National Curriculum Development in Climate Change Mitigation and Adaptation and Disaster Risk Reduction Consultancy for the Government of St. Vincent and the Grenadines

Working towards a Resilient Future: A Disaster Risk and Climate Change Resource Manual for Lower Secondary School Teachers and Teacher Educators

Prepared by
David Selby, Fumiyo Kagawa
and Rowan Oberman

SUSTAINABILITY FRONTIERS CIC, UK

3 December 2019

sustainability frontiers

Prepared by
David Selby, Fumiyo Kagawa & Rowan Oberman

Sustainability Frontiers CIC, UK

6 April 2020

Table of Contents

Acknowledgement

The Sustainability Frontiers team would like to acknowledge the contribution of Susan Pike, Dublin City University, in the researching and writing of earlier drafts of some of the case studies.

Introduction

This *Resource Manual* lays out vital information designed to enable teachers to launch into climate change mitigation and adaptation (CCMA) and disaster risk reduction (DRR) teaching and learning.

Learning Resources 1 to *3* aim to extend teacher familiarity with disaster risk reduction and climate change education by offering annotated lists of electronically accessible resources. The *Learning Resources 1* section lists sources for CCMA/DRR-related interactive and participatory learning with sub-sections on global good practice (*1.1*), practice specific to small-island developing states (SIDS) around the world (*1.2*), and Caribbean best practice (*1.3*). The *Learning Resources 2* section lists information and data sources on disasters and climate change that teachers can draw upon to extend their own knowledge and/or use in classroom with students. Once again, the list is organized into global, SIDS and Caribbean-specific sub-sections. The *Learning Resources 3* section lists resources, similarly organized, on the fields of climate change education and disaster risk reduction education as specific fields of educational practice. This will be of considerable interest to teacher educators and teachers who wish to deepen and advance their professional interest.

The *Learning Resources 4* section presents twenty-three detailed case studies of climate change, hazard and disaster impacts and responses on St Vincent and the Grenadines in particular but sometimes extending to the wider Caribbean region. The case studies offer a rich resource for understanding the CCMA/DRR ‘state of the art’ on SVG. It is recommended that relevant cases be read through before going into classroom to teach a climate change or disaster-related lesson. The text of the activities in the curriculum modules refers to the specific case or cases that should be read in preparation for teaching a specific climate change, disaster risk or environmental topic.

Learning Resources 1

Interactive and Participatory Student Learning Materials and Initiatives

1.1. Global Good Practice

Grant, T. & Littlejohn, G. (2017). Teaching Teens About Climate Change. **Toronto: Green Teacher.**
https://greenteacher.com/teaching-teens-about-climate-change/

This practical collection of papers guides teachers on how to tackle the topic of climate change with secondary students. There are activities on understanding the difference between climate and weather, climate change denial and overcoming despair, a simulation on the pros and cons of reducing carbon emissions, and a sequence of activities on children's rights and climate change.

Keeley. M.A. (2001). Marvelous Mangroves in the Cayman Islands: A Curriculum-based Teachers' Resource Guide. **Grand Cayman, Cayman Islands: Department of Education. [**Note: various country and region specific editions, some in translation; also subsequently reissued for all schools by Cayman Islands Government].

For the Cayman Islands portal on the *Resource Guide*, go to:
http://www.gov.ky/portal/page/portal/cighome/pressroom/archive/200704/marvellousmangroves

For Mangrove Action Project and its educational work, go to:
https://mangroveactionproject.org/mangrove-education/

Australian edition of the *Guide* available to download:
http://www.bmrg.org.au/resources/education-resources/marvellous-mangroves/

For YouTube video on Marvelous Mangroves curriculum, go to:
https://www.youtube.com/watch?v=Eq1D0h4YFQE

This guide introduces students to the fauna and flora that make up the mangrove habitat, explores mangrove ecology, looks at destructive human impacts on mangrove swamps and explores what peoples and communities can do to best protect and preserve mangrove habitat. The curriculum begins with familiarization lessons in the classroom prior to a field trip (on land, by boat and/or using snorkeling) to be followed back in class with investigation of species found in water samples, consideration of food chains, food webs and mangrove degradation, and determination of mangrove-protective and conserving behaviors. For each section of the *Guide* a range of hands-on activities have been developed. Essentially a tool for the grade 4 to 8 science curriculum, *Marvelous Mangroves* also includes activities for social studies, language arts, mathematics, drama and art. The strategy of the Mangrove Action Project is to draw on local expertise to contextualize the curriculum

before launching it in a new country or region and to offer professional development workshops to familiarize teachers with the materials, activities and overall pedagogy. *Marvelous Mangroves* has been added to the curriculum of a range of island, including Caribbean, states and coastline countries; as such it also has relevance for sections 7.2 and 7.3 below

Lindsay, S. (2018). Manitoba Emission, Impacts, and Solutions: A Climate Change Resource for Grades 5 to 12 Teachers. Manitoba Education and Training/Climate Change Connection.
https://www.edu.gov.mb.ca/k12/esd/emissions/full_doc.pdf

While the text is very much rooted in the climate change situation in Manitoba, Canada, it is rich in classroom activities and lesson plans drawn from Canada and beyond that could easily be downloaded and adapted and also excellent video links that could be used from a distance. The resource has three sections: Emissions, Impacts and Solutions. For each section lines of enquiry are proposed and critical thinking questions posed. The resource is also very good in guiding teachers in connecting classroom learning to the community. There is an excellent closing section listing a range of whole school solutions that could in many cases be pursued by SVG schools and their communities. This is an inspiring resource.

***Oberman, R. (2016). Creating Futures*. Dublin: Trocaire/Centre for Human Rights and Citizenship Education, Dublin City University**
https://www.trocaire.org/getinvolved/education/creating-futures

This cross-curricular resource is intended for use in senior primary school classrooms. It contains ten lessons exploring the science of climate change, the injustices of climate change and possible responses to climate change. A range of methodologies is proposed including: inquiry packs, simulation games, ranking activities and arts based activities. The lessons are designed to encourage children to work creatively and collaboratively and to think critically about the challenges climate change poses. The lesson plans include a range of resources: photographs, game materials and worksheets. An inquiry frame is proposed for the lessons, where the program begins with and continually responds to children's developing knowledge and questions. A booklet titled *What Teachers Need To Know* is also provided setting out key information in relation to teaching climate change.

