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STRENGTHENING EARLY WARNING SYSTEMS IN THE CARIBBEAN

SAINT VINCENT & THE GRENADINES

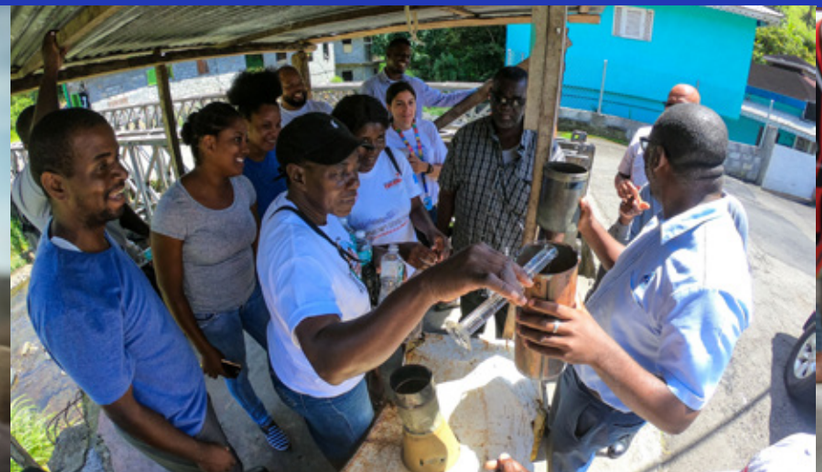
VOLUNTEER RIVER OBSERVATION

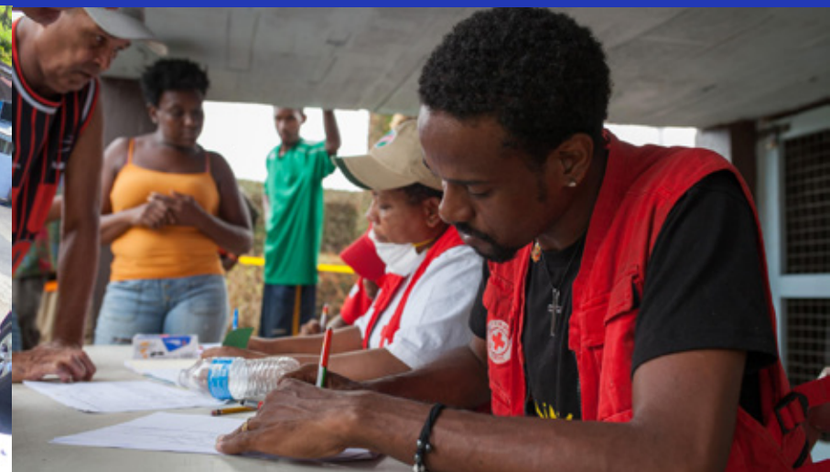
PRIOR KNOWLEDGE AND IDENTIFICATION OF RISK

MONITORING AND WARNING SYSTEMS

DISSEMINATION AND COMMUNICATION

RESPONSE CAPACITY





STRENGTHENING EARLY WARNING SYSTEMS IN THE CARIBBEAN SAINT VINCENT & THE GRENADINES

Author
Claudia Gazol

Coordination
Janire Zulaika

Editing
Jacinda Fairholm

Photography
Zaimis Olmos

Art and Design
Estudio Varsovia

Support
Luisa Pareja
Kieran Davey

Contributors
Saint Vincent and the Grenadines: Central Water and Sewage Authority; National Emergency Management Office, Meteorological Services: Danroy Ballantyne Michelle Forbes, Bill Jeffers, and Kenson Stoddard.

UNDP: Marlon Clarke, Dayana Kindelan, Almudena Montoliú, John Walcott, and Janire Zulaika

Many photographic contributions were also provided by implementation partners and national counterparts.

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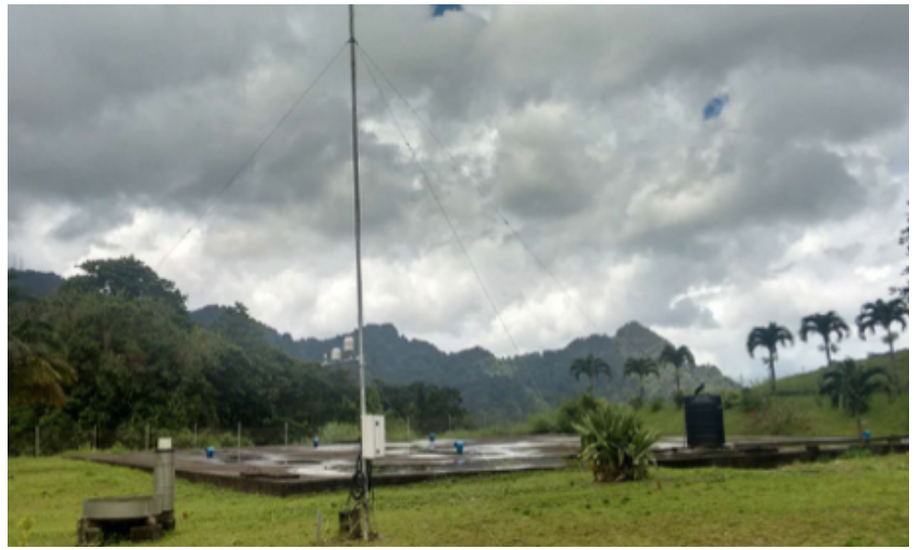

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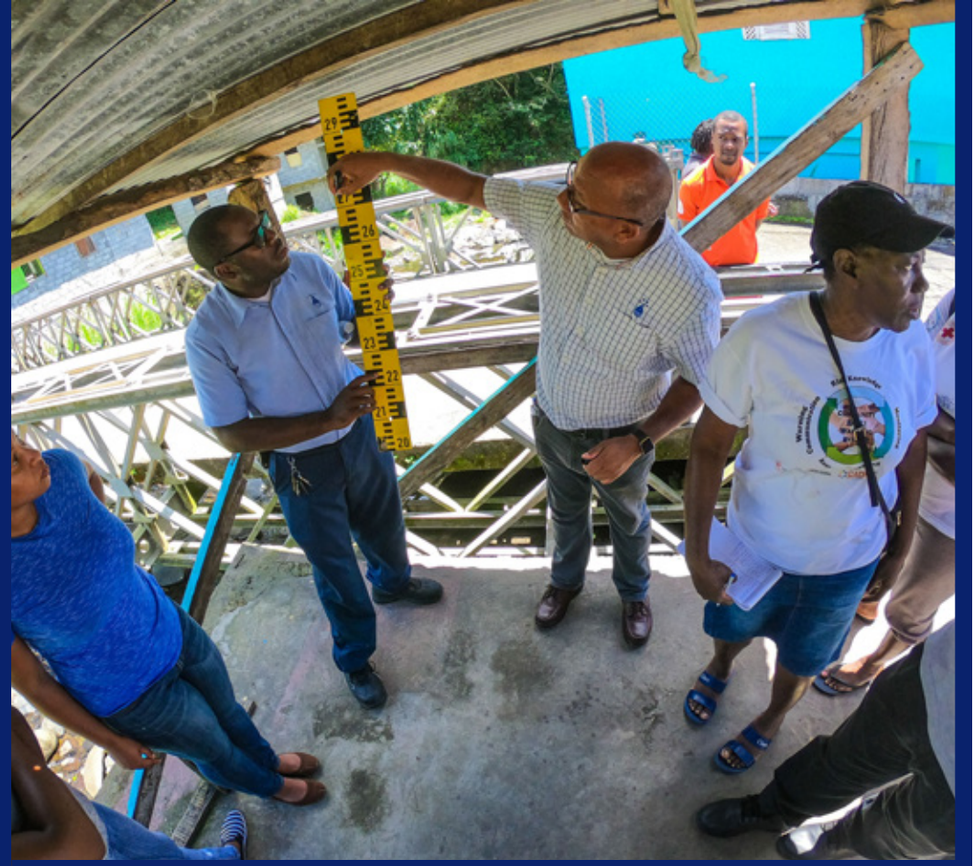
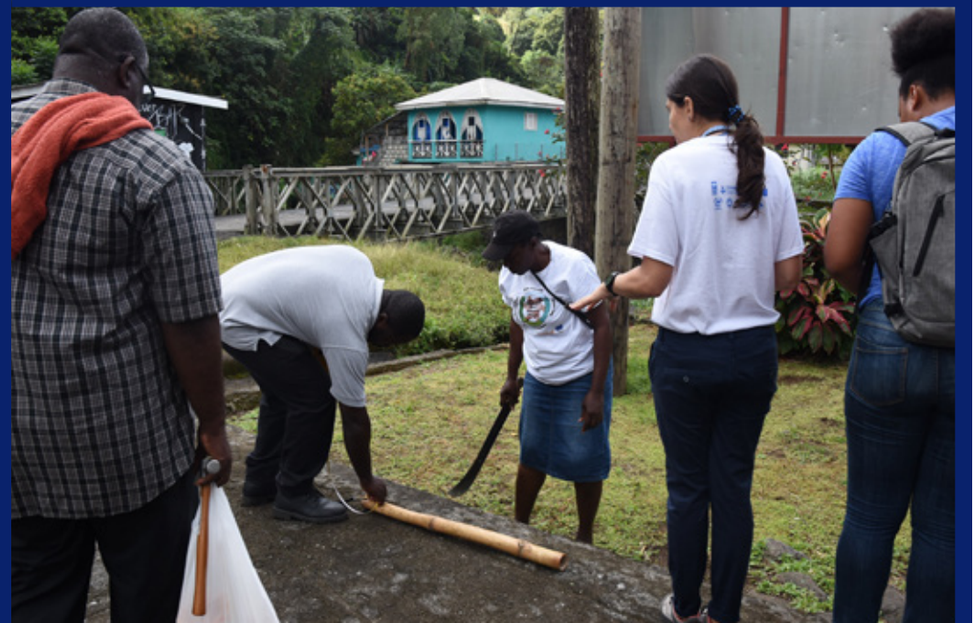




