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The Caribbean Institute for Meteorology and Hydrology (CIMH) and some National Meteorological and Hydrological Services (NMHS) in the Caribbean provide climate services to enhance resilience at the national and regional levels in the Caribbean. However, much of a country's climate resilience is built at the community level where actions in response to climate conditions typically emanate. In an effort to have some insights into the effectiveness of current climate services delivered in-country and, by extension, how to better serve communities in the Caribbean, the CIMH contracted Dr. Andrew Simmons and his team based in St. Vincent and the Grenadines to conduct an assessment of the impact of climate early warning information services and products provided by CIMH and NMHSs. The assessment focused on indigenous communities in the Caribbean.

The primary objective of this Consultancy was to develop and test an approach to participatory climate services development and delivery at the community level with a focus on vulnerable rural communities, particularly indigenous populations. This approach would have been based on an assessment of the need for and an understanding of how climate early-warning information can reduce the vulnerability of such communities, as well as possible ways of downscaling and delivering seasonal and sub-seasonal climate information targeting these communities.

The Consulting Team was requested to design and conduct studies to assess awareness, use and usability of national and regional climate information products and services to include aspects such as: 1) perceptions, understanding, and use of monitoring information as well as probabilistic forecast guidance and related uncertainty information within communities; and 2) identification of barriers and opportunities for applying monitoring information and probabilistic seasonal and sub-seasonal climate forecast information for community resilience. The Consulting Team would also assess the feasibility of downscaling and/or tailoring seasonal and sub-seasonal climate information for delivery in formats and dissemination modes suitable for communities, including indigenous communities. Finally, the assessment process would include the design and testing of prototypes of community scale climate information products and services.

After discussions with several partners, including NMHSs and indigenous communities in the three target countries, St. Vincent and the Grenadines, Dominica and Guyana, it was agreed that the Consulting Team, with support from CIMH, would seek case studies that would include in-country stakeholder engagement meetings with:

- The Kalinago people of Dominica;
- The Garifuna/Garinagu people of St. Vincent and the Grenadines and/or Belize;
- The Moco Moco Amerindian community of Guyana.

The Consultant/Consultant Team was also requested to present their findings at a regional climate forum led by the CIMH with support from the finances under this Action. The results were presented at the National Framework for Climate Services workshop financed under this Action and held in Christ Church Barbados in March 2024.

The CIMH intends to work closely with the NMHSs in the three countries to enhance climate services to these communities. Through lessons learnt under this Action and future activities with these three

indigenous communities, CIMH will seek to expand this work with other indigenous communities across the Caribbean. In particular, CIMH will seek to:

- Enhance communication and engagement with these communities through inter alia, partnerships (including other relevant national agencies, schools, churches, sports clubs in the community) social media, newspaper, radio, TV, word of mouth and any means possible based on the uniqueness and nuances of the community. Using the languages or dialects of the community would also be paramount;
- Enhance the capacity of the human resource base of the indigenous communities to interpret, apply and deliver climate early warning information services, including partnering with extension services



**Summary of findings of the CIMH Climate Early  
Warning Information Project in Guyana, Dominica  
and St Vincent and the Grenadines**

## Acronyms

CIMH: Caribbean Institute of Meteorology and Hydrology

NEMO: National Emergency Management Organisation

SIDS: Small Island Developing State

## Definition of terms

**Early warning systems:** an integrated system of hazard monitoring, forecasting and prediction, disaster risk assessment, communication and preparedness activities, systems and processes that enable individuals, communities, governments, businesses and others to take timely action to reduce disaster risks in advance of hazardous events (<https://www.undrr.org/terminology/early-warning-system#:~:text=An%20integrated%20system%20of%20hazard,in%20advance%20of%20hazardous%20events>)

**Vulnerability** is the conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards (<https://www.undrr.org/terminology/vulnerability#:~:text=The%20conditions%20determined%20by%20physical,to%20the%20impacts%20of%20hazards>)

**Resilience** is the ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management. (<https://www.undrr.org/terminology/resilience>)

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# Introduction

"Enhancing Climate Resilience in the Caribbean through Improved Caribbean Climate Outlook Forums" project was implemented by the Caribbean Institute of Meteorology and Hydrology (CIMH) and supported by the USA Department of State funding through the National Oceanic and Atmospheric Administration (NOAA). The project works with Indigenous communities in St Vincent and the Grenadines, Guyana, and Dominica to assess the impact of climate early warning information services and products provided by the National Meteorological Services and CIMH.

The consultant team adopted the participatory climate risk mapping approach to execute the assignment in the respective countries. The approach consists of qualitative and quantitative research approaches to collect data in the field. The consultants engaged in in-country consultations with indigenous communities, prioritizing the insights and perspectives of participating indigenous populations and recognizing their unique challenges and strengths in the face of seasonal and sub-seasonal climatic conditions.

## Aim and objectives of the CIMH Consultancy

The Project aims to assess the climate early warning information delivered to vulnerable rural communities, including indigenous populations in Dominica, Guyana and St. Vincent and the Grenadines. As stated in the TOR, the Consultant/Consultant Team will conduct in-country stakeholder engagement meetings with indigenous rural communities in St. Vincent and the Grenadines, Dominica, and Guyana to produce an assessment Report detailing how climate early warning information can reduce the vulnerability of such communities, as well as the need for and possible ways of downscaling, tailoring, and delivering seasonal and sub-seasonal climate information targeting these communities.

