on by the COVID-19 pandemic in Dominica. Interviews resumed in August 2020, and in total, 23 interviews were conducted with 25 participants (interviews 10 and 11 with one couple with a male and female each), 19 in Dominica, and 6 in Guadeloupe. NMP conducted the interviews in Dominica and MB in Guadeloupe. The respondents were identified through key community persons, including members of the health

194 teams and village council officials, who were considered to know individuals who had been
195 displaced. In Guadeloupe, fieldwork was conducted from January 2021 to May 2021. The
196 recruitment of migrants from Dominica was undertaken with the support of local research
197 partners. A slight adaptation of the interview guide to the local context was necessary to include
198 a question specific to cross-border mobility (Appendix B). Except for one interview, which was
199 done remotely in Dominica, all interviews were face-to-face. Interviews were conducted in
200 English, lasted 45 to 60 minutes, and were audio-recorded.

201 *Data analysis*

202 All interviews were verbatim transcribed by a research professional using the online software
203 Otter.ai followed by manual corrections. Transcriptions were uploaded to QDA Miner© for data
204 processing and coding. A mixed method of analysis - deductive and inductive - was initially
205 conducted by MB and PC and inspired by (24). The first stage of the coding process was
206 conducted using a preliminary list of codes related to the aforementioned frameworks on weather-
207 related human mobility, health, and vulnerability (including adaptive capacity) and allowed in vivo
208 codes to emerge from data (17). SC carried out a second stage of analysis in collaboration with
209 PC to, more specifically, pursue and deepen the analysis of preliminary codes related to
210 knowledge, internal and external drivers of vulnerability, and adaptation. This second stage
211 allowed the identification of in vivo codes concerning the participants' perspectives on social
212 cohesion, their recommendations on preparedness and adaptation, and any political barriers to
213 adaptation to climate change. SC and PC carried out the final steps of the analysis and made the
214 final decision on the themes.

215 *Ethical considerations*

216 This research was approved by the Research Ethics Board (Society and Culture) of the University
217 of Montreal (CERSC-2019-110-D-1). The Dominica National Board of Ethics also gave approval.

All methods were performed in accordance with relevant guidelines and regulations. All participants provided written informed consent prior to participating in this research.

Results

The presentation of themes that are described in this section is guided by the aforementioned frameworks to answer our research objectives and are made up of: experiences and knowledge about climate change and environmental change, vulnerabilities exposed in the context of climate change and displacement, external drivers of vulnerabilities such as unequal access to resources and political and organizational assistance, building adaptive capacity through social capital and community engagement, and finally recommendations from communities for a comprehensive approach for climate change adaptation.

Climate and environmental changes: experiences, knowledge, and awareness

Interviews showed that understanding what "climate change" refers to differs from participant to participant and is somewhat dependent on education level, socioeconomic status, and exposure to climate change information messages in mass media or community. In fact, six participants had never heard of the concept, had anything special to say about it, or had a vague understanding of its meaning. This is unsurprisingly related to the formal education level and age of participants. Others had a broad understanding of climate change and its environmental impact. Their observations showed an awareness of the increased risk of extreme climate events and slow onset events such as higher intensity of storms, changes in weather patterns, increased precipitations, and changes in seasonality (dry and wet seasons being longer, shorter, and unpredictable). Samara, who was displaced to Guadeloupe, thinks that: "people [are] more aware of climate change now. They [are] actually taking it more into consideration after Erika and Maria".

Those participants who knew about climate change had varying observations. Ines observed that with climate change, "you get more intense rain, and intense sun", while Camilo thinks that climate

change is impacting the weather on the island, causing: “it [to be] so hot that it is affecting the plants, things are changing”. He also noted that a ravine close by deepened because of the heavy rainfall that accompanied both storms. “When rain falls it is [the ravine] becomes a big river, so everything is changing.”(Participant Camilo).

Dalian, an older participant who was displaced within Dominica, drew on his experiences of Hurricane David (1979), offering his understanding concerning climate change and pointing out that the changes Dominica is currently experiencing are unlike anything seen before:

> “I was maybe just in my teens when hurricane David struck [in 1979]. I remember well, vividly what happened. And it really surprised me, because we'[d] never experienced that before. Now, Hurricane Maria was even worse. But in between, we have not had to talk about climate change. Apart from these two major and devastating hurricanes, we have had other conditions, heavy rains, and so on, that have impacted some of our lands, we have had mudslides and landslides, we have had broken up roads and washed away bridges, and so on. So[,] with regard to climate change and what is happening now, I think the change, what we have actually seen is something we had not seen before. So really climate change, in a sense, for us in Dominica is real.”

