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OPINION

Put the money where the gaps are: Priority areas for climate resilience research in the Caribbean

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Climate change threatens the fabric of social, environmental and economic existence of Caribbean nations. Countries and regions around the world have been battling the impacts of climate change, with rising temperatures, changing rainfall patterns, more frequent and severe hydro-meteorological events such as hurricanes, droughts, floods, and storm surges, rising sea levels and changing rainfall patterns. The Caribbean region is no exception, and has been identified as the most vulnerable to the impacts of climate change. These island states are not uniform in their vulnerability, and their capacities for effective climate change adaptation and resilience building are also vastly heterogeneous. However, though unique and diverse, their vulnerability is often compounded by common challenges such as their small size, limited capacity to mobilize resources, topography, high debt, and dependence on climate-sensitive sectors.

Nevertheless, Caribbean territories have been making strides in bolstering their resilience to the current climate emergency through the implementation of various programmes and projects, as well as strategic development plans that are closely aligned with the *2030 Agenda for Sustainable Development*. Caribbean nations have been investing in the blue, green and circular economy, climate-proofing infrastructures, and exploring renewable energy sources, as well as engaging in a collective effort to establish the region as the world's first climate-smart zone [1]. Research has also been active and ongoing on several fronts including published articles and grey literature from regional organizations such as the University of the West Indies, (UWI), Caribbean Public Health Agency (CARPHA), Caribbean Natural Resources Institute (CANARI), Caribbean Community Climate Change Centre (CCCCC), Caribbean Agricultural Research and Development Institute (CARDI) among others. Jamaica recently developed its first Climate Change Research Agenda which prioritizes research areas that should guide, inform and complement mitigation and adaptation strategies across sectors, as well as promote integration and synergy among stakeholders for proactive action to address the challenges of climate change [2].

However, persistent climate risk to the region's societies and economies is underpinned by insufficient funding for research and technology development; a common feature linked to many fiscal consolidation (debt stabilization) programmes designed by the International Monetary Fund (IMF) which limits discretionary public spending in these states [1]. The Caribbean is said to have some of the lowest levels of research and financing in the world, where 0.09% of GDP is spent on investment in research and development. In Jamaica, less than 1% and 0.3% of GDP is spent on science and development and research and development respectively [1].

This limited emphasis on funding research throughout the Caribbean has resulted in knowledge gaps and an increased reliance on outdated data which may hinder effective and innovative plans, programmes and policies that are critical for climate resilience.

While there are currently several areas of broad research interest including climate modelling and forecasting [3, 4], coastal zone management and adaptation [5], disaster risk reduction [6] nature or ecosystem-based solutions [7], water resource management, availability and demand [8], vulnerability and impact assessments [9, 10], among others, we have selected three areas that we deem as priority for climate resilience. First, there is a need for research to focus on quantifying the risk posed by concurrent and successive compound hazards [11]. It is crucial for Caribbean nations to examine how these contribute to recurring damages and losses, impact climate resilience at different scales and how data is integrated into risk reduction plans, policies or progammes to inform a 360-degree resilience framework. For example, while the globe battled the Covid-19 pandemic, many Caribbean territories were experiencing this health threat alongside several other hazards. St. Vincent and the Grenadines was one such island that was affected by several hazards including the dengue epidemic, the 2021 volcanic eruption, and tropical storm Elsa which further exacerbated some of the risks created by the volcanic eruption.

Accurate and reliable climate models and forecasts are also essential for predicting future climate changes and impacts in the Caribbean, as well as planning for and responding to the impacts of climate change across different sectors. While downscaled climate change projections continue to be developed and refined by the Climate Studies Group Mona (CSGM), technology gaps to process 'big data' remain. Similarly, while there has been some progress towards strengthening Early Warning Systems (EWS) across several Caribbean islands including Antigua and Barbuda, Dominica, Dominican Republic, Saint Lucia and Saint Vincent and the Grenadines (SVG) [12], there is a need for community level research on knowledge and perception of EWS and the barriers to responding to EWS.

Another important area where there is a paucity of literature in the Caribbean is the psychosocial impacts of disasters and the implications for resilience building. Although there is a growing interest in the epidemiological understanding of the consequences of climate change for mental health in the Caribbean [13, 14], there is still a need for research to understand the psychological impact of climate related hazards including longer term climate dynamics such as sea level rise, heat stress and ocean acidification [15]. Resilience building must integrate mental health which influences how persons interact with their environment.

In each of the highlighted research priority areas, cross cutting themes such as gender, age and people with disability (PWD) must also be addressed. Mainstreaming climate change adaptation research that is gender-responsive, inclusive, and participatory is critical for fair and just climate resilience. Likewise, in recognizing the disparities in climate vulnerability, adaptation, and recovery, evolving climatic conditions require an iterative approach to adaptation planning and action. Research on the monitoring and evaluation of the effectiveness of resilience building measures, policies, plans and adaptation interventions has been limited throughout the region. The acceleration of scientific research that measures resilience over time and space is critically important. Without systematic monitoring, knowledge of a nation's progress in climate resilience remains in the dark.

Therefore, we believe that progress in research priority areas requires an efficient mechanism or enabling environment that facilitates sustainable financing, such as the integration and institutionalization of research priorities in national and ministerial budgeting processes. This is particularly important given the human and financial capacity constraints that limit climate related research in the region. Likewise, advancing the climate resilience agenda in the Caribbean also requires strengthening inter-regional collaboration among diverse stakeholders

and knowledge systems, because the impacts of climate change are not only complex, but also transboundary.

Author Contributions

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