These engagements will include developing and implementing survey instruments to collect data from indigenous communities as well as preparing case studies on:

- The Kalinago people of Dominica.
- The Garifuna/Garinagu people of St. Vincent and the Grenadines and
- The Amerindian people in the Moco Moco, Region 9, in Guyana.

**Delivery of presentations:** The Consultant/Consultant Team will present interim and final findings reports at relevant CIMH-convened meetings, including:

- The initiative-funded National Framework for Climate Services Workshop for awareness-building and feedback



**Deliverables of the Consultancy:** as stated in the TOR, key deliverables are as follows:

- Draft and final versions of an Inception Report, including a consensus-based approach for implementing the Consultancy.
- Draft and final versions of an Assessment Report detailing how climate early warning information can reduce the vulnerability of such communities, as well as the need for and possible ways of downscaling, tailoring, and delivering seasonal and sub-seasonal climate information targeting these communities. The assessment will be based on current early warning information produced and supplied by CIMH and NMHS.
- Draft and final versions of reports of in-country stakeholder engagement meetings with selected rural communities.
- Final versions of presentations delivered at relevant CIMH-convened meetings, including the National Framework for Climate Services Workshop.

## Summary of Indigenous People in the Caribbean

The indigenous people who participated in the Climate Early Warning Information project funded by the NOAA and implemented by CIMH include the Garifuna in North Windward, St Vincent and the Grenadines, Kalinago in Kalinago Territory, Dominica and the Amerindian in Moco Moco, Region 9, Guyana. The islands are home to vibrant indigenous communities, each preserving a unique cultural heritage deeply intertwined with the island's history. Climatic variabilities have amplified indigenous community challenges. Flooding, driven by heavy rainfall or storm surges, poses a significant threat to low-lying coastal areas. High seas and storm surges endanger coastal communities, impacting infrastructure and livelihoods. Landslides risks to settlements nestled in hilly terrains. Agriculture, a cornerstone of indigenous life, faces dual challenges: the increasing frequency of extreme weather events and the spread of crop diseases. Changing climate patterns disrupt traditional farming cycles, affecting the availability of staple crops. Additionally, rising temperatures contribute to the proliferation of pests and diseases, jeopardizing food security.

### St. Vincent and the Grenadines

In approximately 1635, Spanish ships carrying enslaved Africans shipwrecked between St. Vincent and Bequia. Surviving Africans sought refuge and formed alliances with the local Carib Indians, adopted the Carib language and customs and intermarried, giving rise to an Afro-indigenous culture independent of colonial slavery. Designated as the Black Carib and Garifuna by the British colonial administration, distinguishing them from non-intermarried natives, the Garifuna faced challenges during the British-French conflicts in the late 18th century. The British Army's victory in 1797 led to

the deportation of nearly 5,000 Garifuna, while some non-rebelling Garifuna were relocated to Sandy Bay on St. Vincent's northeast coast. (African American Registry, 2023).

Land was crucial for the indigenous communities, defining their way of life and identity. Before 1797, the indigenous people maintained control over their land and lives, confident in their identity. However, the mass exodus of indigenous populations led to the government taking control of their lands, dividing them into estates that were subsequently sold. A treaty in 1805 allocated 230 acres at Morne Ronde to those who surrendered. Some in the North Windward area were permitted to occupy lands under the condition of working for the landowners, primarily involved in transporting sugar to ships anchored offshore. (*Saint Vincent and the Grenadines | History, Geography, People, & Culture*, 2023).

## Guyana

Guyana is home to over 60,000 Amerindian people (9.2% of the Guyanese population) settled in 134 tilted villages, mainly in the country's hinterland and riverain areas. Moco Moco is situated near the foot of the Kanuku Mountains, approximately 15 km northeast of Lethem. The village was formerly named “Ka-ya-Weng”, a Makushi phrase meaning “Sky Valley”. The Moco Moco plant, commonly found along the banks of a tributary of the Takutu River that runs through the centre of the community, is the basis of the community's later renaming. (<https://moaa.gov.gy/indigenous-villages/moco-moco/>).

Moco Moco is 266.346 square miles. Its primary economic activity is ranching, and cassava is one of the main cash crops grown in the area. The languages spoken are English and Makushi. From a governance standpoint, the village elects a council biannually headed by Toshaos, village Captain or Chief, to administer affairs. The council is linked to the National Toshaos Council, which is the national body representing all Amerindian communities. The Toshao of Moco Moco sits on the national body. This August, the body will meet to elect its 20-member executive for two years.

Although Moco Moco has scenic views, including beautiful mountains and waterfalls, its effort to promote tourism is thwarted by the harsh climate conditions of two dry seasons followed by heavy rain.

## Dominica

The Kalinago people significantly enriched Dominica's cultural tapestry, drawing upon their ancestral connections to the land. In the early 17th century, Africans aboard Spanish ships bound for the Americas were shipwrecked, and seeking refuge, alliances with the indigenous Kalinago people and intermarried. Designated as Black Caribs and later as Kalinago by colonial powers, they experienced the conflicts between the British and French in the late 18th century similarly to SVG. Nearly 5,000

Kalinago were deported to Roatan Island in the late 1700s. Some non-rebelling Kalinago resettled in the northeast coast of Dominica. (African American Registry, 2023).

Most of the indigenous population resides in the Kalinago Territory, located on the eastern coast of Dominica. Visitors engage with the Kalinago people, learn about their traditional way of life, and purchase authentic handmade crafts. The community also participates in eco-tourism initiatives, offering experiences highlighting their cultural heritage and environmental connection. Despite modern influences, the Kalinago community strives to preserve and pass down its cultural legacy to future generations.