Anton made connections between the local and global, referring to other extreme climate events such as bush fires occurring on the west coast of Dominica and other parts of the world.

> “The void is left there when the rains fall and they sip into these crevices because remember the roots had spaces they were occupying. Now, who's going to occupy the spaces? Earth, then the water will come and occupy the space and is like thinking scientifically, yes you can understand why the earth is moving now, so much earth is moving because we have too many voids. I think we need to do a serious reforestation project in Dominica.”

Participant Anton referred to other events such as bush fires that are occurring on the West Coast but also in other parts of the world, making therefore links therefore between the local and the global. Some talked about slow onset events such as seasonality changes, warming of temperatures, sea level rise, flooding, landslides, and impacts on soil and water systems. However, there was little to no mention of the loss of biodiversity and/or pollution. Some participants referred to other environmental threats, including volcanic activity, mudslides, earthquakes, and tsunamis. Mirlande raised concerns: “some rivers are drying" which might be related to human activities, like construction and deforestation. Ines emphasized the changes in the sea’s behaviors, indicating that as Dominicans, “we notice even the slightest change in the waves, the slightest changes in the way the sea behaves and it has been rougher.”

Overall, the participants’ observations demonstrate a broad understanding of environmental changes. Some participants have recognized climate change impacts as interlinked between broader environmental and human activities, including land use changes, natural disasters, and river drying.

Vulnerabilities uncovered: Health challenges, access to care, and mental health in the context of climate change and displacement

The multifaceted challenges individuals and communities face in the wake of extreme climate events and displacement include healthcare access, mental impacts, and social vulnerability. The participants' narratives painted a vivid picture of the struggles and hardships they encountered, revealing climate change's far-reaching consequences on the well-being of affected populations.

A particular finding was the varied perception of healthcare needs among participants. Some participants (eight) did not perceive having the need for healthcare at the interview, while others described existing diseases or injuries that necessitated medical attention. Gisele stated that her health had deteriorated following Hurricane Maria, which resulted in increased issues

related to diabetes, blood pressure, and mobility. The case of Dalila's husband's exemplified the socioeconomic implications of a pre-existing medical condition during an extreme climate event. His back pain deteriorated, and its impact on their household income highlights how a pre-existing medical condition can create social vulnerability during an extreme climate event that links medical conditions to increased sensitivity to extreme climate events. Participant Amani, who was displaced within Dominica, had a pre-existing health issue and decided to self-treat because "the hospital had enough [patients] […] so I decide to look [after] myself". This reflects the strain the healthcare system faces during and after the extreme climate event and perhaps the need for alternative healthcare approaches.

Our participants also described the challenges encountered in accessing healthcare services. Participants described several obstacles, including confidence in public healthcare facilities, difficulty in reaching healthcare centers due to blocked roads, or the unavailability of services due to being closed or damaged. The absence of seeking services was also attributed to fear or distrust of caregivers and community members. Dalian thinks that the focus should be on the preparedness of the healthcare centers for extreme climate-related events, especially in relation to the Kalinago Territory. Dalian said,

> "The health facilities, in the community, in the entire Kalinago territory, should be well equipped. That is the first thing, because if something happens, how would you treat people? So that is the most important[, we need] [t]o be properly equipped, and properly manned […] And our disaster preparedness committees and all the agents [ ] who are working with them[, need to] be ready to work and to do what they have to do."

Dayana, who was displaced within Dominica, expressed that: "Like even a nurse, but which nurse? (…) There are nurses but (...) sometimes you don't know, I don't know who to trust....".

315 This lack of trust in the healthcare providers and the system hindered individuals' access to the
316 needed care.

317 Evident in the narrative of those participants who were displaced to the neighbouring island of
318 Guadeloupe highlighted the impact of limited healthcare access. Four individuals who were
319 displaced to Guadeloupe described lack of access to healthcare as the primary reason for their
320 displacement. Some participants even compared the healthcare experiences between that of
321 Guadeloupe and Dominica. Amongst the participants who moved to Guadeloupe, all six
322 mentioned a medical condition that they or someone in their family needed attention to in
323 Guadeloupe. Guerdy declared:

324 "I had some injur[ies], I had a cut there, and I had some stitches […] from the hurricane
325 and I decided no more, I just [need to] get to Guadeloupe, to take this to a hospital, […]
326 so that is the reason I left Dominica."