ACRONYMS

CAP » Common Alerting Protocol

CDEMA » Caribbean Disaster Emergency Management Agency

CDM » Comprehensive Disaster Management

CWSA » Central Water and Sewerage Authority

DIPECHO » Disaster Preparedness Program of the European Civil Protection and Humanitarian Aid Operations

DRR » Disaster Risk Reduction

ECHO » European Civil Protection and Humanitarian Aid Operations

EU » European Union

EWS » Early Warning System

HIP » Humanitarian Implementation Plan

HVR » Hazard, Vulnerability, and Risk

IFRC » International Federation of Red Cross and Red Crescent Societies

IN-MHEWS » International Network for Multi-Hazard Early Warning Systems

INRH » National Institute of Hydraulic Resources

NEMO » National Emergency Management Organization

SIDS » Small Island Developing State

SSC » South-South Cooperation

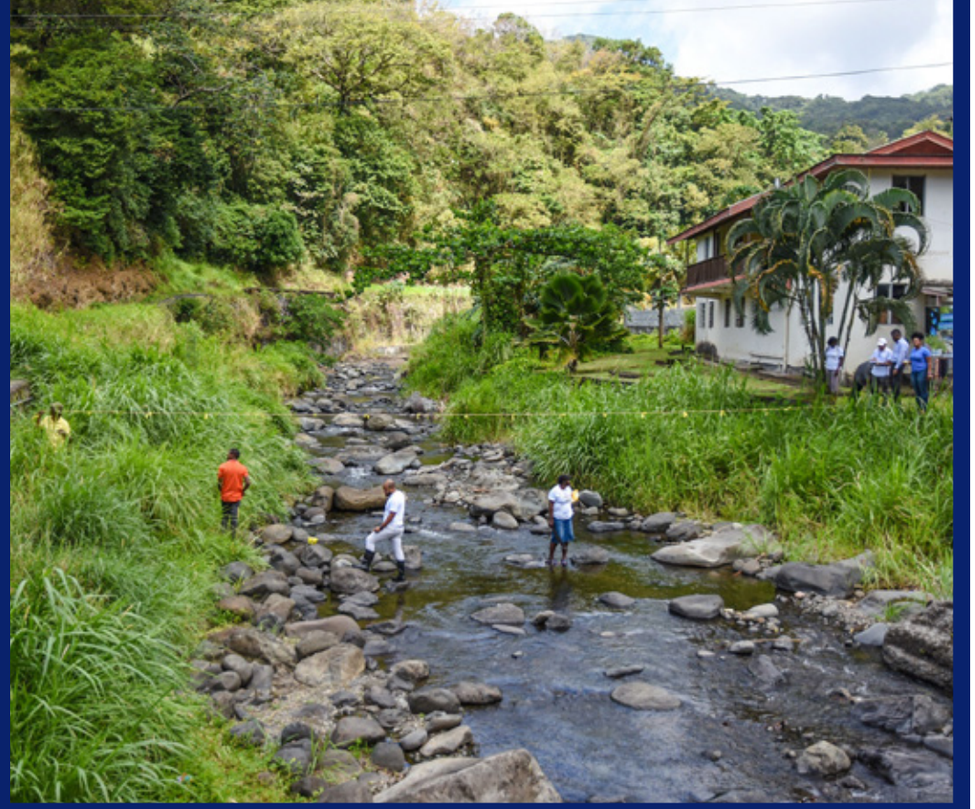
SVG » Saint Vincent and the Grenadines

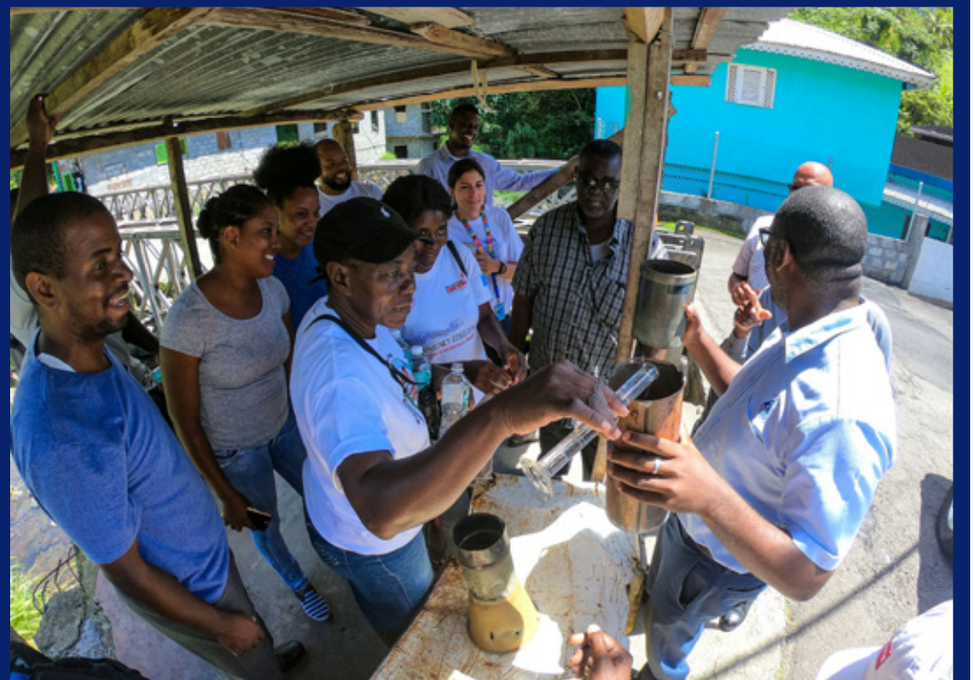
UNDP » United National Development Program

VINLEC » St. Vincent Electricity Services

VO » Volunteer Observers

WRMU » Water Resource Management Unit





1. INTRODUCTION

The Caribbean region is highly prone to natural hazards such as hurricanes, floods, volcanic and seismic activities, droughts and forest fires. The increasing impact of global climate change and the risk posed by a range of natural, environmental and technological hazards are among the Caribbean's most critical development problems. The past decades have been marked by an intensification of the impact of disasters, such as destruction of livelihoods and communities, as well as a setback in development gains.