***Pike, S. (2010). EcoDetectives. Teachers' Resource Pack: Environmental & Climate Change Investigations for Primary Schools*. Dublin: Department of the Environment, Heritage and Local Government**
https://drive.google.com/drive/folders/0B9Dy75bP0m8menpnclZlZklvWjg

EcoDetectives, is a teacher resource pack for environmental and climate change investigations at primary level, produced by the Irish Department of the Environment, Heritage and Local Government. By experiencing the activities in this resource, it is hoped that the youth of today and of tomorrow will endeavor to help change our behavior so we address the effects of climate change and do all they can to help protect the environment. The resource draws together creative ways to teach about climate change,

primarily through geography and science. The resource also provides for children's learning in other curriculum areas, particularly language, mathematics and Social, Personal and Health Education. The activities in the workbooks are designed to help students feel as if they are real eco-detectives as they conduct a range of outdoor investigations and experiments in the case of the older students and games for younger students.

Red Cross/Red Crescent Climate Centre (Undated). Y-Adapt: Youth Action on Developing Adaptation Plans for Tomorrow
https://www.weadapt.org/knowledge-base/y-adapt
https://www.climatecentre.org/downloads/files/Y-Adapt%20Curriculum%3B%20Facilitation%20Guide%281%29.pdf
https://sdg.iisd.org/news/youth-curriculum-helps-communities-adapt-to-climate-change/

Y-Adapt is a curriculum of seven sessions for young people consisting of games and activities helping them to understand climate change and then take practical action to adapt to and reduce the impacts of a changing climate in their community. The first session introduces youth-led adaptation examples from around the world and starts students thinking about how they can prepare for climate change in their community. The second uses playful activities to distinguish weather from climate, understand the science of climate change, and understand human-induced climate change. The third has students mapping hazards in their own community as they take a vote on the most impactful hazards. The fourth takes a systems look at community and at how people, places and resources interact and how climate change will impact the system. The fifth, 'Act to Adapt', is a giant board game in which youth prioritize resources that are vulnerable to specific weather events and negotiate protective actions. The sixth challenges participants to create an action plan for their community while the seventh has students creating an Adaptation Card to be shared globally on their chosen real-world adaptation. The resource is a collaboration involving Red Cross/Red Crescent and Plan International.

Shaw, R. et al. (2009). 1-2-3- of Disaster Education. **Bangkok: UNISDR Asia and the Pacific.** https://www.unisdr.org/we/inform/publications/12088

The *'1-2-3'* formula refers to a 1-year education program that has 2 levels (introductory and advanced) and deals with 3 kinds of disaster, i.e. typhoons, floods and earthquakes, for each of which there is a workbook. The resource sees disaster risk reduction education as a *process* that breaks through the boundaries between school education, family and community. Many of the activities, admirably, involve student enquiry and action out in the community. There are many well thought out learning activities with high potential for interactivity; for instance, around analyzing disaster films, using puppetry, developing hazard response plans and frameworks for students to develop their own activities. This is an innovative and worthwhile resource.

UNISDR. (2018). Play and Learn to Stop Disasters!
http://www.stopdisastersgame.org/#1540393288105-457a25c1-59a6

Targeting 6-19 year-old children, this online simulation game involves five scenarios (i.e. flood, hurricane, tsunami, wildfire, earthquakes) requiring players to save lives by building the defenses of an established community including upgraded housing to prepare for an inevitable disaster threat.

UNISDR/UNICEF (2004). Let's Learn to Prevent Disasters: **Educational Kit and *Riskland* Game.** https://www.unisdr.org/we/inform/publications/2114

Subtitled *Fun ways for kids to join in risk* reduction, the resource covers earthquakes, floods, hurricanes, volcanic eruptions and landslides. It is directed at 8 to 12 year olds and is conceived as supplementary material for the teaching of social studies, science and environmental studies. As such, it does not include structured curriculum but rather factual information supported by (attractive) graphics with activities such as alphabet and maze puzzles, joining dots in a picture and crosswords. There are ideas for more comprehensive activities and guidance on drawing a disaster risk map of the local community. The kit includes the well-known board game, *Riskland.*

1.2. Materials Specific to Small Island Developing States

Cambers, G. & Gina, F. 2005. Introduction to Sandwatch: An Educational Tool for Sustainable Development. **UNESCO Coastal Region and Small Island Papers, 19.**
https://www.zaragoza.es/contenidos/medioambiente/onu/379-eng-ed1.pdf

Cambers, G. & Diamond. P. 2010, Sandwatch: Adapting to Climate Change and Educating for Sustainable Development**. Paris: UNESCO.**
https://unesdoc.unesco.org/ark:/48223/pf0000189418

Formally launched in 2001 in Saint Lucia at a regional meeting of 18 Caribbean countries, Sandwatch is a program that brings together children, youth and adults, supported by teachers, local community and non-governmental organizations in fostering ecosystem resilience and climate change adaptation with a focus on beach and other coastal environments. The approach uses a four-step 'hands-on' methodology that encompasses monitoring, analyzing, sharing and taking action. Participants regularly monitor a designated beach environment, looking, for instance, at beach erosion, accretion, composition, fauna and flora, beach quality and degradation, human impacts including beach debris, and waves and currents. They analyze their findings before communicating results locally through community meetings, storytelling and drama and through other social and traditional media. Sandwatch teams then plan and implement change and advocacy activities to protect and restore ecosystems and promote climate change adaptation. The 2010 version of this resource explains Sandwatch, its links to education for sustainable development and how to get started with a project before setting out, step by step, the Sandwatch methodology and offering guidance on practical activities to support each program element. The manual offers multiple opportunities for forging links to the school curriculum. While the updated 2010 handbook makes reference to one SVG-based

project (p.11), the earlier 2005 version includes a full SVG case study of the Sandwatch program implemented over several years at Bequia Community High School with integration into the science, social science, English, woodwork, mathematics and information technology curriculum (pp. 58-9). Beginning as a Caribbean small island developing states project, Sandwatch is now being implemented in more than 50 countries worldwide.

***Said, M. et al. 2016. Climate Change Education for Asia Pacific Small Islands Developing States.* Paris/Jakarta: UNESCO**
https://unesdoc.unesco.org/ark:/48223/pf0000244336

This 160-page teacher handbook, the product of a Malaysian-based 'Promoting South-South Cooperation through Climate Change Education in Asia Pacific Small Island Developing States' project, is designed to enhance the capacity of teacher trainers to equip primary and secondary teachers in the Pacific islands with the knowledge and pedagogical skills to deliver climate change education. It consists of two parts. The first part lays out basic knowledge on climate change covering, over three modules, the science of climate change, the causes and effects of climate change, and sector-by-sector impacts of climate change (e.g. impacts on food security, gender inequality, health and safety, energy, biodiversity and water resources). The second part offers eleven classroom activities and seven lesson plans picking up on topics in part one with, in each case, a lesson overview and explanations of learning objectives, methodology and learning resources (handouts in the appendices). The whole is well illustrated and easy to follow.