## CIMH and partner institutions participating in the Climate Early Warning Information project

CIMH collaborated with partner institutions across the Caribbean to implement the Climate Early Warning Information project. These include:

### St. Vincent & the Grenadines Meteorological Office

The St. Vincent & the Grenadines Meteorological Office (SVGMO) is the official weather and climate authority of St. Vincent and the Grenadines. It is attached to the Civil Aviation Department, Ministry of National Security, and Air and Sea Port Development. SVGMO is located at Argyle International Airport. It has a staff complement of 11 members. Besides being responsible for climatic and weather issues, there is a demand for NMS services across the island. The centre has recently been designated the tsunami warning focal point for St. Vincent and the Grenadines.

“The main purpose of the Meteorological Services is to provide meteorological information such as airport meteorological reports (METAR) and aerodrome special meteorological reports (SPECI) to airline operators, flight crew members and air traffic services for the performance of their respective functions. These services are in keeping with the international regulations.” It also provides weather monitoring, relayed forecasts and warnings and climate data services for St. Vincent and the Grenadines and adjacent waters to protect life and property and develop the national economy.

Met Services provides daily forecasts three times daily, including 6 am, midday, and evening (6 pm) forecasts. It delivers an extended forecast for 42 hours (three days), updated daily. SVGMO branded itself as a Category 2 climate services provider, offering a basic range of climate services, products, and predictions. The SVGMO provides a monthly weather bulletin, an agro-meteorological bulletin, seasonal rainfall, temperature and drought outlooks, a drought and precipitation statement, and wet and extremely wet spell outlooks.

The socio-economic sectors that benefit from climate services are the agriculture, water, disaster risk management, health, and tourism sectors, as well as the public. Other sectors that could potentially benefit from climate services in the future are the construction and financial sectors. The SVGMO is putting mechanisms in place to collect feedback from the stakeholders using its products and services to organize a National Climate Outlook Forum in the near future.

The National Met Service collaborates with CIMH to ensure the development and delivery of Climate viability and early warning information services (<https://projects.noc.ac.uk/cme-programme/news/saint-vincent-and-grenadines-met-office-visit>).

## Guyana Hydrometeorological Service

The Guyana Hydrometeorological Service is the official governmental agency responsible for developing climate early warning information services and products (<http://www.hydromet.gov.gy/weather.html>). It is also responsible for the monitoring of stations across the country. The sectors in which it produces products and services include Agriculture, Water and DRM. Users of climate services in Guyana obtain their seasonal climate forecasts from government agencies and departments (<http://rcc.cimh.edu.bb/files/2018/06/Country-Profile-Guyana.pdf>).

The socio-economic sectors that benefit from climate services in Guyana are agriculture (particularly farmers and extension officer sub-groups), water, disaster risk management, health, and energy. In addition, the HMSD also interacts with students, research institutions, and other private sector interests (e.g., engineers).

The HMSD interacts with specific organisations to enhance the delivery of its services, including:

- Guyana Water Incorporated;
- The Ministry of Agriculture; and
- The University of Guyana.

The HMSD identifies mining, academia and financial sectors as services that can benefit from climate information services. The HMSD is enhancing its interaction with users of climate information through mediums such as email, telephone, and social media. The HMSD is also in the process of implementing the following recommendations to enhance its effectiveness and relevance: a) Improve access to financial resources (allocated government funding, as well as project grant funding that has an agriculture research & development focus); b) Expansion and renewal of network instruments (especially mercury-based instruments); c) General improvements to the organisational structure to address stakeholders' needs (e.g. additional climatology staff to improve its ability to provide specialised products and information); and d) Advanced training and capacity building for staff in climatology, long-range forecast production, and GIS

mapping. The agency partners with CIMH to deliver climatic products and services to enhance the nation's socio-economic development sector overall.

## Dominica Meteorological Service

The Dominica Meteorological Services falls under the Ministry of National Security and Legal Affairs. It plays a crucial role in providing weather and climate-related information and services to the people of Dominica. Located in the capital city of Roseau, the Dominica Meteorological Services operates under the auspices of the Ministry responsible for Disaster Management and the Environment. The Dominica Meteorological Services currently employs a dedicated team of meteorologists, technicians, and support staff to fulfil its mandate. The exact number of personnel may vary over time based on operational needs and available resources.

One of the primary functions of the Dominica Meteorological Services is to issue weather forecasts, warnings, and advisories to help citizens and stakeholders prepare for and mitigate the impacts of adverse weather events such as tropical storms, hurricanes, heavy rainfall, and flash floods. Moreover, the Dominica Meteorological Services collaborates closely with the Office of Disaster Management (ODM) to enhance the country's resilience to natural disasters. They provide critical data and information to support disaster preparedness, response, and recovery efforts.

The Dominica Meteorological Services also engages in public outreach and education initiatives to raise awareness about weather hazards and promote disaster resilience at the community level. By disseminating timely and accurate meteorological information, the Dominica Meteorological Services contributes significantly to safeguarding lives, property, and infrastructure across Dominica.

The Dominica Meteorological Services offer weather monitoring, transmit forecasts and warnings, and manage climate data services for Dominica and neighbouring waters. These efforts aim to safeguard lives and property from adverse weather conditions and foster the sustainable development of the national economy. The Dominica Meteorological Services regularly provides weather reports and forecasts to the country to keep the public, businesses, and government agencies informed about current and upcoming weather conditions. Meteorological reports are typically issued several times throughout the day to ensure timely and accurate information.