Due to the high levels of vulnerability, there is a broad recognition of the need to strengthen capacity for preparedness, response, and recovery, and integrate risk reduction measures into development paths to create safe, resilient and sustainable communities and States in the Caribbean. As one component to reducing risk, the Caribbean Comprehensive Disaster Management (CDM) Strategy 2014 – 2024 prioritizes integrated, improved and expanded community early warning systems.[1] This focus is reinforced by the Sendai Framework for Action which calls for enhanced disaster preparedness.[2] Likewise, UNDP's Strategic Plan 2018 – 2021 aims to strengthen resilience to crisis and shocks and support countries with assessments, planning tools and mechanism so that gender-sensitive and risk-informed prevention and preparedness solutions are available to limit the impact of natural hazards.[3] Reducing risk and building resilience is a theme that cuts across the Sustainable Development Goals.

As identified in the ECHO Humanitarian Implementation Plan (HIP) 2017, preparation and response capacities in the Caribbean have improved. However, the need for further action to address preparedness capacities, reinforce Early Warning Systems (EWS) and foster exchanges between countries and linkages with regional institutions is crucial. The HIP specifically highlighted that "collaboration between countries on Early Warning Systems to exchange on good practices should be

1. Priority Area 4, Outcome 3, Regional CDM Strategy 2014 – 2024 https://www.cdema.org/cdm
2. Priority Area 4, Sendai Framework for Disaster Risk Reduction 2015 – 2030. https://www.unisdr.org/we/coordinate/sendai-framework
3. Outcome 3, Signature Solution 6, UNDP Strategic Plan 2018 – 2021 https://strategicplan.undp.org/

fostered" and stressed that the "compilation of DRR tools and processes endorsed at national and regional level, led by national systems in coordination with the CDEMA, EU Delegations and other development actors" are priority areas for action.

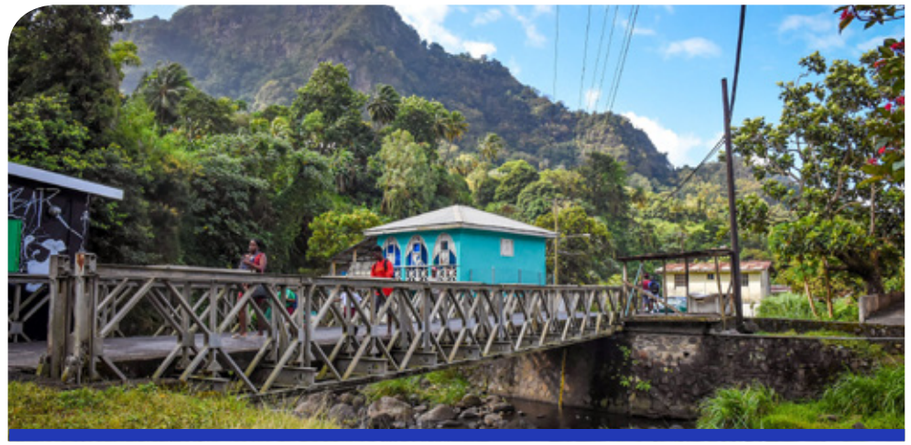
Thus, Antigua and Barbuda, Dominica, Dominican Republic, Saint Lucia and Saint Vincent and the Grenadines (SVG) set out to improve their Early Warning Systems (EWS) through an 18-month project financed by European Civil Protection and Humanitarian Aid Operations (ECHO). The *"Strengthen Integrated Early Warning Systems for more effective disaster risk reduction in the Caribbean through knowledge and tool transfer"* project sought to strengthen EWS components and close priority gaps at a national level, contributing to the integration of national and community EWS, and addressing sustainability and national ownership of EWS.

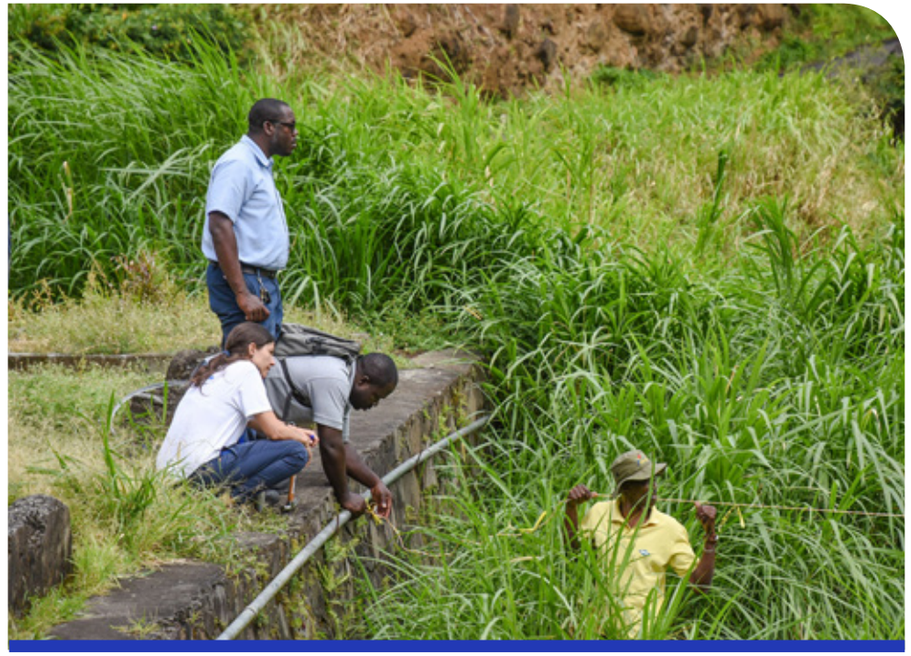
The country level actions were supported by UNDP, International Federation of the Red Cross and Red Crescent Societies (IFRC), and the Caribbean Disaster Emergency Management Agency (CDEMA), who embraced a partnership approach and helped reinforce the efforts to realize a more integrated EWS and enhance disaster risk reduction at the regional, national and community level.

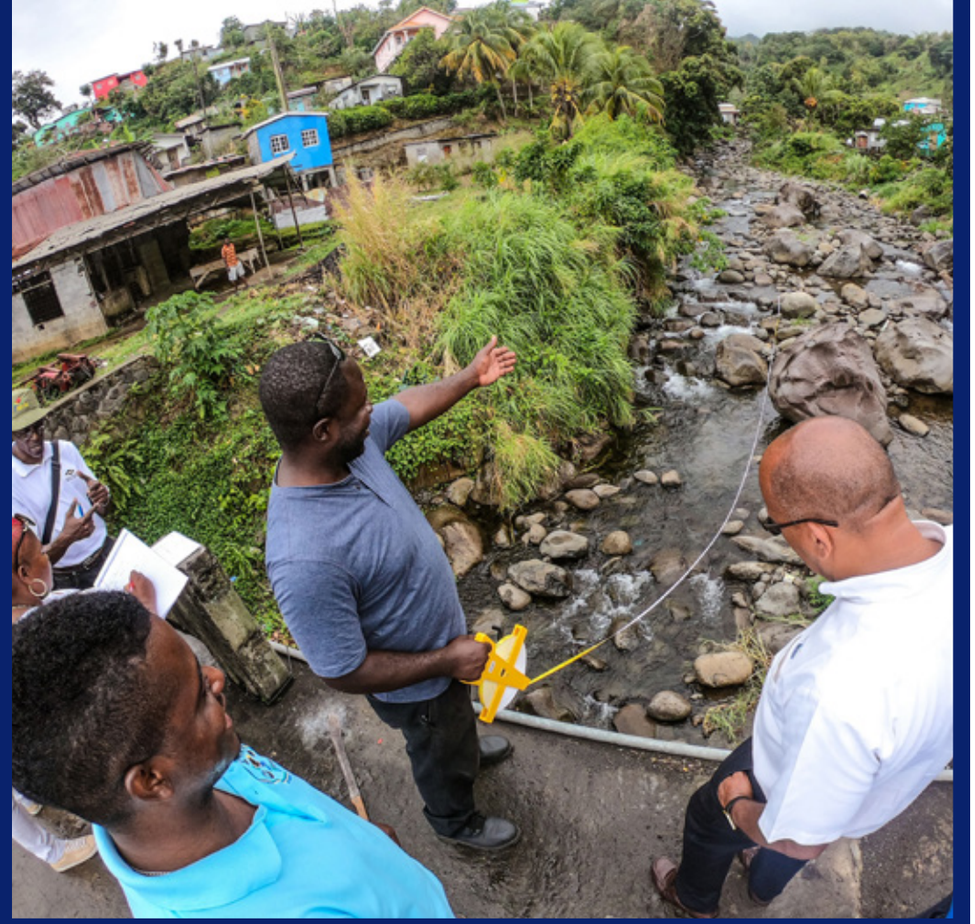
The project also aimed to increase access to tools and knowledge of EWS at a regional, national and regional level, through development of, improvement to, and translation of models, methodologies and toolkits to distinct contexts. Emphasis was put on knowledge transfer and exchange, allowing actors to leverage the expertise that exists in the Caribbean to reduce disaster risk and foster stronger linkages between countries exposed to the similar risks.