1.3. Caribbean Materials

Caribbean Community Climate Change Centre. (2012). 1.5˚C Stay Alive – An Education Initiative
https://caribbeanclimateblog.com/1-5%CB%9Ac-stay-alive-an-education-initiative/
https://www.caribbeanclimate.bz/education/2012-1-5˚-stay-to-alive-education-initiative/

The Caribbean Community Climate Change Centre launched its campaign 1.5 ˚C to Stay Alive, ahead of COP15 in December 2009. The aim of the initiative was to sensitize citizens across the Caribbean community about the impact of Climate Change on livelihoods in the region, and to make a convincing case at the global level for the reduction of greenhouse gas emissions to a level not exceeding 350 ppm (parts per million) as an effective means of stabilizing global warming. This initiative has developed a curriculum resource designed for Caribbean children ages 12 to 16 years. Teachers and the Centre's technical experts put the resource together. It contains four units: The Warming Climate, Sea Level Rise, Pine Forest and Social Impacts of Global Warming. The units each include between ten and thirteen lessons with a total of 46 lessons all told in the program. Each lesson includes a detailed lesson plan setting out the objectives, skills, attitudes and concepts being addressed. There is a list of proposed questions, extension activities, detailed teacher notes, a glossary and student activity sheets. The bulk of the lessons are classroom discussion based activities that draw on the students' own

experiences and provide for group work. The program is cross-curricula, supporting a variety of skills including: investigating, questioning, predicting, testing, analyzing, team working and language skills. Field trips, workbooks and varied assessments are also included. Videos depicting the majority of the lessons being enacted, are also provided on the website.

Richmond Vale Academy, Environmental Education Lesson Guide for Teachers https://richmondvale.org/en/

The Richmond Vale Academy (RVA) is an educational institution situated in the Chateaubelair area of St. Vincent and the Grenadines. It was established in 2002 to train activists from all over the world in fighting global warming and global poverty. The main initiative of the RVA is the Climate Compliance Conference, a program which runs experiential learning courses focused on poverty reduction, environmental conservation and climate change awareness. The course aims to build participants' self-reliance and to support personal, academic and social development. Students participate in research, related to climate change, sustainable agriculture, pollution, the oceans and biodiversity, and complete adaptation projects working with local residents. RVA also engages actively in community volunteer work. The Academy has produced a short toolkit for use with senior primary and secondary level students. The toolkit contains four lessons looking at biodiversity, climate change adaptation, climate smart agriculture and ecotourism. For each lesson, the toolkit sets out the main content of the lesson, suggested methodology and contains relevant videos on the lesson topic originating from different institution around the world. Assessment is included as the final lesson.

Selby, D. & Kagawa, F. 2014. Disaster Risk Reduction Education Toolkit. **St. Michael, Barbados: CDEMA**
https://www.cdema.org/joomdocs/CDEMA_DRR_Edu_Toolkit_MAY_22_2015.pdf

This toolkit is the outcome of a 2014 Disaster Education Project for the Caribbean Disaster Emergency Management Agency involving sixteen English-speaking Caribbean countries. Over five introductory sections the toolkit explains key concepts and ideas in disaster risk reduction, explores the links between disaster risk reduction and climate change, lays out what the authors see as the five dimensions of disaster risk reduction education, demonstrates how disaster risk and climate change can be integrated into the school curriculum and looks at learning and teaching approaches. There follows a 140-page section containing a wide range of primarily secondary learning activities, with sub-sections on: introductory and awareness-raising activities; activities for disaster preparedness and risk reduction (covering climatological, geo-seismic and human-induced hazards), climate change activities, activities for resilience building, and activities for use with students in post-disaster and post-trauma contexts. The toolkit ends with sections on student assessment, resource lists on other practical guides and on sources of disaster risk information for the teacher, and, finally a collection of PowerPoint slides for use with the activities.

Learning Resources 2

Information and Data Resources to Use with Students

2.1. Global Good Practice

Adaptation Learning Mechanism http://adaptationlearning.net

This is a global knowledge sharing and learning platform for good adaptation practices, tools and resources. Resources are searchable by keywords, region and country and filtered by themes (e.g. agriculture/food security, biodiversity, coastal zone management, community-based adaptation, disaster risk management, education, gender, infrastructure, low emission adaptation, natural resource management, public health and water resources) and type (i.e. project, resource).

Centre for Research on the Epidemiology of Disasters (CRED), EM-DAT International Disaster Database http://www.emdat.be/

EM-DAT (Emergency Events Database) is an online open access database that provides information on the number and types of disasters in a given country but also provides data on their human impact; such as number of deaths, injuries or economic damages. It covers 1900 until the present day. There is an up-to-date 'Disasters of the Week' section covering both natural and technological disasters.

Climate Visuals www.climatevisuals.org/

Based on international social research, this resource offers seven core principles for effective visual communication, plus a library of images. The website contains a growing library of high quality photographs to provide inspiration and guidance for teachers of climate change. Each image is linked to its original source and many are available to download for free under Creative Commons licenses for use in blogs, articles and campaigns.

Earth Vision Institute. Getting the Picture: Our Changing Climate
http://www.gettingthepicture.info

This free interactive online multimedia tool helps students and educators (especially at secondary school level) gain a fresh perspective on climate change. It employs an interdisciplinary approach to teaching climate science. Step-by-step lessons uniquely combine science, art and adventure and include animations, photographs, field expedition stories and video clips from James Balog's documentary films (*Chasing Ice* and *the Human Element*). The website also offers resources on climate change for students and teachers.

European Geosciences Union (EGU). (2018). Using Paired Teaching for Earthquake Education in Schools.
https://www.youtube.com/playlist?list=PLYJjP6lVJvswbQzrA1O_VA_StEun7HqN8

The ‘paired teaching technique’ encourages the in-class teacher to collaborate with the video teacher (i.e. a geoscientist) to help students understand the basic science of earthquakes and safety measures they can take (e.g. drills and planning). The 10 learning videos - freely available on the YouTube channel of the European Geoscience Union - are designed to be viewed in short segments. In each segment, the geoscientist asks questions that will be explored through hands-on activities under the guidance of the in-class teacher in between the segments.

Global Footprint Network
https://www.footprintnetwork.org/resources/footprint-calculator/

The ecological footprint provides an indicator of human pressure on nature. Teachers can use the ecological footprint calculator to find out students’ own ecological footprint to raise awareness and discuss their footprint implications and also possible solutions helping them tread more lightly on the Earth. An online calculator is also available from Caribbean Community Climate Change Centre: https://www.caribbeanclimate.bz/carbon-footprint-calculator/

Missing Maps www.missingmaps.org/

Each year, disasters around the world kill nearly 100,000 and affect or displace 200 million people. Many of the places where these disasters occur are literally 'missing' from any map and first responders lack the information to make valuable decisions regarding relief efforts. Missing Maps is an open, collaborative project in which those using it can help to map areas where humanitarian organisations are trying to meet the needs of vulnerable people

NASA Climate Change https://climate.nasa.gov/resources/education/

The NASA climate change website has a wide variety of resources for exploring climate change with students. There is a section bringing together graphic and multimedia resources which include, for example, satellite images documenting the reduction in Greenland ice sheets, visualizations capturing sea surface temperature changes and videos taken while flying over glaciers. There is a NASA Climate Kids section that brings together information sheets for children, games and activities. There is a section for teachers including lesson plans and assessments; there are also images, apps and information that can be used directly with students.