327 Additionally, the study uncovered the mental health challenges experienced by participants in the
328 aftermath of Hurricane Maria, such as shocks, anxiety or fears. Alvita described a general panic
329 among community members due to a lack of communication and access to necessities such as
330 water, stating that "for the majority of persons their state of mind was panic."

331 Moreover, participants expressed concerns about the potential recurrence of new hurricanes and
332 the precarious living conditions they were faced with, such as leaking roofs and unstable housing.
333 Jade, for instance, described the fear, stress, and anxiety arising from climate-related impacts
334 such as landslides, floods, and displacement, painting a grim picture of the emotional distress
335 experienced by those affected. Ines shared a poignant account of the deteriorating health of older
336 people in her community after relocation, highlighting their challenges in adapting to a new urban
337 environment. She explained how her father's health significantly declined after the storm, as he
338 was restricted in his movements after being placed in a house in Goodwill, Roseau:

> "the elderly, from the community who relocated, again to the same urban environment, [a] number of them could not adjust. And as a result, they got sick, and many of them died. […] My father died, not soon after, but his health deteriorated quite a bit since the storm. He was living at his house. […] But then, after it's someone [who] took him, [and] put him in a house in Goodwill, Roseau. He was not able to move around at all. So he was restricted, kind of, […] as a result of this, his health deteriorated."

The study also brought attention to the mental health issues that arise among children and the younger population due to the challenging housing conditions after Hurricane Maria. Agathe highlighted the mental health issues of the younger population due to the challenging housing conditions after Hurricane Maria. She also expressed concerns about gender roles and how men may suffer more in a disaster:

> "we focus a lot on the women, but I think the men tend to suffer more in a disaster than women […] The men […] kind of get scared because they feel that they are the protector and they are not sure how […] to continue protecting their family, continue doing what they have to do for their family".

Psychological aid was offered to displaced people after Hurricane Maria but only for those living in temporary shelters like a school. Overall, our study revealed a complex web of vulnerabilities stemming from the intersection of climate change, displacement, and healthcare access. It highlighted the various challenges faced by individuals and communities in the aftermath of extreme climate events, including limited access to healthcare facilities, negative perceptions of public healthcare, a lack of trust in caregivers and healthcare providers, and the exacerbation of pre-existing medical conditions. Additionally, the study shed light on the profound mental health impacts experienced by participants, underscoring the urgent need for comprehensive support systems that address the psychological well-being of affected populations.

External drivers of vulnerabilities: Unequal access to resources and political and organizational assistance

Following the extreme climate event, participants faced various challenges in returning to their original homes. Factors restraining participants from rebuilding were money and material resources. At the time of the interview, only four participants had returned to their original house following the extreme climate event. Rebuilding efforts were mainly reported as a household-level process involving cleaning, salvaging, and rebuilding damaged areas. However, access to external support and resources was crucial in facilitating these efforts. Participants mentioned experiencing varying waiting times to access government or internal support, with some waiting for days to even a couple of years. Immediate support came in the form of temporary roof coverings and food supplies, but vigorous rebuilding efforts took up to two years. Dalila discussed her husband's situation:

> "He had applied for some assistance though the parliamentary representative,[…] [but so far, he has only received] promises. And he [is] still waiting for the tools, because some of his tools were stolen."

The findings suggest that access to assistance schemes appears to have been very disparate among participants, with assistance disparities attributed to political divisions. Housing assistance was reported as being undertaken by various organizations, both international (Red Cross or Samaritan's Purse) and local, and varied in content and scale among participants. Only one participant mentioned a government relocation program which took a while to acquire. Ines, displaced within Dominica, declared:

> "Red Cross came to Layou [about] that time. There was a home that was damaged, but I saw in my mind's eye as salvageable. So[,] I requested that Red Cross assist through the Layou committee (...) - I got a roof for that house, and I fixed it, and I moved my family."