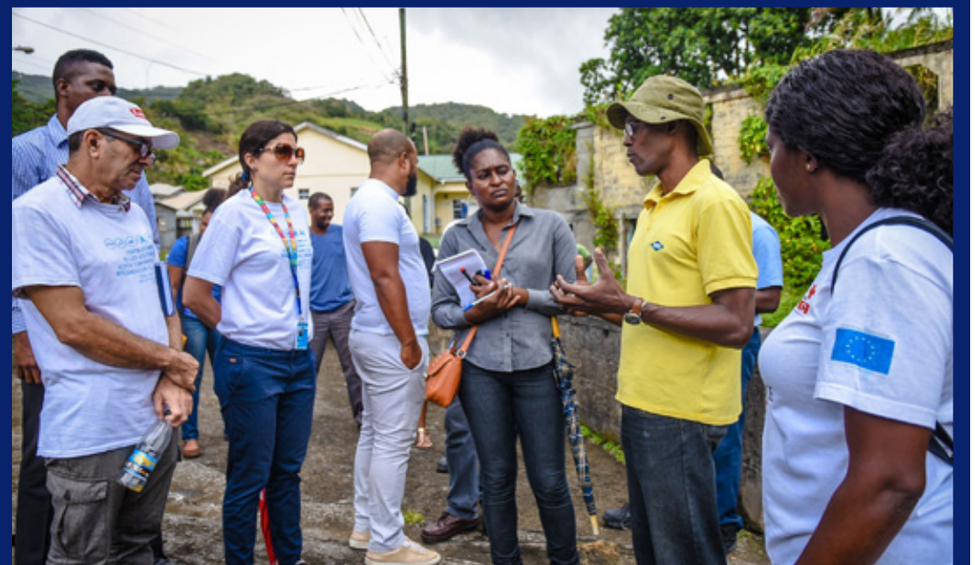
This case study details the South-South Cooperation (SSC) process and activities between Saint Vincent and the Grenadines and Cuba. Based on the EWS analysis, SVG identified communities with high levels of exposure to flooding from intense rains as a specific area that could benefit from Cuban expertise. Cuba offered to assist SVG institutions in implementing a pilot project that addressed identified deficiencies in the early warning system and applied a system of voluntary river observation in high-risk areas. This document provides a systematization of the results, lessons, processes and tools used in the process of transferring knowledge and capacity between Saint Vincent and the Grenadines and Cuba.

This document is intended to be read together with, and complemented by, the *Strengthening Early Warning Systems in the Caribbean* and *Strengthening Early Warning Systems in the Caribbean: South-South Cooperation* documents.









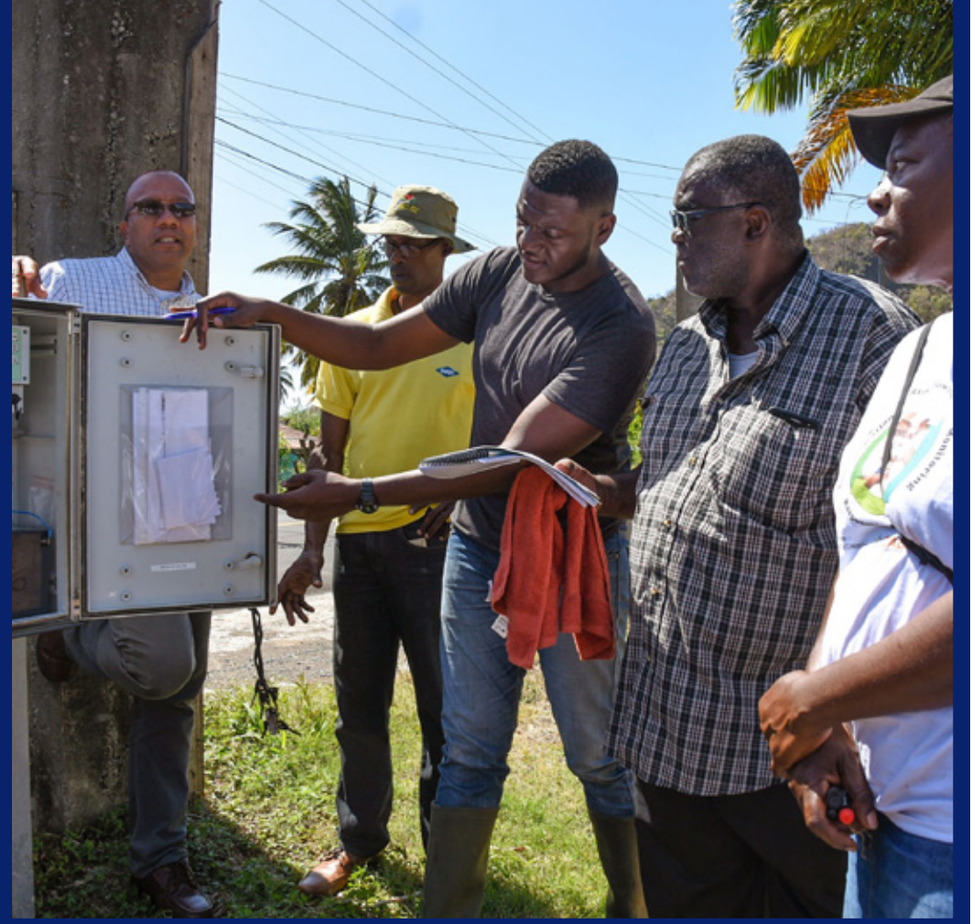
2. CONTEXT

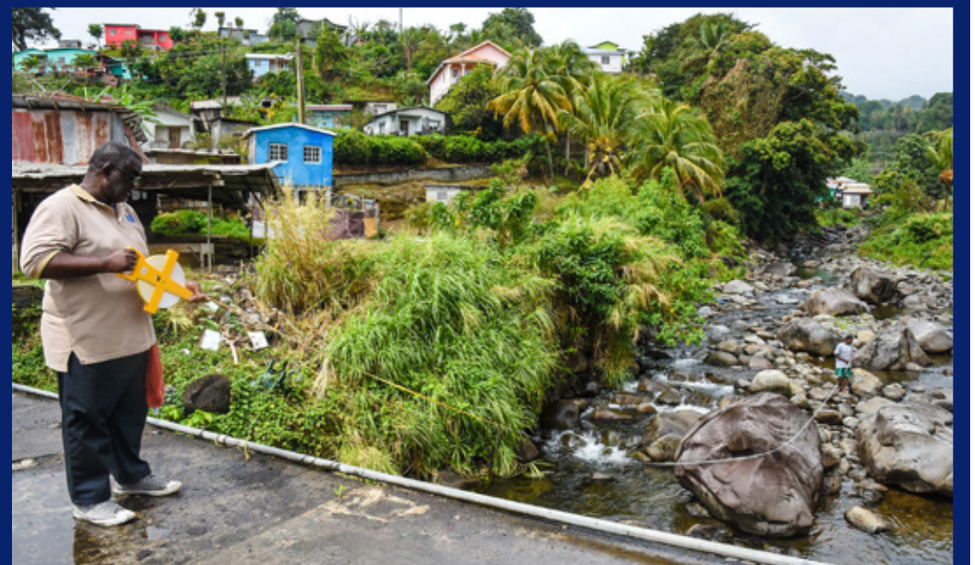
St. Vincent and the Grenadines (SVG) is a Small Island Developing State (SIDS) and like many islands in the Caribbean, is exposed to multiple natural and anthropogenic hazards. These include hurricanes; droughts; floods; landslides which are generally triggered by excessive rainfall; geological hazards including volcanic eruptions, earthquakes and tsunamis; human-induced disasters such as technological-industrial accidents; biological epidemics, and climate change. Flooding is the most prevalent hazard; in 2013, the country suffered a devastating flash flood, affecting over 13,000 people and causing significant damage to homes, public buildings and critical infrastructure, including bridges and roadways.[4] In 2016, a similar flash flood affected 25,000 people.[5] There was little or no early warning for these flood events, underscoring the need to strengthen the national early warning system in SVG.