Nature Works Everywhere https://www.natureworkseverywhere.org/about/

Nature Works Everywhere is an educational resource built by a large team of scientists involved with the Nature Conservatory. The materials aim to support teachers and students in exploring and understanding nature. It includes ‘virtual field trips’ looking at different climate affected environments. It also has videos with lesson plans and student handouts on climate change, climate change mitigation and adaptation projects.

Plan International, Sendai Framework for Disaster Risk Reduction, Child Friendly Version https://plan-international.org/emergencies/disaster-risk-reduction-drr

The Sendai Framework for Disaster Risk Reduction is an international agreement signed by governments which aims to reduce disaster risk and losses over the period 2015-2030. The Children in a Changing Climate coalition (ChildFund Alliance, Plan International, Save the Children, UNICEF, and World Vision) has developed a child-friendly guide to this agreement. The guide was developed in consultation in an effort to support processes of child-friendly accountability. It is especially aimed at young people aged 10 to 14.

Prevention Web https://www.preventionweb.net/english/

This website includes rich collections of DRR related information, resources and tools for teachers and students. SVG country specific information can be found at https://www.preventionweb.net/english/countries/americas/vct/ and education materials are searchable by key word at: https://www.preventionweb.net/educational/list/#hits=20&sortby=default&view=pw&filter=unisdrcontenttype%3A%5E%22Educational+materials%22%24

UN CC: Learn https://www.uncclearn.org/learning-resources/library

UN CC: Learn (The One UN Climate Change Learning Partnership) is a collaborative initiative of more than 30 multilateral organizations supporting countries to design and implement climate change learning. The 'Learning Resources' section of the website includes sixteen online courses that focus on various aspects of climate change and green economy. Its library section includes important publications by UN CC: Learn partners on the subject of climate change. Resources are searchable by key words and can be filtered according to, for instance, organization and theme.

WMO for Youth http://youth.wmo.int

This website offers a wide range of resources focusing on weather, climate and water. An 'Impact' section explains risks of hazards with a focus on tropical storms, floods, drought and extreme temperatures. The 'Take Action' section gives tips on actions to be taken by young people. The 'Fun' section includes a collection of quizzes, interactive web games and scientific experiments.

2.2. Materials Specific to Small Island Developing States

WeAdapt - Collaborative platform on climate adaptation with a knowledge-base focused on Small Islands Developing States
https://www.weadapt.org/knowledge-base/small-islands-and-climate-change

WeADAPT is a collaborative platform on climate adaptation issues supported by the Stockholm Environment Institute established since 2007. WeADAPT allows practitioners, researchers and policy-makers to access credible, high-

quality information and connect with one another. Through the platform, it is possible to learn about current climate adaptation work, methods and tools; share initiatives in climate adaptation to increase visibility and connect and engage with other climate adaptation professionals and organizations. The information collated is organized around twenty themes, one of which is *Small Islands and Climate Change*. This section brings together a range of documents responding to some of the challenges faced by small islands in respect of climate change. These documents include: a handbook to support community training in climate change adaptation, a cartoon to build climate resilience, research analysis and assessment tools.

***Berg, J. et al. 2015. Urbanization and Climate Change in Small Island Developing States*. United Nations Human Settlements Programme, Nairobi: UN-Habitat**
https://sustainabledevelopment.un.org/content/documents/2169(UN-Habitat,%202015)%20SIDS_Urbanization.pdf

This briefing paper provides contextualized information on the challenges and opportunities presented by climate change in relation to human settlements in Small Island Developing States (SIDS). The briefing paper presents some of the key aspects discussed during the third international conference on Small Island Developing States (Samoa, 2014). It also links the climate challenges faced by human settlements with opportunities for a renewed urban focus not only because more than half the population of SIDS already live in cities but because urban areas are vital for building resilience to climate change.

OECD Making Development Co-operation Work for Small Island Developing States
https://read.oecd-ilibrary.org/development/making-development-co-operation-work-for-small-island-developing-states_9789264287648-en#page1

This report on development co-operation between Small Island Developing States (SIDS) from OECD contains relevant data related to the vulnerability and specific impacts that climate-related natural disasters have in these nations. The report builds on several sources of OECD data presented through visual tools such as infographics, charts and graphs that might be useful for engaging students in discussion of sustainable development indicators and good practices.

Portraits of Resilience
http://www.manystrongvoices.org/portraits/stories.aspx?id=6726&t=229

Portraits of Resilience is a project of Many Strong Voices, a partnership program bringing together organizations working in the Arctic and Small Island Development States to take collaborative and strategic actions on climate change mitigation and adaptation at the local, regional and international levels.

Portraits of Resilience trains children in regions most affected by climate change in the use of photography and other digital media, enabling them to

document and share their personal stories of climate change. These photographs and testimonies are organized and accessible on their website.

Trends in Sustainable Development: Small Island Developing States (SIDS), United Nations, 2010.
https://sustainabledevelopment.un.org/content/documents/313Trends_in_Sustainable_Development_SIDS.pdf

This report developed by the United Nations highlights recent trends and key developments in Sustainable Development across Small Island Developing States (SIDS). The publication presents statistical data comparing regions and illustrating the unique challenges and, hence, solutions to sustainable development that SIDS face. The report focuses among other issues on climate change, disaster management, energy, natural resources and social development. The statistical data as well as the visual tools presented are tools for students to explore and use as well as valuable resources for classroom activities.

2.3. Caribbean Materials

Caribbean Community Climate Change Centre: Regional Clearing House Search Tool http://clearinghouse.caribbeanclimate.bz

The Caribbean Community Climate Change Centre coordinates the Caribbean regional response to climate change and works on effective solutions to combat the environmental impacts of climate change. Its Regional Clearinghouse Search Tool allows users to search, access, request, contribute and exchange digital information and data on climate change in the region.

Caribbean Disaster Emergency Management Authority (CDEMA). We Ready Portal. http://www.weready.org/

This CDEMA *We Ready* web portal is clearly structured according to key hazards including earthquakes, floods, hurricanes and tsunamis and other coastal hazards. Under each hazard, there is a section dedicated to kids (with no specification of target ages/grade levels). Using colorful, child-friendly illustrations and simple text, it offers a definition and key characteristics of each hazard as well as safety practices in the light of the hazard. 'Games and Activities' included for each hazard are in the same three formats (i.e. a coloring book, word find puzzle and story book). Multiple-choice quizzes are included for each hazard to check kids' knowledge of hazards and safety procedures. Children are 'certified' when they answer the questions correctly.