Four participants who returned to their original house with limited external support expressed an important mental burden in assuming this process by themselves. Some participants had to make

do with "intended to be temporary" makeshift homes, which were still in use at the time of the study, without a near prospect of change. Elian, displaced within Dominica, expressed his concern about the ongoing situation:

> "[the government] did well though after the hurricane but I don't know what[‘s] going on, I still see roof[s] uncovered as we're talking right now. […] I see around town and goodwill, […] people still live [] under tarpaulin [roofs]. [ ] I don't know what the government is doing [to provide assistance]. At least people that [are] less fortunate [can be] assist[ed] [to and, with], roofs and stuff like that. That's the only way."

In terms of adaptive capacity, the findings suggest that the participants' ability to recover and rebuild their homes after the extreme climate event was highly dependent on their access to external support and resources. The disparities in access to assistance schemes are perceived to be related to political division and suggest a lack of coordinated effort in providing relief and rebuilding efforts.

Some participants raised political favoritism as a barrier to receiving support after a storm or a hurricane. Some felt that the government should work to benefit all communities and put aside party politics and differences. They emphasized the need for the government to plan, decide what to do, and then take action to help everybody affected by the disaster. Clara said:

> "The government of […] need[s] to work [for] both sides, they need to come together [for the betterment of] both sides. Forget about party politics and all [the] differences and […],sit down as [the[government in office, come together, decide what you are you going to do. Make a plan (accentuated), decide what you're going to do and do it. […] You need to help everybody."

Camilo expressed a need for clearer roles and better coordination between the government and village councils in the field after an extreme climate event. He suggested that the government should work with the council and people on the ground, rather than trying to control everything

from a central position. He also raised concerns about selective or preferential intervention in the distribution of relief resources, which can lead to some people getting too much while others do not receive enough. This can be a barrier to proper adaptation and could potentially increase the health vulnerability of those affected by the extreme climate event. Camillo said:

> "Then […] the government c[a]me [to] build for people but that was still […] like picking and choosing who to give [materials]. So[,] most people who needed they didn't give them, [while] some people [got] too much. Some people['s] structure [was] still up, [yet] they g[o]t [many] things[.] [Even] some people [who] c[a]me from overseas, [with] money they [got] materials. I d[id not] get [even when] I ask[ed.] [T]herefore I said I [am] tired [of] beg[g]ing."

These extracts suggest that selective or preferential intervention, as well as government control, in terms of resource assistance after an extreme climate event can create barriers to proper adaptation or maladaptation, potentially leading to increased health vulnerability to the extreme climate event.

Building adaptive capacity through social capital and community engagement

The impact of extreme climate events, such as TS Erika or Hurricane Maria, has highlighted the capacity of individuals to adapt to changing circumstances. While some chose to migrate to Guadeloupe as an opportunity to start fresh, others who were displaced faced significant vulnerabilities due to the extreme climate events, including difficulties accessing basic needs like food and water. The decision-making process for seeking shelter during the hurricane was influenced by the perceived risk caused by the individuals' dwellings and their social ties. This lack of confidence in their own homes and the reliance on social connections showcases the role of social capital in adaptation.

Following Hurricane Maria, many participants engaged in mobility before and after the extreme climate event because they thought their house was not sturdy enough. Findings from our

interviews showed that participants engaged in an arbitrary decision-making process on where to take shelter based on the perception of the risk caused by their dwelling and their social ties. Participants would either decide to go to a local shelter (e.g., church or school) or to a friend or families' apartment/ house whose structure was deemed resistant enough. Clara said that just before Hurricane Maria hit Dominica, she

> "choose to go to [her] sister-in-law, because her house is more structured than [Clara's] because she has a blockhouse and concrete roof. It was [ ] safer than [Clara's]."

Risk perception, community level disaster management and social capital were the main drivers and determinants in what participants felt was supposed to be short-term displacement.

The effects of climate change, including housing insecurity, food and water insecurity and job loss, have created significant challenges for communities. Farming was mentioned by participants as being heavily impacted in both aspects of job and food insecurity. With agriculture comprising 19.9% of Dominica's economic activities and being the second most significant contributor to the economy (19), it is clear that Dominicans rely heavily on farming. As Dalian aptly pointed out, "they are a farming community." However, with the looming threat of climate change, the potential long-term damage to Dominica's economy raises concerns about increased dependency on external aid. Dalian said:

> "We depend on our agricultural product more than we depend on the rice and flour […] now that [agriculture]is gone; and [then] rice and flour would be in shortage in Roseau and elsewhere, and clearly you wouldn't have food. […] The State [then] had to come in and do what they had to do to provide the people with […] food daily. [That's what I mean when I say] at the mercy of the State."