Weather forecasts are usually provided multiple times daily, with updates as needed based on changing weather patterns and conditions. These forecasts include short-term predictions for the next few hours and medium-term forecasts covering the next several days. In addition to the regular forecasts, the Dominica Meteorological Services may issue special advisories or warnings in severe weather events or other significant weather-related hazards that may impact the country.

While the standard forecast horizon typically covers the next few days, meteorological services may also provide longer-term outlooks, including a 42-hour outlook or extended forecasts, to help individuals and

organisations plan and make informed decisions regarding activities, travel, and emergency preparedness. These outlooks consider various meteorological factors and trends to provide an overview of expected weather conditions over the specified time.

## Caribbean Institute of Meteorology and Hydrology

The Caribbean Institute for Meteorology and Hydrology (CIMH) (<http://www.cimh.edu.bb>) is a specialized Institution of the Caribbean Community (CARICOM). The CIMH is the technical Organ of the Caribbean Meteorological Organization (CMO), with sixteen Member States. The mandate of the CIMH is to improve the meteorological and hydrological services in CMO Member States and to assist in promoting the awareness of the benefits of these services for the economic well-being of Member States.

The overall mandate of CIMH is to support the region's socio-economic development by generating suites of user defined climate products and services to inform risk-based decision-making in climate sensitive sectors at national and regional levels. This is achieved through training, research and the provision of specialized services and advice.

The CIMH performs several functions for which it is recognized by the World Meteorological Organization (WMO) and the region, including inter alia (i) a Regional Training Centre (RTC) for meteorology, hydrology, and related disciplines; (ii) the Climate Data Archive for CMO Member States; (iii) Regional Instrument Centre; and (iv) the Regional Climate Centre for the Caribbean (Caribbean RCC). The Institute is actively monitoring and forecasting various climate and other environmental variables of interest in adapting to climate extremes, variability and change.

## Summary of Review of Literature

### Capacity building

Mainstreaming Climate early warning information services into policy development is an essential strategy to implement across all sectors of society (Chevallier, 2010; England et al., 2018; Chanika Mataya et al., 2020). There is a clear understanding by climate change practitioners and policymakers that adaptation is not a one-off action but a process that requires adaptive management reflecting unfolding climate impacts, the prescriptive nature of risk tolerance, and the tipping points between both phenomena (Wise et al., 2014). Although knowledge of adaptation is necessary for the successful implementation of climate early warning information services programmes, there is the absence of an exact blueprint on what should constitute climate and early warning information services actions for an area or region due to the context-

specific and process-based nature of implementing adaptation action (Williams, Fenton, & Huq, 2015; Chanika Mataya et al., 2020).

Although reiterative reflections within adaptation processes help to highlight the most appropriate adaptive pathways (Tschakert & Dietrich, 2010), on a broader scale, social learning can include reflecting knowledge sharing and provide opportunities for the co-creation of knowledge so that change goes beyond individuals into the community and national level practices and applications (Ensor & Harvey, 2015; Chanika Mataya et al., 2020). Meaningful learning that evolves from earlier applications of climate change adaptation practices is that adaptation knowledge needs to be shared widely to build adaptation capacity (Chanika Mataya et al., 2020).

## Indigenous knowledge and climate early warning information

Indigenous people hold a meticulous relationship with extreme weather events. Local knowledge has played an active role in rural communities. Traditional cropping systems based on local informal learning have been practised in such rural island communities prior to slavery and play a vital role in meeting food security and sustaining other basic needs such as shelter and livelihoods of indigenous communities. Therefore, traditional knowledge is valuable, adaptable, and necessary in coping with the risk and uncertainty of changing climate (Beckford and Barker, 2007).

Climate change accentuated the difficulties already faced by indigenous communities, including political and economic marginalisation, loss of land and resources, human rights violations, discrimination, and unemployment. Climate change has the potential to decrease agricultural productivity, increase food insecurity and challenge the livelihoods and survival of poor people, particularly smallholders/ farmers, livestock keepers and the landless in the least developing countries (LDCs) and SIDS.

The greater rainfall variability would have significant consequences for food security, the livelihoods of millions of indigenous people, and the migration decisions of vulnerable households. To make informed decisions about adaptation planning, development, and a transition to a more climate-resilient future, policymakers and development actors need a better understanding of the linkages among changes in the climate, household livelihood, food security profiles, and migration decisions.

Climate variability will prompt some indigenous people to seek livelihoods elsewhere and may trap others in poverty. Therefore, it is necessary to address the climate crisis urgently. However, addressing the climate crisis requires a concerted effort by the Government and all stakeholders in food, environment, and sustainable development.

Research findings have recommended a collection of actions that can support poor populations to make informed choices about migration, adaptation, and food security that uphold their dignity and safety and enhance their resilience in the face of climate change. Understanding the circumstances and factors that

shape household migration choices can help policymakers create enabling environments that allow people to adapt to a changing climate and access migration as a resilience-enhancing strategy rather than an erosive survival strategy. This strategic report reinforces the call to tackle the climate crisis and integrate climate change and gender considerations into national and regional food and nutrition security efforts in policies and practices for indigenous people. It also recognised the critical roles of NMMSs and CIMH in working with government and indigenous communities to deliver climate early warning information services and products to indigenous people. ([https://www.un.org/en/development/desa/population/events/pdf/11/warner\\_climate\\_change\\_food\\_security\\_migration.pdf](https://www.un.org/en/development/desa/population/events/pdf/11/warner_climate_change_food_security_migration.pdf))

## Findings of the research project

### Relevance and effectiveness of the participatory methodologies implemented to assess in-country stakeholder engagement meetings with selected rural communities

The consultants utilised a combination of qualitative and quantitative research methods. The participatory mapping model was the main methodological approach used to enhance the awareness of participants on the climate stressors impacting the indigenous communities and help them to identify the climatic risk. From all accounts, the methodologies utilised were considered relevant and effective.