Under each hazard heading, there is a section called 'Education Centre' which includes a sub-section titled 'Teacher's Tools' or 'Teacher resources.' Types of information covered under these sub-sections are not consistent. For earthquakes, there are some simple cross-curricular integration ideas that lack age specification and curriculum progression advice. Teacher resources

for tsunamis include a Teacher Education Resource Kit, a Student Handbook, Teacher PowerPoint slides, and a Cartoon Booklet (see the section on Tsunami Smart Teacher Materials below). In the treatment of both hurricanes and floods, the portal section is either undeveloped or very limited with no curriculum links forged.

CORELAC. (2014). Priorities in Resilience for Children, Adolescents and Youth in Latin America and the Caribbean. Coalition for the Resilience of Children and Youth in Latin America and the Caribbean.
https://www.unisdr.org/files/43611_declaracioncorelacenglish1.pdf

This document is the outcome of the Voices Movement that elicited the voices of over 18,000 Latin American and Caribbean children and youth on disaster risk reduction. Out of the consultation emerged six themes: the right to participate in risk reduction, risk management in educational settings, the right to health and protection, environmental protection, social risk, issues related to gender and persons with disabilities. What needs to happen to give children a voice in disaster risk reduction is spelt out in considerable detail for each of the six themes, the whole providing a canvas and framework for disaster risk curriculum and whole school disaster risk management through the fresh eyes of children.

Grenadines Marine Resource Space-use Information System (MarSIS)
www.grenadinesmarsis.com/Files_and_Maps.html

The Grenadines Marine Resource Space-use Information System (MarSIS) brings together a variety of social, economic and environmental information drawn from both scientific and local knowledge into a single information system. Therefore areas important for livelihoods and conservation can be better identified and this information used to assist the management and planning of sustainable development across the Grenadine island chain. The maps are varied but all are high quality for use on phones or white boards.

Youth Climate Change Conference, (2017): Youth Statement on Climate Change.
http://www.latinamerica.undp.org/content/rblac/en/home/library/environment_energy/youth-statement-on-climate-change.html

This statement resulted from the Youth Climate Change Conference (YCCC) in Kingstown, Jamaica in 2017, co-hosted by the USAID-funded Jamaica Rural Economy and Ecosystems Adapting to Climate Change II (Ja REEACH II) Project and the United Nations Development Program's (UNDP) Japan-Caribbean Climate Change Partnership (J-CCCP) Project in collaboration with the Ministry of Education, Youth and Information. The theme of the Conference was *Our Climate, Our Voice, Our Change*. 600 delegates aged 14 to 29 years, from Japan and eight Caribbean countries, including St. Vincent and the Grenadines, attended the conference. The conference included a series of climate advocacy training workshops and presentations, exhibitions and competitions to increase participant awareness and enabled knowledge transfer concerning the various challenges and proposed solutions. In the

Statement youth delegates commit to supporting a series of climate change actions organized under five headings: youth activism, capacity building, policy, research and legal framework. The statement calls on young people, communities, institutions, leaders and policy makers to cement the role of youth in climate action.

Learning Resources 3

Teacher Guidance and Training on Climate Change and Disaster Risk Reduction Education

3.1. Global Good Practice

Children in Emergencies https://childreninemergencies.org/

When an emergency hits, be it a natural disaster or protracted conflict situation, children are often the most seriously affected. The Children in Emergencies Toolkit helps to make sure that those involved are addressing the most important needs with the most effective programmes for children, as well as ensuring responses in other sectors are keeping children safe. Particularly relevant material is that on creating youth friendly spaces.

Climate Literacy and Energy Awareness Network (CLEAN), USA. Climate and Energy Educational Resources
https://cleanet.org/clean/educational_resources/index.html?q1=sercvocabs__18%3A4

This extensive collection of climate change education and emergency education resources include middle and high school lesson plans to teach climate change, climate science and energy awareness. Lesson materials are all peer-reviewed by scientists and educators for scientific accuracy and pedagogical effectiveness. Resource collections within the site are easily searched according to resource type, grade level, regional focus and key words, among others.

Deeb, A. et al. 2011. Climate Change Starter's Guidebook: An Issues Guide for Education Planners and Practitioners. **Paris: UNESCO**
https://unesdoc.unesco.org/ark:/48223/pf0000211136

This short guidebook is designed to inform the understandings of education policy makers and implementers, including teachers and teacher trainers concerning the science of climate change, actual and anticipated impacts of climate change (sub-sections on migration, poverty, health, gender and ethics), and responses to climate change, with a particular focus on mitigation and adaptation. There is a fourth section on education and climate change. This makes the case that climate change education must go beyond the science curriculum, be linked to education for sustainable development, and consider both mitigation and adaptation. There is a final section stressing the importance of disaster risk reduction education as a vital complement to climate change education. The charts and graphs in the science section are particularly enlightening and vivid in their explanation of why climate change is happening and to what effects.

First, J., Millis-Sandoal, T., First, N., Houston, J. B. (2016). Picturing Resilience Intervention (PRI): Using Photovoice for Youth Resilience.
https://www.preventionweb.net/files/62864_dcc2016picturingresiliencerevised.pdf

The *Picturing Resilience Intervention (PRI)* offers group intervention activities designed to promote resilience and empowerment, to foster healthy coping skills, to facilitate self-expression and to encourage peer support among youth (age 10-17) following a disaster, community crisis, or other challenge resulting from daily life stresses. PRI participants, working in a small group, are provided with cameras and instruction in basic photography and camera use. PRI encourages participants to 'voice' their experience and perspectives on issues discussed in group sessions through photography and brief written narratives. During each PRI session, a main topic is discussed and then followed by a group activity and a photography homework activity. At the end of the PRI group sessions, youth participants display their photography with accompanying written narratives in a final PRI exhibit.

Food and Agricultural Organization of the United Nations (FAO), the World Association of Girl Guides and Girl Scouts (WAGGGS), Youth and United National Global Alliance (YUNGA). 2009. Food Security and Climate Change Challenge Badge.
http://www.fao.org/climatechange/18820-04f5d6f7e9296cb1b2ced188e8824cb52.pdf

This publication offers learning activities arranged according to the following three categories: 'Our Climate' (concerned with understanding the nature, impacts, and solutions to climate change); 'Our Food' (concerned with the consequences of food and lifestyle choices for our planet); and 'Our World' (encouraging young people to carry out community-based activities). Activities are categorized according to three age groups: 5-10, 11-15 and 16-20.