The TC had an impact on various infrastructures in Dominica, resulting in road closures and water shortages, which further disrupted people's lives and livelihoods, making it difficult to access jobs and essential supplies. Individuals, such as Elian, have had to adapt to the changing circumstances by finding alternative sources of income after losing their jobs. The observation by

Elian highlights the impact of climate change on employment and the need for individuals to adapt to changing circumstances. He said:

> "I [had] to change jobs after Hurricane Maria because I was a security guard. At that time the supermarket [where I worked] was damaged [by the floods].[..] So I['ll] say [for] about one year (accentuated) I [didn't] work for the supermarket, [b]ut I [found] somewhere else to work."

Alvita as well, declared that:

> "You find in certain areas [ ], if you did not have enough food at your home, and […], you [were unable] to access the shop because of the level of the disaster. There were landslides [and] there were road cuts. So [depending on] where the shop was located [to] your home [..], then [ ] you w[ould] not be able to access food. Water was totally shut off."

Many participants had to relocate due to unstable housing, 17 out of 25 participants moving to a new dwelling that was not their original home prior to the TC. Six participants had eventually returned home after being displaced for varying lengths of times. For Alvita, life completely changed since relocating since she "ha[d] to start all over". For others, like Mirlande, it presented as an opportunity for a fresh start after Hurricane Maria by migrating to Guadeloupe, which was viewed as moving to "greener pastures". However, for others who migrated to Guadeloupe, they faced migration issues such as visa or passport related challenges.

Amidst the challenges, participants recognized the importance of community engagement and solidarity in adapting to climate change. They recognized the negative impact of extreme climate events on community cohesion and the tendency towards individualism, which can hinder the ability to respond effectively to disasters. Before and after an extreme climate event, "there [was] a selfishness in the community you know, each man to himself" (Dalian, displaced within Dominica). Others like Camilo and Dunia raised concerns regarding loss of unity and social inequalities in terms of differentials in access to resources.

Despite this negative attitude sensed toward the current community cohesion following extreme climate events, at the same time there was a positive attitude from participants who expressed a desire for community involvement and to help one another. Dalila wants to "offer, [her] hand in whatever way [she] can to [help] others". Similarly, Clara suggested that "we need to come together as a community to help one another". Another participant emphasized the importance of returning to past levels of community cohesion, saying:

> "I believe we need to go back to those days, the old-time days when people used to have one little fowl and you would kill it and give the neighbour piece. Or tell the neighbour I cannot give you piece […] but I can give you gravy. We need to go back to those days." (Camilo and Gisele, interviewed at same time, displaced within Dominica)

Overall, building adaptive capacity in the face of climate change requires leveraging social capital, accessing resources, and fostering community engagement. The vulnerabilities and risks experienced by individuals extend beyond the initial climate event, necessitating ongoing efforts to adapt and support one another. Despite concerns about current levels of community cohesion and inequalities in access to resources, participants expressed a desire to come together as a community to help one another and emphasized the need for greater unity in the face of future climate risks.

Some recommendations from communities for a comprehensive approach for climate change adaptation

The participants in this study provided a range of valuable recommendations for future climate change adaptation, which encompasses a range of themes related to awareness, education, access to information, and preparedness for climate disasters. Alongside technical needs, participants also highlighted the need for other types of adaptation, including sensitization and awareness initiatives to prepare individuals and communities for the impacts of climate change.

As Camilo points out the need for education and access to information on climate change and its potential impacts, particularly for individuals with lower levels of education:

> "We have to sit down and talk about [climate change]. What can we change? Some people might just be hearing the name [climate change], and [they] don't understand. Because he may have a lower [education] level."

Education was a key theme in the recommendation for future adaptation plans, with suggestions including education in the community about the meaning of climate change, the inclusion of the churches in the discourse, and more psychological programs to deal with the stress and anxiety post the extreme climate event. Some participants expressed the need for education or programs about climate change and climate disasters to be targeted to schools. It was felt that youth was among the most important populations to target since they would be the population the most affected by the ramifications of climate change. Samara had this to say:

> “Yes, I feel that it's not only talking about it, it's like, not only on the radio, they should go into different sectors, schools, and give practical [ ] demonstration[s] with children and show them how it can impact [ ] their lives. And what the effects and the advantages and disadvantages [are]. So that children will be not only hear[of] it, but when it's time, they'll be able to participate and demonstrate to others as well.”