**Methodology:** Participants discussed the climatic stressors impacting their communities, the extent and severity of the effects and how they utilise the early warning information provided by the Meteorological Services to enhance their livelihood, health, and well-being. From the climate stressors discussed, they identified five-six climate stressors that are impacting their communities. Here colours will be identified for each climate stressors. The participants used a large drawn map to identify the areas across the community impacted by climate stressors. A GIS expert at the Physical Planning Department digitized the consensus data on the map.



**Table 1:** Climate stressors and colours used to represent these stressors

Climate Stressors	Colours
Flooding/heavy rains	Pink
Drought	Purple
Heat waves	Neon green
Invasive diseases and pests (Agriculture and food security)	Orange
Disease that affects health (diarrhoea, malaria, dengue etc)	Yellow



*Figure 1: Image showing Participatory Mapping by members of Moco Moco Indigenous community, Region 9, Guyana.*

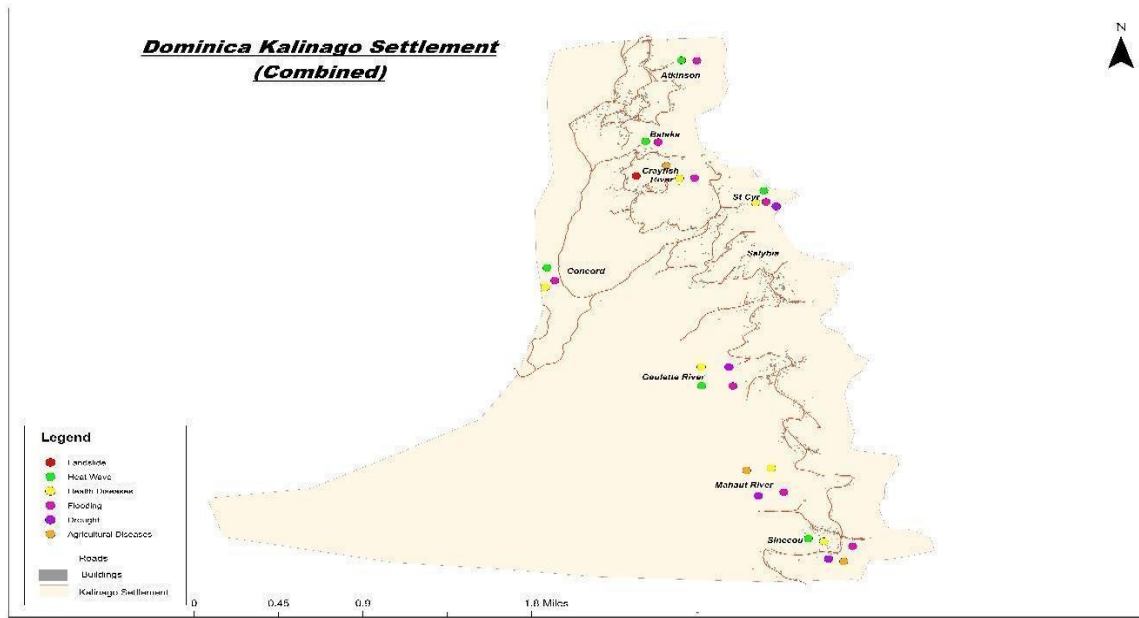


Figure 2: Map generated from data collected from participants at the consultative workshop showing the impacts of climate stressors in the Kalinago Territory, Dominica.

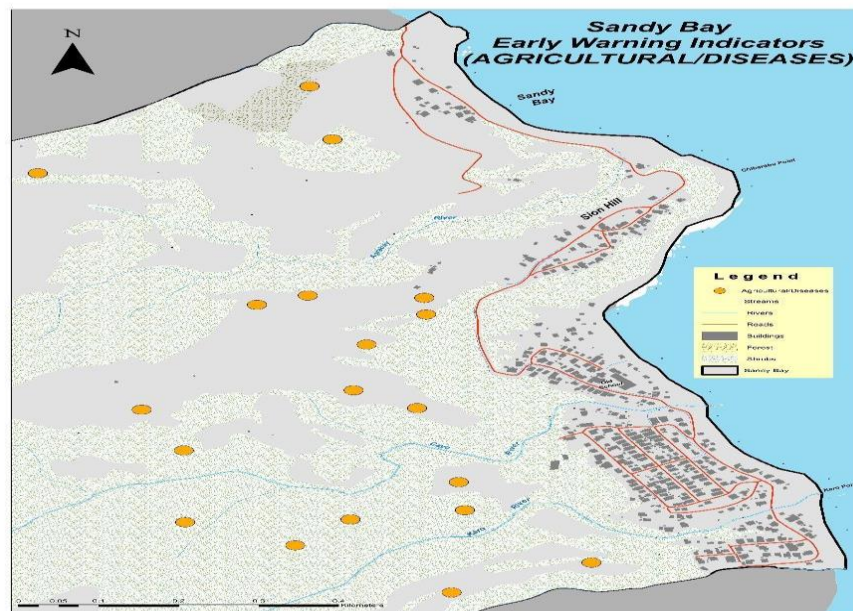


Figure 3: Data for the map was collected through the consultative mapping exercise showing the impact of invasive species and diseases on the agriculture sector in Sandy Bay, North Windward area (product of the workshop).