Geographical Association: Resources for Teachers

The UK Geographical Association produces a range of informational (case study), interactive and participatory resources for teachers. Its website provides easily accessible resources for teachers, many on disaster-related and climate change-related topics. For example:

- Earthquake and tsunami case studies:
  https://www.geography.org.uk/teaching-resources/earthquakes-tsunamis
- Flooding case studies:
  https://www.geography.org.uk/teaching-resources/flooding-case-studies
- Extreme weather case studies and climate change (including case study of Hurricane Irma, 2017):
  https://www.geography.org.uk/teaching-resources/weather-climate-change

Although many of the case studies are UK based, there is a good range of wider world examples to draw upon, and the pedagogies proposed are transferable.

National Centre for Atmospheric Research (NCAR), USA. Climate Discovery Teacher's Guide
http://eo.ucar.edu/educators/ClimateDiscovery/index.htm

The Guide includes a collection of lessons appropriate for grades 5-9 on various aspects of the planet's climate system. The four units available include: Investigating climate past: The little ice age case study; Investigating climate present: cycles of the earth systems. NCAR & UCAR (University Corporation for Atmospheric Research) also have 24 primary and secondary level climate change classroom activities https://scied.ucar.edu/slider/climate-change-activities

National Curriculum and Assessment Centre, Ministry of Education, Georgia & UNICEF. (2012). Teaching Disaster Risk Reduction with Interactive Methods: Book for Head of Class Teachers Grades V-IX.
https://www.preventionweb.net/files/22730_22730headteachersguideengncac1.pdf

This guide is for lead teachers of grades V-IX of secondary schools in Georgia and is designed to help teachers provide students and their families with information about natural hazards and disaster risk reduction. It includes interactive learning methods (i.e. mini-lectures, discussions, excursions, brainstorming, presentations, case studies, role plays, the Socratic method, learning while doing) and sixteen hazard-specific thematic modules aimed at helping teachers and students to develop the dispositions and skills necessary to prevent disasters and be better prepared for them.

National Oceanic and Atmospheric Administration (NOAA) Ocean Service Education, USA. Lesson Plan Library.
https://oceanservice.noaa.gov/education/lessons/welcome.html

The NOAA Lesson Plan Library includes climate change and natural hazard-related lesson plans for the middle and high school levels for the following subjects: Geography, Earth Science, Life Science, Mathematics and Physical Science.

New Zealand Ministry of Civil Defence and Emergency Management. 2006. What's the Plan Stan? (WTPS) http://www.whatstheplanstan.govt.nz

The resource features the cartoon figure of Stan the dog and five children who model best practices in disaster preparation and response. It is aimed at teachers, offering guidance on incorporating the material into their teaching and learning, at principals, offering advice on school emergency management, and at students, offering easy-to-assimilate user-friendly DRR materials. *WTPS* focuses on both 'natural disasters' such as earthquakes, tsunamis, volcanoes, storms and floods and 'non-natural' (i.e. human-induced) hazards such as pandemics, wildfires, biohazards, transportation accidents and terrorist bombs. The package includes a *Teachers' Guide*, a CD-ROM and a website.

The *Teachers' Guide* emphasizes the match between what the resource offers and the New Zealand national curriculum vision of nurturing confident, connected and actively involved young people; also highlighted is the fit with the curriculum's core value of community engagement and its associated key competencies. Curriculum areas identified as suitable for incorporating *WTPS*

are: health and physical education (safety management), social studies (identity, culture and organization and continuity and change curriculum strands), science (nature of science, Planet Earth and beyond) and English (listening, reading, viewing, speaking, writing and presenting).

Plan International. (2010). Child-centred DRR Toolkit.
https://plan-international.org/publications/child-centred-disaster-risk-reduction-toolkit

This toolkit provides practical tips and advice for those who work with children with a focus on community-based DRR. The toolkit includes four modules: training children on DRR through hazard, vulnerability and capacity assessment; planning, monitoring and evaluating child-centered DRR programs; action planning with children on DRR; advocacy for children on DRR.

Selby, D. & Kagawa, F. 2013. Climate Change in the Classroom: UNESCO Course for Secondary Teachers on Climate Change Education for Sustainable Development. Paris: UNESCO.
http://www.unesco.org/new/en/ccesd

*Climate Change in the Classr*oom offers a six-day teacher education program on climate change education and is designed to give teachers the confidence, understanding and skills to in turn help their students understand the causes, drivers and consequences of climate change and equip them with the necessary skills and dispositions to contribute to climate change adaptation and mitigation. The program takes climate change education beyond the science classroom by also looking at ethical, social, economic, cultural and political dimensions of climate change. There is much, therefore, for the social studies, languages, and creative and performing arts teachers in the activities and materials. The activities are suitable for both pre-service and in-service teacher education. The teaching pack opens with a Start Menu with a click-on facility to the following materials: Course Framework and Overview; Daily Course Material for Teacher Educators (with step-by-step daily programs, detailed description of activities, support materials, PowerPoint slides for training inputs); bespoke Regional Resource Packs for Africa, Asia, Europe and North America, and Small Island States; Daily Classroom Materials for Teachers (activities for back in classroom linked to the theme of each training day). *Climate Change in the Classroom* stands as the first online teacher education pack for secondary teachers. It uses Flash-based software to support a flipbook format providing an on-screen textbook page-turning experience.

Selby, D. & Kagawa. F. 2012. Disaster Risk Reduction in School Curricula: Case Studies from Thirty Countries. Paris/Geneva: UNESCO/UNICEF. https://unesdoc.unesco.org/ark:/48223/pf0000217036

This publication captures key national experiences in the integration of DRR in the curriculum, identifying good practice, noting issues addressed or still unaddressed, and reviewing learning outcomes. The study is based on research into DRR related curriculum development and integration, pedagogy, student assessment, teacher professional development and guidance,

learning outcomes and policy planning and implementation aspects covering thirty countries.

Selby, D. & Kagawa, F. 2011. 'Climate Change Learning: Unleashing Blessed Unrest as the Heating Happens'. **Green Teacher, 44, 3-15.**
https://greenteacher.com/unleashing-blessed-unrest-as-the-heating-happens-2/

Arguing that educational responses to climate change are too comfortable and not sufficiently challenging to 'business as usual', the authors suggest learning that looks into the 'dark corners', i.e. those dimensions of climate change that we prefer to avoid because they are unsettling and challenge our behaviors, the way we see ourselves and the way we see ourselves. These include: scrutinizing our fixation on economic growth and consumerism, addressing personal and societal climate change denial, restoring our relationship with nature; developing radically different 'good life' aspirations.