The National Emergency Management Organisation (NEMO) had long embraced the Comprehensive Disaster Management (CDM) strategy and programme to build the country's resilience. In the area of early warning, NEMO has worked closely with the SVG Meteorological Services to disseminate early warning for hydro-meteorological hazards. Forecasting has improved with the increase in the number of forecasters at the Meteorological Services and greater interaction with the public. Meteorological Services, along with NEMO, have been able to disseminate early warning information via traditional media and the Common Alerting Protocol (CAP).

4. IFRC. 2014. Emergency Plan of Action Final Report – St. Vincent and the Grenadines, Americas: Flood. Panama: IFRC; pg. 1

5. Guha-Sapir D, Hoyois P, Wallemacq P, Below, R. 2017 Annual Disaster Statistical Review 2016: The Numbers and Trends. Brussels: CRED; pg. 33





3. DEMAND & OFFER

3.1 The Demand

Initial Identification of Needs: The demand articulated by SVG for the horizontal transfer with Cuba stemmed from the national process of EWS assessment carried out in April and May 2018 and echoed in the findings of the national Multi-Hazard Early Warning System (MHEWS) Gap Report and MHEWS Roadmap.

Scoping Mission: An initial visit to SVG occurred on the 28th - 29th of May 2018, composed of the Head of Cooperation of the Cuban Civil Defence, the Cuban National Coordinator of Hazard, Vulnerability and Risk (HVR) Studies, and two UNDP regional project coordinators.

The visit included a field trip to the east and west coasts and two communities with high levels of exposure to flooding from intense rains due to their proximity to mountains and a river, as well to communities affected by landslides. Other sites visited included the meteorological office at the airport, which is connected to a regional station in Barbados, several hydrometeorological-seismological station and a water pumping station that stores 43% of the water consumed on the islands and where pluviometric and other hydrometeorological monitoring takes place. The second day consisted of a meeting with NEMO and key institutions, where the EWS gaps were discussed and the following areas of potential collaboration were highlighted:

- Standardized studies to analyse risk, HVR executive reports and risk scenarios
- Early Warning Points
- Technical assistance to the forecasting services and forecast reports
- Volunteer Observers (VOs)
- Information exchange on DRR curricula, DRR municipal and national plans, communication protocols, and Risk Reduction Management Centres

Solutions Packages: Based on the scoping mission findings, the Cuban SSC Expert Committee prepared and delivered a Solution Package to SVG authorities, with three options of offered support:

1) Volunteer River Observation
2) Hazard, Vulnerability and Risk (HVR) Studies
3) Weather Forecasting

Selecting a Priority Action & Preparing the Proposal: The Solutions Package was received by SVG and discussed within NEMO to select one of the options to pilot, in accordance with the implementation timeframe and budget available for each country. SVG selected the Volunteer River Observation option and submitted a proposal to the Project Coordination Team, requesting $ USD 31,900.

Identification of Leading Recipient Organization and Team: NEMO was selected as the leading organization, with the Central Water and Sewerage Authority (CWSA) established as the co-lead. The CWSA includes Water Resource Management Unit (WRMU), which monitors the hydrological and meteorological parameters in the upper and lower watersheds of the country through its network of stations and maintains the hydrological database. The WRMU manages ten automatic river water level recording stations, 5 automatic climate stations, 26 automatic tipping bucket rainfall stations, 26 groundwater measuring stations, and 21 flow measuring stations.

Implementing Partner: The implementing partner that supported SVG was UNDP. Its role was three-fold; to facilitate all exchanges between Cuba and SVG; to ensure that tools, training and methods used by the offering country were properly adapted to the context, time available and language of the recipient country; and to support the purchase of equipment needed.

3.2 The Offer – River Observation

The volunteer river monitoring methodology in Cuba is a practice that relies on VOs to measure the rain every day and maintain the rain gauges. In Cuba at present, of the total stations of the rainfall network, 1,198 are operated by VOs.