## Moco Moco (Health-Dengue Asthma)

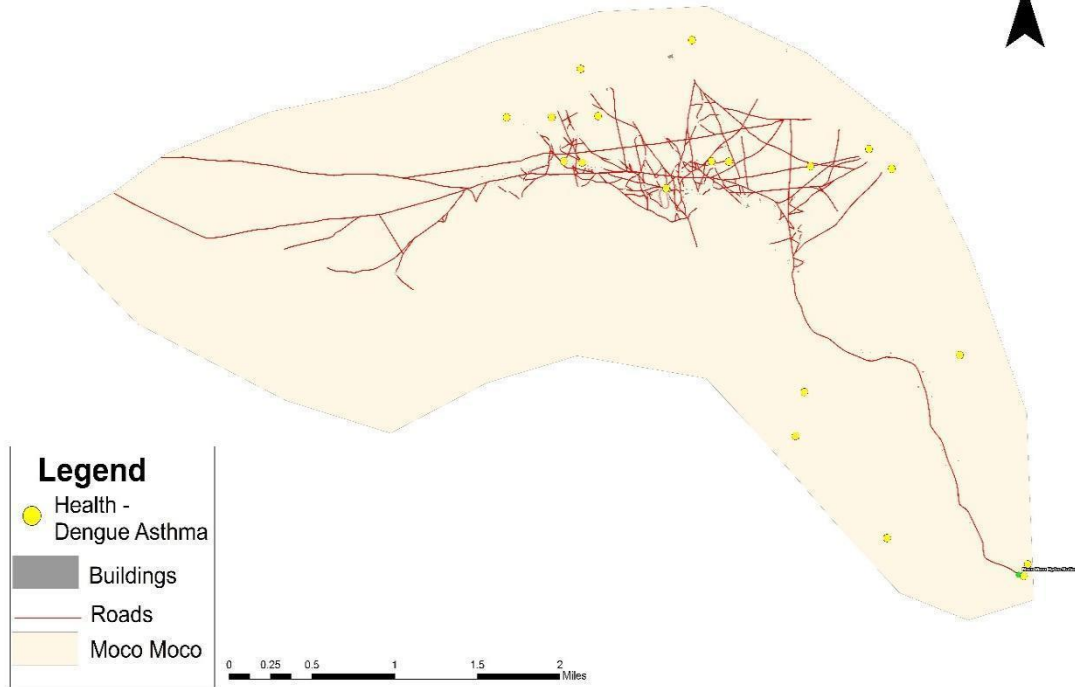


Figure 4: Map generated from data collected from participants at the consultative workshop showing the impacts of invasive species/diseases on the health of Amerindian people.



Figure 5: Participants at the CIMH Consultative workshop in Sandy Bay, North Windward, St Vincent and the Grenadines.

## Questionnaires

Questionnaires were administered to participants to collect data on the perception of the participants on the climatic stressors impacting their communities, the extent of the impacts of these climate stressors on their livelihoods (agriculture, fisheries, and tourism), their health and the physical infrastructure of the Community.

The householders also respond to questions on the relevance and effectiveness of climate early warning information services provided by the National Meteorological Services in the various countries. Householders expressed their enthusiasm to participate in the project activities. Approximately 50% of participants experiences difficulties responding to the questionnaires due to a) literacy challenges faced by these participants, b) lack of comprehension of the English language because most of the participant communicated in their native languages (Amerindian in Moco Moco, Region 9, Guyana), their local dialect (Gurifuna in St Vincent and the Grenadines) and Patois (Kalinago, Kalinago Territory, Dominica).

## Focus Group Discussions

A Focus Group Discussions (FGD) were administered to fifty-two participants from the Kalinago Territory, Dominica representing women, farmers, businesses, and other sectors in the Community. Over 25 participants were involved in the FGD in Moco Moco, Guyana; 12 participants were involved in the Garifuna community FGD in North Windward, St Vincent and the Grenadines. Data were collected on a) the the climate stressors impacting on the community, b) the effectiveness of the climate early warning information services and products provided and whether the these products and services assisted the indigenous communities to build their resilience to adapt to the impact of climate stressors impacting on these communities.

Moco Moco persons were unaware of the Climate Early Warning Information provided by the Hydrometeorological Services due to the geographical remoteness of the community, lack of and/or limited access to the internet and lack of support from the Agriculture Extension Workers. The situation in Dominica and St Vincent and the Grenadines was completely the opposite where participants were already utilising provisions from the Dominica and St Vincent Meteorological Services.

During the general consultative discussion, participants expressed satisfaction with the participatory nature of the consultative exercise. They hoped these exercises will become a regular feature in Meteorological Services in the future.

## Interviews

The Consultancy interviewed Mr Itoma James, Head of Dominica Meteorological Services, Billy Jeffers Head of the St Vincent and the Grenadines Meteorological Services and Dr Cummings, Head of HydroMeteorological Services, Guyana, on the relevance and effectiveness of the services provided. The heads provided insights on the services and products provided, the weaknesses of the services to the communities and the strategies for enhance the qualities of the products and the services.