Selby, D. & Kagawa, F. 2014. Towards a Learning Culture of Safety and Resilience: Technical Guidance for Integrating Disaster Risk Reduction in the School Curriculum. **UNESCO/UNICEF.**
https://unesdoc.unesco.org/ark:/48223/pf0000229336_eng

This guide first offers a rationale for disaster risk reduction education (DRRE) explaining the benefits of introducing disaster risk reduction (DRR) into the curriculum within an Education for Sustainable Development frame and, more broadly, within a quality education framework that also includes climate change education, life skills education and child-friendly education. It goes on to: present a typology and discussion of different approaches and strategies for integrating DRR in the curriculum; give guidance on the formulation of DRR curriculum goals and grade-related learning objectives; demonstrate alternative teaching approaches, alternative ways of sequencing knowledge, skills and attitudinal development, and different ways of progressing learning materials development; provide benchmarks and reference standards for monitoring and evaluating student progress; showcase relevant planning, assessment, review and discussion tools relating to DRR curriculum development; provide case study examples of successful integration of DRR into school curricula and practice; offer guidance on the scaling up and mainstreaming of DRR curriculum initiatives within education systems; demonstrate how to monitor and evaluate DRR curriculum change.

Selby, D. & Kagawa, F. (2013). 'World as "Lasting Storm": Educating for Disaster Risk Reduction', **Green Teacher, 100, 21-32.**
http://greenteacher.com/world-as-lasting-storm-educating-for-disaster-risk-reduction/

After a brief overview on the global emergence of disaster risk reduction education, the article lays out five essential dimensions for disaster risk curriculum, teaching and learning: understanding the science and mechanisms of natural disasters; learning and practicing safety measures and procedures; understanding rick drivers and how hazards can become disasters; building disaster risk reduction capacity; building a culture of safety and resilience. The article ends be looking at how disaster risk reduction education and environmental education are linked together.

Taking IT Global. (2010). Tread Lightly: Steps Towards a Greener Future: Teacher Toolkit
http://store.takingitglobal.org/programs/treadlightly/TL-Teacher-Toolkit-V2-EN.pdf

These secondary school lessons plans are to help students understand and assess how human activities contributes to climate change and to help them become environmental leaders in the fight against climate change. The *Toolkit* contains nine activities organized into three modules in the following sequence: 'Stepping In' (i.e. stepping into the concepts of climate change and ecological footprints), 'Stepping Up' (i.e. assessing personal ecological footprint and reducing our own consumption) 'Stepping Forward' (i.e. extending learning beyond the classroom).

UNESCO. (2012). Education for Sustainable Development: Good Practices in Addressing Climate Change
https://unesdoc.unesco.org/ark:/48223/pf0000220304

This is a compendium of seventeen noteworthy practitioner examples of teaching and learning programs addressing climate change within the framework of education for sustainable development. The examples cover formal, informal and non-formal education, addressing a wide range of topics from various countries that includes the Compass School Initiative (Thailand) in which schools and students identify and act on local climate change response priorities, and the Earth Hour campaign (Sweden) in which schools and students, often involving their communities, switch off their lights for one hour as a consciousness-raising stand against climate change. There are some useful ideas here for student involvement in and with their community in combatting climate change.

UNESCO. (2012). Education for Sustainable Development: Good Practices in Addressing Biodiversity
https://unesdoc.unesco.org/ark:/48223/pf0000220307

A companion to the above compendium, this volume contains twenty-four examples of noteworthy teaching and learning programs addressing biodiversity and biodiversity loss within the framework of education for sustainable development. The examples include: promoting biodiversity through environmental education centers (Cyprus); a 'fans of the planet' biodiversity project for students with a website to promote community exchanges (Mexico); an 'ambassador species for diversity' project to foster environmental concern through identification with a particular species found in the locality (Netherlands)

UNESCO/UNEP. (2011). Youth Xchange Climate Change and Lifestyle Guidebook https://unesdoc.unesco.org/ark:/48223/pf0000212876

This guidebook aims at educating youth (15-24 years old) about how our everyday lifestyle choices (including our food, energy, travel/transport, leisure, shopping and spending choices) contribute to climate change. It compares a

high carbon consuming lifestyle to sustainable consumption and seeks to motivate young people to take action against climate change.

3.2. Materials Specific to Small Island Developing States

GIZ & the Secretariat of the Pacific Community. Learning about Climate Change the Pacific Way: A Guide for Pacific Teachers. https://www.spc.int/cces/resources

Using Pasifika, an imaginary island, this unique picture-based education resource consists of 16 illustrated posters that depict the Pacific and global climate; causes of climate change; interrelationships between the land, the atmosphere and the ocean; the changing climate of six Pacific island countries; mitigation and adaptation measures that can be implemented through gardening, forestry and fishing activities and in a town center. There is a country specific teacher guide (for Kiribati, Samoa, Tonga, Vanuatu, Tuvalu) that complements the visual guide. Each teachers guide offers background information, and advises on how to use each picture and hands-on learning and teaching activities.

Ministry of Education, Heritage and Arts, Fiji. (2016). Helping Students Recover from Cyclone Winston: Tips for Teachers.
http://www.education.gov.fj/images/2016/PHYCHOSOCIAL/TIPS_4_TEACHERS/3._Tips_for_teachers_Helping_Students_Recover_Teacher_Guide.pdf

This publication provides practical tips and actions for teachers in helping students recover from trauma caused by the devastating Category 5 Tropical Cyclone, Winston. It gives helpful guidance on how to organize daily routines, how to create opportunities for self expression using speaking, writing, storytelling, arts and drama and how to use physical education, sports, music, and recreational activities to build a sense of belonging, hope and enjoyment.

WWF South Pacific. (2009). Climate Witness Community Toolkit.
http://wwf.panda.org/?162722/Climate-Witness-Community-Toolkit

This *Toolkit* aims at documenting local impacts of climate change and helping to develop and implement locally appropriate and diverse adaptation measures by local communities themselves. The *Toolkit* include thirteen activities that can be adapted for school lessons.

3.3. Caribbean Materials

CDEMA. Tsunami Smart Teacher Materials
http://weready.org/tsunami/index.php?option=com_content&view=article&id=11&Itemid=23

The *Tsunami Smart Teacher Education Resource Kit*, consisting of four lesson plans, is accompanied by supporting teaching and learning materials such as a *Student Workbook*, PowerPoint presentation slides and a *Cartoon Booklet* (which is a Caribbean adaptation of UNESCO material). The *Kit* is an

informative handbook for teachers as it gives succinct but detailed information on Tsunami science and mechanics as well as preparedness measures. The *Kit* offers one lesson for each of grades 7, 8 and 9 and one lesson applicable for all grades between 7 to 9.