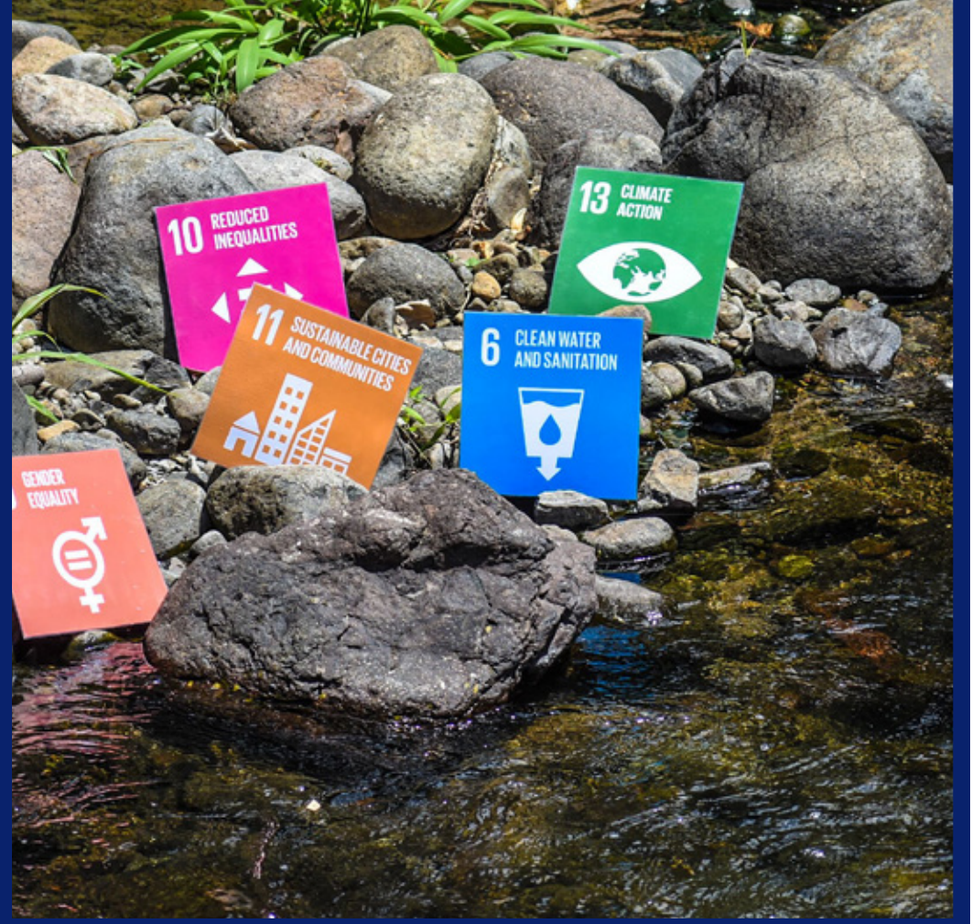
RIVER OBSERVATION

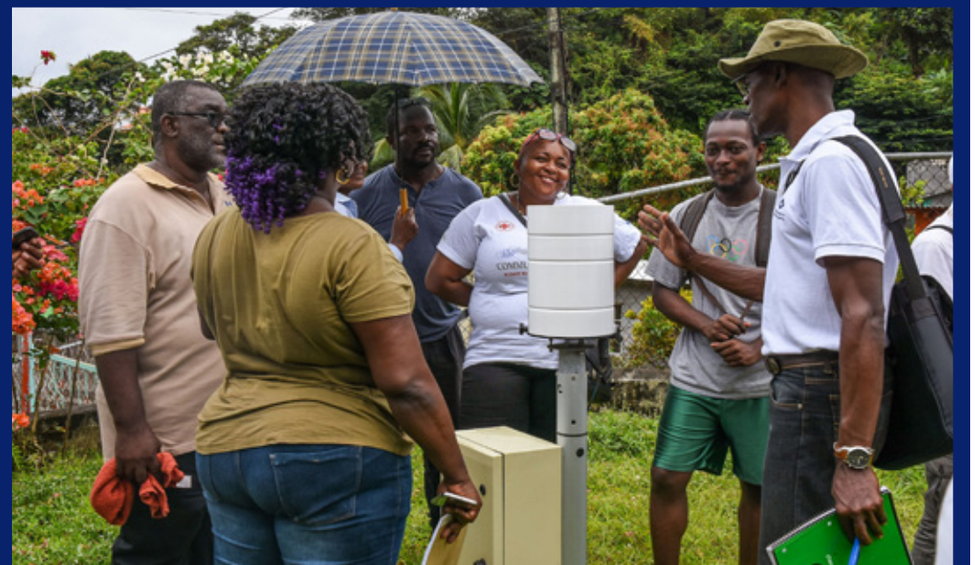
PRE-REQUISITES:

- The standard rain gauge used is the D-8 model, which refers to the eight inches measured by its diameter.
- Stilling wells and/or river gauge polls.

SUMMARY OF THE METHODOLOGY:

- These rain gauges are conventional, manual gauges made of a metallic cylinder that collect rainwater. The level is measured daily using a graduated scale ruler.
- A single rainfall annotation is made daily, corresponding to the rain accumulated in 24 hours, starting at 0800 hours. In exceptional situations of intense rains and hurricanes, several observations will be made on the day in rainfall stations specially selected for monitoring these events.
- The readings are recorded in a Rainfall Logbook by the VOs.
- Additional training includes learning how to observe and detect rainfall that would cause floods downstream and identify the alert thresholds and actions for rising water levels.
- Community members are identified, selected and trained to become VOs, using defined criteria.





4. TRANSFER & ADAPTATION

Visit to Cuba: Between the 19th and 22nd of November 2019, a two-person delegation from SVG, composed of the Head of the WRMU and the Deputy Director of NEMO, visited Cuba and met with National Institute of Hydraulic Resources (INRH), UNDP Cuba, Volunteer River Observers, and other key Cuban technicians. The purpose of the visit was to gain an understanding of the Cuban river monitoring methodology and see it used in the field, including observing the daily operations of VOs and learning about the equipment requirements and the processes to put into practice.

The Cuban team shared the overall Cuban EWS and the role of the main institutions, the water management context of the country, and the key elements and success factors of the river observation methodology, including:

- The role of the VOs in the hydro-meteorological monitoring and surveillance system in Cuba and how they complement the rainfall monitoring and river flow analysis of the INRH.
- The link that the VOs have with the farming communities which has led to greater reliability of information, dedication, and ownership of the VO practices, given the critical importance this information has for local agricultural activity.

The group went on a field visit to the Pinar del Rio province to observe the operations of the water resource company, the protocols used by the VOs to measure water levels, and the rainfall gauges.

Finally, work sessions were held to define in further detail how to carry out the transfer of the methodology to SVG. Information was presented about the hydrological context in SVG, including climate, infrastructure, processes of flood and rainfall monitoring, the role of the CWSA in EWS, and a detailed description of the two river basins and the two villages (South Rivers and Vermont) selected for the initiative.

The participants agreed to adjust the workplan so additional information could be collected before the training and so the right type of equipment could be purchased. The agreed pre-training actions were as follows:

1) A desk review of the hydrometeorological infrastructure in SVG;

2) A review of the characteristics of the South River and Vermont Watershed and an assessment of the runoff information in both rivers to develop baseline data at various points in both rivers;

3) A field trip to both water sheds including an assessment of the infrastructure at existing gauging stations;

4) An evaluation of the river monitoring networks and infrastructure at existing gauging stations, based on existing knowledge and field observations; this would determine if the existing networks were able to give an adequate representation of rainfall information and promote effective monitoring and surveillance of rainfall and river flows in SVG;

5) Development of materials to be given to the VOs for the observation and reconstruction of flood history;

6) A field trip to identify the VOs in both communities;

7) Training of VOs;

8) Development of an EWS methodology aimed at forecasting floods (assessing the river response time to a rainfall event, peak flows, and time of rise and peak flow) for both basins

Fact-Finding & Adaptation Mission: Between the 3rd to the 7th of December 2018, two Cuban technicians from the INRH visited SVG. Rather than a training mission, the visit was to follow-up on the agreement made during the trip to Cuba, with a focus on gathering information to better tailor and adapt the transfer, taking into account the characteristics of SVG.

a) Data Collection: During the visit the following information was gathered through meetings, desk work, and field visits to the basins and communities:

- Hydro-meteorological networks and infrastructure of SVG
- Water services budget
- Desk review of the available hydrological data
- Data gathering exercises at the Meteorological Office and at the facilities of the Water Authority and Electricity Services agencies
- Observations related to the monitoring of rainfall events and river runoff in the communities of South Rivers and Vermont, and consultations with members in the two communities and their local knowledge and experiences

b) Analysis & Adaption: The data was then analysed and processed to highlight the main findings and proposals for the transfer workplan. Elements identified as critical for its adaptation and transfer to the SVG were grouped into three areas:

- ***Volunteer (Non) Remuneration:*** Socio-cultural differences could constrain the implementation of VOs in SVG as the culture of volunteerism is different and may be difficult to sustain if done on a purely non-remuneration basis.
- ***Location of VOs & Monitoring Variables:*** Monitoring of river runoff and changes in river water levels was considered to be most appropriate for SVG, as the villages affected by floods are closer to the mouth of the rivers, as opposed to Cuba where most of the flood prone communities are located closer to the source and the central sections of the rivers. Small communities in the rugged upland regions of the drainage basins will limit the number of VOs at higher elevations.
- ***Refinement of Forecast and Thresholds:*** Flood forecasting is the most critical activity for effective river monitoring in SVG as most of the streams are short, making the response time tight (e.g. for major flood events, communities have approximately 15-20 minutes to respond to a flood warning). There

is a need to better forecast the behaviour of the rivers by assessing past events and correlating rainfall data with river discharge levels. This would also increase the accuracy of established thresholds and ultimately provide information for timely warnings that can improve river flood analysis and facilitate early evacuations where necessary.

c) Feedback: On the final day, these findings and recommendations were presented for feedback with stakeholders.

The participating agencies and stakeholders involved in the visit were the Meteorological Services, the CWSA, St. Vincent Electricity Services (VINLEC), the Forestry Division in the Ministry of Agriculture, the Geographic Information Services Unit in the Physical Planning Unit, and Ministry of Housing, among others.

Training Mission: The training mission to SVG was carried out between the 5th and 8th of March 2019. The mission consisted of two Cuban specialists from the National Institute for Hydraulic Resources (INRH), and three UNDP personnel. The purpose of the mission was to train rainfall and river run-off observers in the installation, operation and maintenance of gauging stations, as well as to train local community leaders in the management of VOs and the evaluation of hydrological information for flood early warnings, in the South Rivers community in the Colonaire River and in the Vermont community in the Buccament River.

On the first day, the training mission focused on theoretical aspects with the NEMO team and Volunteer Observers (VOs). Pluviometric and fluviometric observation theory, and management of observation networks was discussed.