Some participants also expressed the need for stronger buildings and infrastructure to better prepare for climate disasters. Anton, displaced within Dominica, suggests “a lot of adjustments need to be made and one of them is [in] housing.” While Dalian suggested that better planning was needed for water, food, and medical supplies, as well as shelters. However, some participants highlighted that climate change adaptation is not just about the infrastructure, but it also involves the adaptation and development of the way we speak about human resources, human development, and human rights. The investment in human resources, including

addressing social vulnerabilities and preparing people mentally and emotional to deal with the impacts of climate change is crucial. According to Agathe:

> "We feel that climate change [only affects] infrastructure [ ] so you [re]build back infrastructure. [Y]ou build back the things you probably built, walls and things to protect the rivers but when you think of it, climate change affects the human way of thinking, human development, human rights. […] I don't think we have enough resources invested in the human resources in the island to prepare us mentally [for] climate change. That's my opinion (…) for instance, like, after Erika, we had tropical storm Erika, anytime [it] rain[s] people start […] panicking. You know, then Maria c[a]me, so anytime […] persons hear [of] a disaster, [they] start to panic and want to stay home because they have a certain level of fear. [S]ome of the fear is because they still don't feel they are prepared enough to deal with climate change."

And according to Samara: “I know that there are a number of persons still living in bad conditions after the hurricane, their homes are not repaired, some people are still living under tents in poor conditions really.” Agathe and Samara’s comments emphasized that people’s mental and emotional preparedness for climate disasters is essential as many individuals still live in poor conditions.

The findings highlight the need for a comprehensive approach to climate change adaptation that addresses both physical infrastructure and human resources. Sensitization, awareness initiatives, and education are necessary to prepare individuals and communities for the impacts of climate change, especially for vulnerable populations. It is essential to invest in human resources and address social vulnerabilities to create a more resilient society to climate change.

Discussion

562 This qualitative study discusses risks, vulnerabilities, and adaptation related to climate change in
563 Caribbean Small Island Developing States (SIDS). This study is based on research data on
564 experiences and perspectives of people who were displaced, relocated, or migrated after recent
565 extreme-weather events –specifically, a storm and a hurricane in Dominica. Our study addressed
566 several climate-related risks, including human mobility, damages and losses (property,
567 resources), and health. Participants were mainly women (18/25) and most did not have a
568 postsecondary education (17/25) (See Table 1 and 2). Among participants, only one had house
569 insurance, which puts the rest at risk of potential impoverishment in the absence of material
570 assistance following an event such as a storm. This qualitative study highlights the urgent need
571 for targeted interventions and policies to address the climate-related risks, vulnerabilities, and
572 inadequate support faced by individuals who have experienced displacement and relocation due
573 to recent extreme-weather events in Dominica.

574 As previously described by Cloos et al. (2023), the available data suggest the direct and
575 indirect impacts of TS Erika and Hurricane Maria on mental health, displacement, housing, living
576 conditions, and unequal access to resources and assistance. Our study reveals specific trends in
577 inequities related to access to healthcare and other resources and opportunities. Some expressed
578 distrust in the healthcare system, or they find it poorly equipped, particularly in the Kalinago
579 territory. Others left the island for medical reasons because they did not feel they would have
580 received proper care. Unmet healthcare needs were previously identified as a concern following
581 the TS Erika in Dominica, including in the mental healthcare field (25). Adaptation planning and
582 implementation prioritizing inclusive practices for equity and justice could lead to more effective
583 and sustainable adaptation outcomes.

584 In our study, mental healthcare was delivered temporarily by a regional team only for those
585 in shelters. As a result, participants dealing with mental health issues arising from living insecurity,
586 uncertainty, relocation, or housing instability, as well as those with persistent needs, faced barriers

in accessing the essential care they required. Mental health should be considered a priority for Caribbean SIDS in the adaptation process to climate change because it is related to social cohesiveness and overall human development (26). Considering the necessity of developing public mental health policy, there is a need to broaden the current focus from mainly emergency and preparedness to potential disasters such as hurricanes. This expansion should encompass more comprehensive and long-term climate change adaptation for all extreme and slower onset events affecting the Caribbean.