## Summary of outcomes of consultative workshops

### Assessment of how Climate early warning information can reduce the vulnerability of indigenous communities

The utilisation of climate early warning information as a strategy for reducing vulnerability of indigenous communities is an interesting debate that is evolving in Guyana. Although there is recognition of the value of traditional knowledge and practice among indigenous communities in St Vincent and Dominica, Guyana is exploring the linkage between traditional knowledge practices with information technology as a strategy to deliver climate early warning information services to the remote Amerindian community in Moco Moco. Hydromet is working with the Ministry of Agriculture extension services to enhance the delivery of such services to indigenous community such as Moco Moco. Similar initiatives are being explored by National Met Services St Vincent and the Grenadines and Dominica Meteorological services.

The Agriculture Ministry, through its Agro-Met initiative, has a WhatsApp group that sends information to farmers across the country, but due to Moco Moco's remoteness and the poor online infrastructure in surrounding areas, it is unable to reach the farmers of the community. Hydromet is considering utilising VHF technologies to enhance communication with the remote community until the digital technological infrastructure is boosted. The agency is considering powering the technological infrastructure with solar power.

St Vincent and the Grenadines and Dominica Meteorological Services are exploring the possibilities of utilizing technologies through apps and social media platform to enhance their delivery of products and services to indigenous communities.

### **Community engagement and future preparedness**

Community engagement, which involves leveraging schools, churches, and village institutions/meetings to improve information dissemination, is a unique strategy for building resilience at the community level.

The need to enhance collaboration, youth/gender engagement, empowerment, sensitisation issues around entrepreneurship, climate variability, and early warning information services emerged as crucial elements for building the resilience and adapting practices of Garifuna, Amerindian and Kalinago indigenous communities. Such engagement must be constructed by harnessing the energies and values of the community around indigenous knowledge and practices. The Heads of the Met Services agreed to put more efforts and resources to engage the participation of community leaders and other key stakeholder in the development and delivery of climate early warning information products and services.

### **Garifuna and Kalinago experience, St Vincent and the Grenadines and Dominica**

Due to increased exposure to climate variability, risks and natural disasters, the Garifuna and Kalinago indigenous communities demonstrated remarkable resilience rooted in their traditional knowledge and the communal bonds handed down through the generations. Conventional farming practices passed down through generations, including terracing, contouring, crop diversification, intercropping, and other soil conservation techniques, help mitigate the impacts of landslides, flooding and other climatic stressors, thus enhancing their overall resilience. Unsustainable farming practices had worsened soil quality.

Farmers in the Garifuna community involved in the workshops shared being more cognizant of the impact of climate stressors on their community and felt empowered to adhere to soil conservation farming and sustainable development practices to enhance soil fertility and food security. Indigenous farmers in both countries stated having greater appreciation of climate early warning information services and products.

### **Embracing modern technology**

Traditionally, the Garifuna, Kalinago and Amerindian people have a rich cultural knowledge of climate early warning systems through observing nature. They wish to complement this understanding through use of meteorological information from media such as radio, TV and climate early warning apps to anticipate extreme weather events and calamities. The Garifuna and Kalinago people committed themselves to embracing modern technology to enhance their adaptive capacities.

### **Adhering to Hybrid rather than the practicing of Top-Down approaches**

The Meteorological Services of Guyana, Dominica and St Vincent and the Grenadines must desist from practicing top-down approaches to developing and delivering services and instead adapt to a hybrid approach combining top-down and bottom-up methods for knowledge exchange.

This approach blends strategies from the Meteorological services as top-down (Sherman and Ford, 2013) and indigenous traditional knowledge practises as bottom-up (Matland, 1995; Danielsen et al., 2009; Commodore et al., 2017; Eicken et al., 2021; Simmons, 2021). Indigenous leaders and the Heads of the National Meteorological Services call for pooling their institutional capacities to enhance the delivery of early warning information services (Dany et al., 2015).



# Strategies for downscaling, tailoring, and delivering targeted climate information

## Communicating in the right language

As observed during the consultative workshops, English is a second language for over 80% of participants; most experienced difficulties communicating adequately in English. When instructions were given, participants who understood English would translate to their immediate group.

The participants expressed appreciation of the opportunity for those not fluent in English to share their experiences with those more fluent. It is important to note that the provision of climate early warning information products and services in English alone meant that many of the Amerindian, Garifuna and Kalinago indigenous population cannot engage with Climate early warning information services provided by the National Meteorological Services.

In Moco Moco, inadequate internet and communication access when compared to the rest of the country leaves gaps in the digital communication network. There is WIFI in one area of the community; the rest have no access to the internet.

Most indigenous residents in the three countries found early warning information too technical. Several people could not understand the meaning of “partly cloudy” or “Scattered showers”. Some who request services may not fully understand the outputs and encounter difficulties interpreting and translating information into viable policies and strategic programmes.

Amerindian people are more fluent in their local languages than in English; no information is currently delivered in the local languages. The Garifuna and Kalinago people are more fluent in Patois and Dialect than in English but as an English derivative, they could more easily understand simple information conveyed in climate early warning systems.

It is recommended that the early warning information products and services be produced and packaged in the main languages used for communication by the residents.

## Packaging and delivering information for people with disabilities

Concerns were raised about getting the information to persons with disabilities. Meteorological Services must make a concerted effort to include sign language and explore using traditional warning signals to communicate with the communities, e.g., using church bells, loudspeakers, the conch shell and drumming.