On the second and third day, site visits were carried out with NEMO and the CWSA to South River and Vermont to conduct the practical exercises with the VOs. The CWSA led the practical training on how to assess the location and installation of rain gauges, and how to use the water level staff gauges and the manual rain gauges.

The Cuban team led exercises focusing on the location and installation of flow measurement sections and an assessment of VOs absorption and understanding. They demonstrated how to measure the river flow, how to calculate the time needed for evacuation, and how to do so using the equipment installed by the CWSA.

CONTENT OF TRAINING

1. Introduction - Theory of River & Rainfall Observations

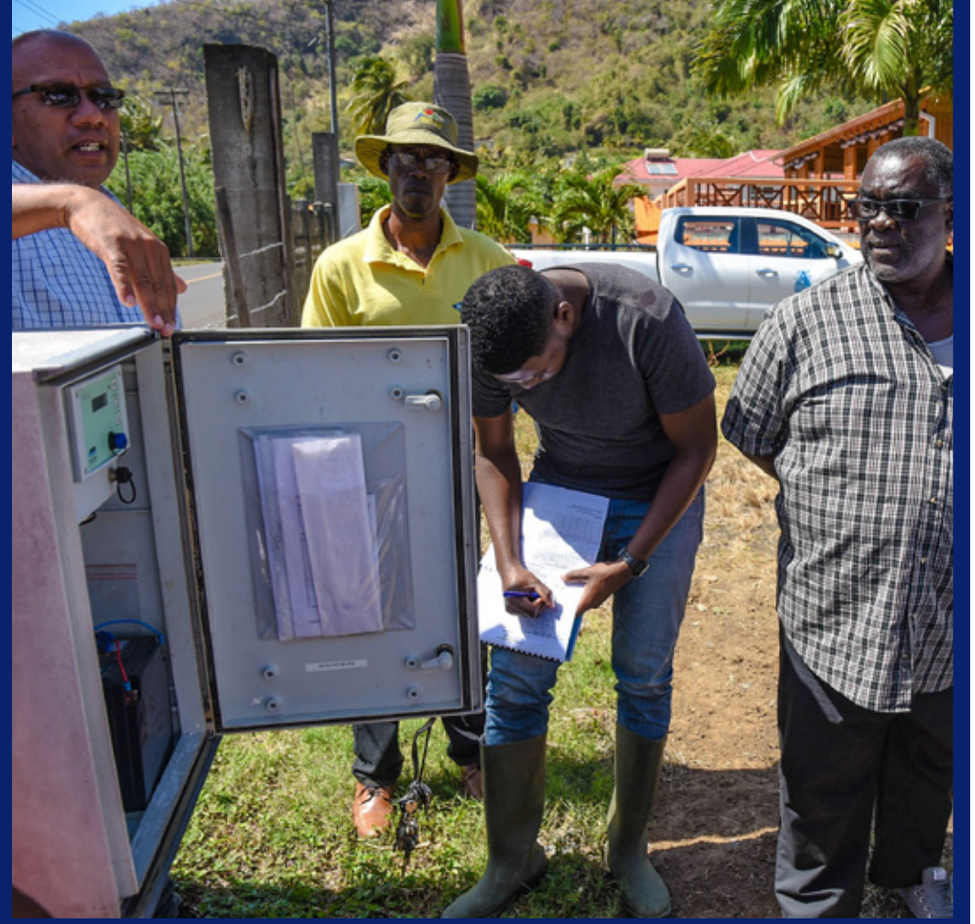
- Notions of rainfall and run-off (genetic factors, regimes, and patterns).
- Calculation methods for extreme rainfall and run-off
- Timely hydrological generalization for forecasts.
- Gauging equipment. Methods, recording and transmission.

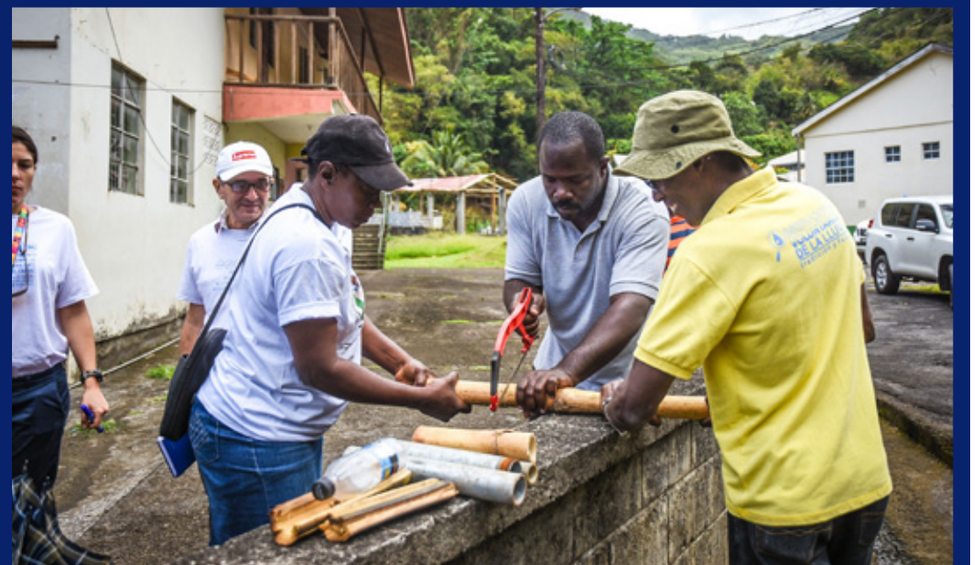
2. Network Management

- Equipment installation, operation and maintenance.

3. Practical Training at River Sites

- Assessment of the location and installation of rain gauges.
- Assessment of the location and installation of flow measurement section.
- Assessment of the in situ understanding of trained observers.



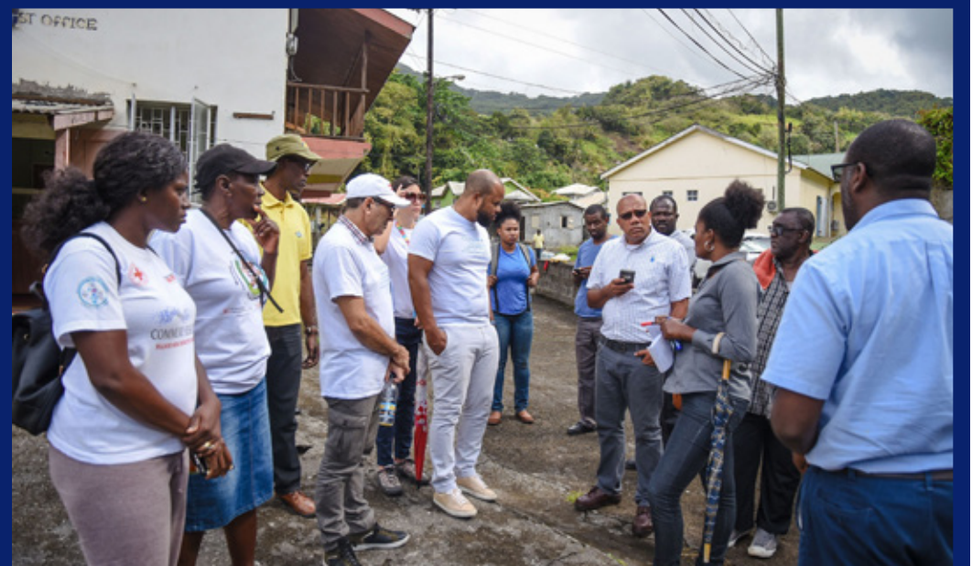


5. RESULTS

- The country has increased river monitoring data generation with the purchase and installation of additional river monitoring equipment for the South Rivers community in the Colonaire River and in the Vermont community in the Buccament River, specifically:
  - Real-time Automatic Rainfall Gauges
  - 5 Water level staff gauges
  - OTT RLS water radar level sensor
- Final report with recommendations to continue improving hydrological monitoring