Our data suggest that participants' varying levels of understanding of climate change are influenced by factors such as level of formal education and exposure to climate change. Based on the participant's perspective, they cited changes in weather patterns, more frequent hurricanes, and slow-onset events such as rising sea levels and more frequent flooding and landslides. Our study suggests adaptation plans in Caribbean SIDS should address knowledge gaps and socioeconomic disparities within communities. This consideration will ensure that adaptation measures in the Caribbean are equitable and effective in reducing risks and building resilience to climate change impacts. To address these gaps, there should be a strong emphasis on national and community media messages to increase awareness and actions related to climate change and its potential impacts on health. As Mocatta et al. (2022) suggest, climate change's escalating impacts on health require place-appropriate adaptation measures, which involve health-related interventions tailored to the social and cultural context. Therefore, there is a pressing need to prioritize national and community media messages, which can effectively enhance awareness and prompt actions concerning climate change and its potential impacts on health. Place-responsive translation can serve as a knowledge broker that employs participatory communication to involve the community in listening, dialogue, debate, and collaborative decision-making on agreed solutions (27).

The lack of social unity and solidarity following an extreme climate event raised by some participants refers to tensions and contradictions following an extreme weather event. This is contrary to the well-known practice of *Koudmen*, a cooperative form of labor exchange where community members help each other through work-sharing and building together for the common good (28). *Koudmen* is a Creole word that refers to this cultural tradition in Dominica that has been credited for building vital aspects of society, such as housing and farming. These indications in the data about the potential lack of social capital may be related to social divisions and inequalities that become pronounced following a post-extreme climate event context, especially in the distribution and availability of resources. Importantly, this study suggests that in certain cases, there may be a dearth of social capital, unequal access to resources, and political polarization, which could contribute to increased social vulnerabilities to climate change (29). Furthermore, a lack of social capital in the form of weak local networks could prevent adaptation to climate change (8).

The issue of equity is a concern raised by participants in our study and noted in the literature. Some participants reported instances of political favoritism in the distribution of post-extreme climate event assistance, food, materials, and other resources. These inequities potentially harm mental health and social cohesion (29). Moreover, the literature suggests growing political polarization leading to various forms of discrimination in Dominica based on political victimization, gender, sexual orientation, and membership of the indigenous nation. Reports from organizations such as the Office of the High Commissioner for Human Rights indicate the need for greater attention to be paid to these issues (30,31). It was already suggested that social inequities in health are not a priority in the Caribbean (32). Moreover, this might increase vulnerabilities in the context of anthropogenic climate change and weather-related events (29) and lead to potential maladaptation.

Adaptation action plans for climate change should be based on scientific and local knowledge (33). This is because communities and their members possess valuable insights into their living context (34). However, local and/or traditional beliefs can also represent a barrier for adaptive capacity (8). There are known local capacities for short-term weather forecasts (e.g. drought incidence) but less evidence regarding the use of local knowledge for long-term climate change forecasting (8). Traditional construction practices are known as increasing adaptive capacity and therefore reducing vulnerability to tropical cyclones and floods (8). This seems especially valid for the Caribbean SIDS in reference to the building of local homes, such as the *Ti Kai Creole*, some of which have withstood multiple hurricanes (35).

Some participants pointed out global environmental changes and degradation that affect the often designated 'Nature Island' of the Caribbean (36). In Dominica, several large-scale projects have recently accelerated, sometimes without the participation, consent, and constructive input of communities and their social and historical eco-systems. One of these projects is the geothermal power plant in the village of Laudat, which benefits from a loan from The World Bank (37). A cable car aerial tram to the Boiling Lake in the Roseau Valley is also constructed. This construction involves deforestation, potentially harming the Morne Trois Piton National Park, a UNESCO world heritage site (38). Moreover, developing an international airport in the north of Dominica is underway, posing potential risks to entire communities, including increased stress, anxiety, and uncertainties (39). It is crucial to consider the potential implications of these ongoing and future projects on the environment and the overall well-being of the local population. These projects involve deforestation, extreme earth movements, and interruption of water supplies and wildlife (38). Despite the rhetoric of resilience from the Dominica government in reports and political and international relations discourse, these large-scale projects do not consider the environment enough, including rivers, the natural environment, and biodiversity. Consequently, without proper environmental impact assessments, land use practices can expose

certain villages more vulnerable to extreme climate events. Due to factors like insufficient political will and unsustainable funding, the lack of climate policy coherence in Caribbean SIDS at regional and national levels is consistent with previous studies (40,41). This article highlights the importance of understanding climate change policy integration to assess environmental governance efforts and set sustainable development goals, particularly considering the challenges posed by new actors, mechanisms, and fragmented governance structures. However, despite regional recognition, there remains a significant degree of fragmentation, silos in governance, data sharing reluctance, and a lack of accountability, hindering climate policy coherence in each Caribbean Island (41).