# Research, collaboration and partnership

## Guyana

Timeliness, collaboration, and partnership are necessary for coordinating, promoting and delivering climate early warning information services. There is recognition on the part of Hydrometeorological Services, Guyana, that a lot more local researchers are required to move the agenda forward. There is little local input to enhance climate early warning information services. The agency is exploring the possibility of collaborating with the University of Guyana (UG) to enhance research and partnership climate early warning information.

## SVG and Dominica

All the participants attending the workshop suggested that governmental agencies such as the NMS and NEMO should consider working with the Ministry of Education (formal and non-formal system) to include Climate early warning information in the national education curriculum and the non-formal education programs implemented by through the Adult Education and Community Development Divisions of the Government of St. Vincent and the Grenadines. These governmental agencies also need to work with NGOs and civil society organisations to support delivering such early warning information to these communities. Participants believe such programmes will support knowledge transfer from the NMS to their communities.

SVG and Dominica Meteorological Services should implement a series of public outreach and education consultative meetings in communities using multichannel communication to showcase the role, function and relevance of the agencies and the climate early warning information services provided to build the resilience of the communities.

## Lessons learned, possible best practices and early indications of potential success for assessing climate early warning information services

Participants and stakeholders who participated in the consultative workshop on Climate early warning information extracted the following lessons learned:



- Climatic conditions are monitored and forecasted at regional and national levels by CIMH and Meteorological Services. Participants and critical stakeholders confirmed the benefits of utilising the participatory methodology for implementing the consultative workshop.
- Meteorological Services can become too focused on building its tools and brand and not invest the time and resources to reach the indigenous and marginalised communities with climate early warning information services and products.
- It is necessary to integrate and build partnerships with other governmental agencies, private sector and civil society organisations (CSOs) while building the institutional capacities of communities to withstand climate stressors.
- Not taking the opportunity to integrate these indigenous communal knowledge practices with scientific knowledge would run the risk of failing to recognise that traditional knowledge is valuable, adaptable, and necessary in coping with the risk and uncertainty of changing Climate.
- The lack of adequate human resources/capacity in many indigenous and marginalised communities would lead to a loss of capacity to take advantage of the traditional knowledge, community leadership, communal structures, and resources to enhance the indigenous community's resilience and sustainable development.
- The cultural and traditional practices in indigenous communities discriminate against women and youth. Women and youth are responsible for working the land and tending to cattle and other livestock, yet the men are responsible for deciding where the products will be sold and how the monies accruing from the sales will be used.
- Funds are needed to develop appropriate climate early warning information tools, products, and services.
- Climate early warning information services appear to be stand-alone and not fully integrated into the work of other socioeconomic sectors, namely Agriculture, education, and Health, to make informed decisions.
- Partnerships between Meteorological Services and bottom-up organisations appear scant and limited and do not promote community development actions. The top-down approach to boost the development of climate early warning information services and products seems too dominant.
- Meteorological Services have limited community engagement due to the tools and workforce available to reach remote and far-off indigenous communities. This limited community engagement retards early action from the community affected by the climate stressor.

## Recommendations for enhancing Climate early warning information services

An evolving theme of the consultative process was collaboration and partnership among key stakeholders as a strategic approach. Meteorological Services must take the necessary strategic interventions to enhance the delivery of its products and services to indigenous communities.

The recommendations are as follows:

**Strategies for enhancing work:** Communication and community development.

- Employ a social scientist and other critical staff to help Meteorological Services communicate its Climate early warning information services to all stakeholders. It will enhance the capacity of the agency to downsize and repackage its products and services to meet the needs of the groups of people to whom they provide supplies.
- Enable Meteorological Services to enhance its services by incorporating more images and graphics into its weather forecast and bulletins. The strategy will improve the presentation of the weather forecast to allow it to reach a broader audience on various platforms.
- The promotion of the concept of "mentorship in reversed" in the indigenous community. In indigenous communities, elders teach youth the knowledge and culture of the indigenous people, and the youth teach the elders, e.g. skills like using a mobile phone, sending and receiving email, using social media and surfing the net.

### **Extension services in communities**

- Providing extension services in communities is an essential strategy for promoting and developing Climate early warning information services and products to the community. Meteorological Services should explore the possibility of working with the Agricultural Extension Officers in the Ministry of Agriculture to deliver climate early warning information services.
- Enhance the capacity of the human resource base of the indigenous communities to deliver climate early warning information services through a) training of residents, and b) establishing community groups to deliver to climate early warning information services and respond to climate risk and disaster management challenges.
- The utilisation of social media platforms and apps to deliver products and services to residents in indigenous communities. Meteorological Services should consider collaborating with government ministries, the private sector and CSOs to assist in distributing its products and services to indigenous and rural communities.

- Organisation of village consultative meetings, working with school principals and parent-teacher associations, churches and football clubs as strategies for enhancing the knowledge of the people in indigenous communities in climate early warning information services. It should develop the necessary actions to be taken to strengthen the community's resilience and adapt to the impact of the risk caused by climate change and disasters.

### **Raising awareness of the broader climate change issues**

- Implement a sensitisation programme on climate change to increase awareness and knowledge of the indigenous people. Develop and implement a climate change adaptation and mitigation plan for the indigenous communities.
- Create research facilities in the indigenous communities to provide drought and disease-resistant agricultural products. Research should be implemented with CARDI, the University of Guyana, the University of the West Indies and other research institutions (specifically research on the vulnerability of cassava sticks/plants and other crops prone to climate stressors).

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