TOOLBOX

- Rainfall Observation Manual
- Volunteer Observer Log
- Water Level Thresholds and Alert Levels Brief
- "Friends of the River" Brief Guide Example



6. SUSTAINABILITY

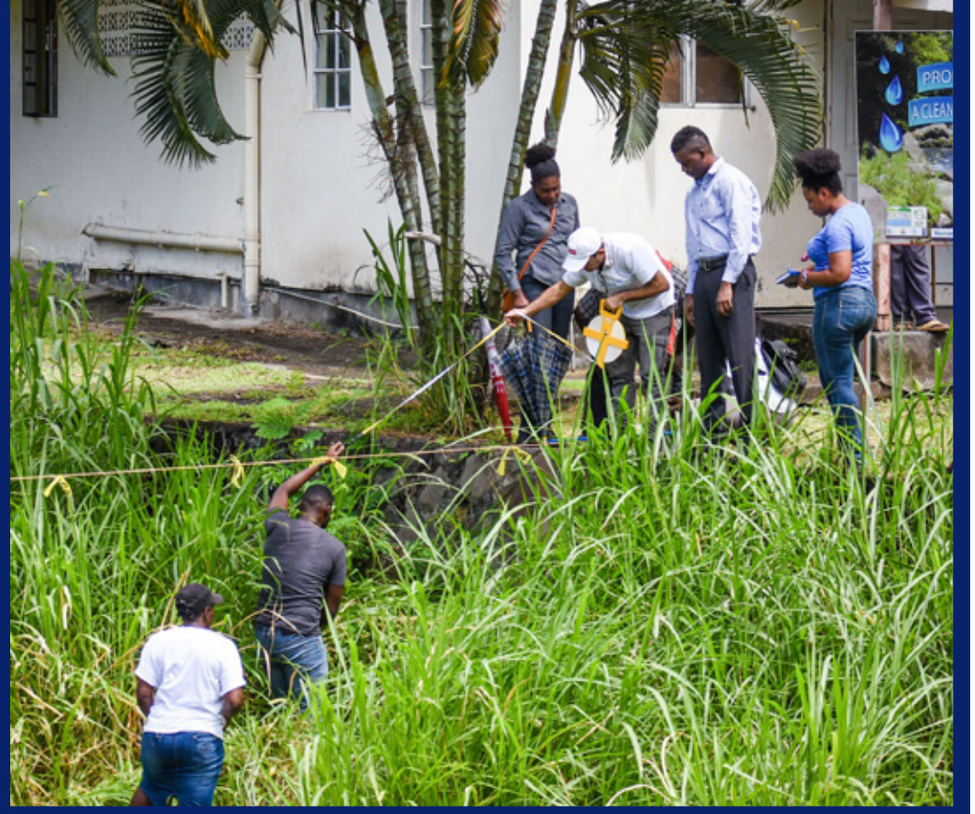
Cuba prepared a final report to NEMO with recommendation to continue improving monitoring of rivers, as well as the Volunteer Observer Manual with technical guidance on each step, to finalize this phase.

The training encountered considerable challenges, which affects potential sustainability. To be sustainable, the two countries would need to decide to take up the training again and include it in the second phase of the project. On the positive side, there is a wealth of information and analysis of adaptability that could be applied to re-envision the training.

7. LESSONS AND RECOMMENDATIONS

LESSONS LEARNED	RECOMMENDATIONS
The methodology relies heavily on a specific type of equipment. This entails a careful analysis of the recipient country's needs, interests and the feasibility of installing said equipment, at the appropriate location, and determining how data will feed into the existing system, as a key input to a technological transfer. SVG has been progressively modernizing its equipment and its network for river monitoring relies mostly on real-time automatic stations that send the readings to mobile apps of the CWSA staff, among others.	*Institutional Integration:* Involve the institution with the primary mandate in this area (i.e. Water) from the moment a Solution Package is discussed to ensure a common understanding of the initiative; to provide essential input for the selection of the relevant communities and types of equipment; and to integrate the new tool into the existing system.
The Solution Package for SVG proposed a methodology with low tech manual gauges based on human observation and paper-based recording of readings; the technological differences in approach caused considerable delays when the suggested equipment list was revised by the water authority who hadn't been fully involved in the definition of the proposal. A series of discussions were then held to determine if a combination of purchases could be made instead, to allow for additional real-time stations and manual ones, and to ensure the investment represented a support to the monitoring capacities of the country.	*Role of Facilitating Agencies:* Ensure that the agencies facilitating SSC accompany all stages of the transfer, especially the definition, planning and adaptation phases; propose solutions; and ensure the aim responds to the needs of the country and can be delivered in the available timeframe with adequate quality. This role encompasses quality assurance of the methodological preparation for the transfer (substantive training and didactic materials); the definition of the methods of transfer (installation and purchase of equipment, technical assistance, data-gathering missions, trainings, and additional analysis required); coordinating the organizational and logistical aspects; and guaranteeing the effectiveness of the activities.

LESSONS LEARNED	RECOMMENDATIONS
Better communication of the complementary nature of the initiative among national stakeholders would have mitigated the initial reticence, as the original vision had been to combine the real-time station systems with the Cuban method for maximum coverage and redundancy. Each real-time automated station is costly to purchase and maintain; in a context of scarce resources, complementing these stations with low-cost, easy to-produce-and-repair technology in areas where the existing stations didn't cover, sought to be a cost-effective strategy. Moreover, it also aimed to address the effectiveness and timeliness of the feedback cycle. Given the nature of the rivers, the margin to alert communities of flash floods is approximately 15-20 minutes, whereas the cycle of warning with real-time stations could be longer, considering the water level data is sent to the CWSA, who then sends it to NEMO, who then issues the alert, which must go back to the community. Community monitoring with a network of radios could provide quicker alerts for these localized, sudden-onset events. This system might serve as back-up if one of the stations is damaged and/or fill gaps where resources aren't enough to guarantee 100% coverage.	*Planning Knowledge Transfers:* During the planning process for a knowledge transfer, take all required elements into account and plan for how to achieve them. Embrace a capacity development approach, recognizing that transferring capacity may entail in-depth capacity assessments, labour force supply and costing analyses, and/or installation of equipment or infrastructure that supports the knowledge components.
Another key element that determines adaptability is the culture of volunteerism, and whether a non-remunerated system can guarantee 24h, year-round monitoring.	*Community Volunteerism:* Reflect on the feasibility of Volunteer Observers, given that VOs are the cornerstone of this methodology. Map the existing volunteer network in the potential communities, with a minimum of emergency and comms training, and scope out the possibility of additional functions.
The preparatory missions conducted before the training did allow for critical data to be collected and guide the transfer; this data can form the basis for the continuation of this initiative in phase 2.	*Stakeholder Analysis:* Compile all information from the preparatory missions for stakeholder analysis to see what has been advanced to date and to redefine the work plan. Use a stocktaking analysis of the different organizational, logistical and methodological challenges that were faced to inform the exercise.



8. CONCLUSION

Together with Antigua and Barbuda, Saint Lucia, Dominica, and the Dominican Republic, Saint Vincent and the Grenadines has advanced in policy making for early warning systems, through analysis of gaps and planning a roadmap forward. This process has reinforced countries' understanding and identification of the strengths and gaps in their early warning systems, the standards for people-centred multi-hazard systems, and promoted commitment to addressing potential risks and threats with prioritized actions plans.

These efforts were supported by Cuban technical assistance, leveraging tested tools and methods, and promoting engagement between countries sharing similar context and exposure to hazards. In Saint Vincent and the Grenadines, the training and application of voluntary river observation in high-risk communities aimed to strengthen EWS Pillar Two – Monitoring and Warning Systems. This experience provides solid lessons and recommendations for planning and implementing future knowledge transfers to Saint Vincent and the Grenadines or other islands. It also lays the foundation for upscaling the model to other communities on the island or to other hazards, providing authorities and decision-makers with the risk analysis necessary to provide effective and integrated early warning to the communities.

This systematization aims to make a fruitful contribution to the region's knowledge on early warning systems and to global knowledge on South-South Cooperation practices.