Limitations

This study has some limitations that should be considered when interpreting the results. First, the sample size was relatively small, as in any qualitative research study. This limits the generalizability of the findings, although knowledge is certainly transferable to similar contexts (like to other Caribbean islands with the same characteristics). Second, the climate change discussion spearheaded by the researcher during the interviews was often oriented to climate disasters and hurricane preparedness and response. This could have influenced how participants responded. However, we think that it also reflects that, as discussed previously, the emphasis is on responding to emergencies and climate disasters. Third, this study represents a limited diversity of experiences and situations. Finally, not all climate-related risks have been studied. Despite these limitations, the study provides valuable insights to inform future adaptation measures from the experiences and perspectives of the participants in this particular case study. Further research is needed to study these issues with other weather-related events and Caribbean contexts. The findings of this study underscore the relevance of exploring and integrating effective traditional/local approaches and knowledge to address health-related risks as a crucial component of building adaptation strategies to climate change in Caribbean SIDS.

Conclusion

Based on qualitative interviews with people who were displaced after a storm or a hurricane in Dominica, this study suggests a potential lack of social cohesiveness; distrust in some institutions like the health system; issues related to environmental degradation and land use; differential knowledge and awareness regarding climate change; unequal access to various resources, services (including health care) and support; difficult living conditions that can create uncertainties and insecurities, potentially associated with mental health issues. A combination of factors which can limit the local capacity to adapt to climate change. Adaptation planning must prioritize equity and justice, and governance must be inclusive to achieve climate resilience (6). Building hurricane-resistant health centers is insufficient if other infrastructure projects expose ecosystems and human societies to climate-related risks. Political engagement, clear institutional frameworks and policies, and adequate resources are essential enabling conditions for adaptation to climate change (6), which requires a concerted effort to integrate considerations of the interconnectedness of various actors, sectors and areas of life.

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Tables

Table 1. Participants' info of displacement

Type of displacement	Type of housing	Length of time of displacement	Identification
Displaced within Dominica (n=19)	Returned home (n=6)	Less than 1 year (n= 3)	Agathe, Benita, Bembe
		1-3 (n=3)	Amani, Clara, Dunia, Juan
	Relocated in new dwelling, either housing or rental (n=6)	Less than 1 year (n=2)	Jade, Elian
		1-3 (n=2)	Ines, Dalian
		4-6 (n=2)	Alvita, Anton
	Shelter (n=2)	1-3 (n=2)	Laurette, Mia
	Other (n=4)	Less than 1 year (n=1)	Dalila
		1-3 (n=3)	Dayana, Camilo, Gisele
Relocated from Dominica to Guadeloupe (n=6)	Renting (n=3)	1-3 (n=1)	Mirlande
		4-6 (n=2)	Guerdy, Samantha

	Temporary renting/housing (n=3)	4-6 (n=3)	Naomi, Samara, Tasha

Table 2 Sociodemographic info

	Displaced within Dominica (n=19)	Displaced from Dominica to Guadeloupe (n=6)
Gender		
Female	13 (68.4)	5 (83.3)
Male	6 (31.6)	1 (16.7)
Marital status		
Single/divorced	7 (36.8)	4 (66.7)
Married/ Common law/Cohabiting	12 (63.2)	2 (33.3)
Education level		
Primary	11 (57.9)	1 (16.7)
Secondary	3 (15.8)	2 (33.3)

Higher education (college/ bachelor degree)	5 (26.3)	3 (50.0)
Age of participant (in years)		
20-39	4 (21.1)	4 (66.7)
40-59	8 (42.1)	2 (33.3)
Above 60	7 (36.8)	0
Number of individuals under 18 living with parent		
0-1	9 (47.4)	1 (16.7)
2-3	6 (31.6)	2 (33.3)
4 and above	4 (21.0)	3 (50.0)
Employment status		
Unemployed	7 (36.8)	3 (50.0)
Employed	12 (63.2)	3 (50.0)