Learning Resources 4

Case Studies of Climate Change, Hazard and Disaster Impacts and Responses in St. Vincent and the Grenadines and the Caribbean region

Case Study 1	Climate Change Impacts in SVG
Case Study 2	SVG and Hurricanes
Case Study 3	2011 Georgetown Floods
Case Study 4	The Flash Floods of 2013 in St. Vincent and the Grenadines
Case Study 5	The Long Drought 2009-2011
Case Study 6	Earthquakes
Case Study 7	Volcanos and Volcanic Eruptions on St. Vincent and the Grenadines
Case Study 8	Trigger Floods and Landslides of 2016 in St. Vincent and the Grenadines
Case Study 9	Tsunami Threat
Case Study 10	Bushfires
Case Study 11	Sargassum Influxes
Case Study 12	Exotic and Invasive Species
Case Study 13	Vehicle Usage
Case Study 14	Coastal Features, Projects and Threats
Case Study 15	Biodiversity Loss and Conservation on SVG
Case Study 16	Panos Caribbean. Voices for Climate Change Education
Case Study 17	Sandwatch on St. Vincent and the Grenadines
Case Study 18	Mangrove Restoration on St. Vincent and the Grenadines
Case Study 19	Alternative Sources of Energy
Case Study 20	Climate-Smart Agriculture
Case Study 21	Youth Action for Climate Change and the Environment
Case Study 22	National Emergency Management Organisation (NEMO)
Case Study 23	Central Water and Sewerage Authority (CWSA)

Case Study 1: Climate Change Impacts in SVG

St. Vincent and the Grenadines is a small country that is highly vulnerable to adverse climate change influences. Some of the impacts of climate change are already experienced through damage caused by severe and extreme weather events and through gradual changes in temperature and rainfall patterns.

Temperature

The mean annual temperature has increased by 0.7°C since 1960, at an average rate of 0.16 °C per decade and this warming has affected all seasons equally. For the period from 1901 to 2016, mean annual temperature is recorded as 26.7°C.

Temperatures are expected to increase between 0.6 and 2.3 °C by the 2060s and between 1.1 to 3.9°C by the 2090s. The projected rate of warming is spread throughout the year, but more rapid in the south than the north. The number of hot days and nights are projected to increase significantly throughout the country by the 2060s. The number of cold days and nights is projected to decrease significantly.

Precipitation

Main rainfall occurs between May and October and averages around 150-200 mm rainfall per month. Average precipitation has shown a decrease of 8.2 mm (-5.7%) per decade in the period from 1960 to 2006, affecting all seasons but most significantly the wet season from June to November. The average decline has been 10.6 to 13.5 mm per month (4.9% to 7.1%) per decade.

Projections indicate decreases in rainfall occurring mostly during the June to November period by the 2090s from 1970 to 1999 baselines, and more so in the south than in the the north.

Tropical Storms and Hurricanes

North Atlantic hurricanes and tropical storms appear to have increased in intensity over the last three decades. Observed and projected increases in sea surface temperatures suggest the potential for continuing increases in hurricane activity. It is projected that storms and hurricanes will increase in intensity but not necessarily in frequency. For hurricanes on SVG see Case Study 2.

Sea Level Rise

Sea level rise in the Caribbean is expected to be near the global mean, although it is not presently possible to project the specific sea level rise for SVG. Model-based projections of global mean rise (relative to 1986-2005) suggest an indicative range of 0.26 to 0.77m by 2100 for 1.5°C of global

warming. Sea level rise will continue beyond 2100 even if global warming is limited to 1.5°C in the 21st century.

In the recent studies examining rapid ice sheet melt (Greenland and Antarctic) there is an emerging consensus that sea level rise by the end of the 21st century will be between 1-2 m above present levels. The Caribbean is projected to experience greater sea level rise than most areas of the world due to its location closer to the equator and related gravitational and geophysical factors.

Together with a projected decrease in rainfall, rising sea levels will lead to saline intrusion into coastal and groundwater aquifers and thus reduce fresh water availability.

Costal Profile Surveys in SVG (CARIBSAVE 2012)

The CARIBSAVE Partnership coordinated detailed coastal profile surveys on 1 m and 2 m sea level rise scenarios and beach erosion scenarios of 50 m and 100 m at five study sites (Belmont Walkway in Bequia; Canash Beach, Indian Beach, Johnson Point and Villa Beach in St Vincent).

Key findings:

- A 1 m sea level rise puts 10% of the major tourism properties at risk, along with 1% of road networks, 50% of airports and 67% of sea ports.
- With 2 m sea level rise, 24% of major tourism resorts will be impacted and 75% of airport land.
- With 100m of erosion (resulting from approximately 1 m sea level rise), 76% of the major tourism resorts and 47% of sea turtle nesting sites will be impacted.
- Annual losses in tourism resulting from the reduced amenity value from beach loss is estimated to be at US$ 174 million by 2080 for a mid range sea level rise scenario.

Sector Specific Impacts: Some Examples

Agriculture

Agriculture is a primary pillar of the SVG economy, accounting for 7.1 % of GDP. It is largely based on banana production. Even without climate change, agriculture already faces significant challenges: the loss of preferential trading relations for bananas, mono-cropping that depletes soil nutrients and makes crops more vulnerable to the spread of pests and diseases, entry of exotic diseases, small scale farming constrained by limited resources, aging agricultural populations, uncontrolled agricultural intensification, poor agricultural practices and inappropriate land use.

An already brittle agriculture sector is highly vulnerable to extreme weather events and changing precipitation patterns. Stronger storms and hurricanes increase the frequency of crop failure. For instance, Hurricane Tomas in 2010 (see Case Study 2) resulted in damage of XCD 35 million, mainly to banana and plantain production. Irrigation infrastructure, feeder roads and farms are repeatedly damaged or destroyed by floodwaters, siltation and high winds caused by storms. Extended droughts greatly affect the sector by decreasing yield, given its heavy reliance on rainfall for production. Sea level rise and saltwater instruction can damage crops in low-lying areas. Increased temperatures will make storing seeds or crops more difficult or exporting crops less certain in the case of increased intensity of tropical storms.

Damaged Banana Trees after Hurricane Tomas (Fairtrade.org.uk, 2010)

Energy

SVG is largely dependent on imported fossil fuels for power, with only 5% of consumption provided by hydropower. Electric power for SVG is provided by St. Vincent Electricity Services Ltd (VINLEC) which operates diesel power stations on St. Vincent, Bequia, Canouan and Union Island and five hydropower stations on St. Vincent.

Climate change can have both direct and indirect impacts on energy generation, distribution and transmission infrastructure, with implications for existing (fossil fuel based) energy systems, as well as renewable energy initiatives. Strong hurricanes impact transmission lines, poles and other infrastructure. Power generating stations and other major infrastructure located on the coastline are highly vulnerable to damage from flooding and inundation resulting from sea level rise and storm induced surges. Temperature increases reduce the efficiency of energy generation at thermal power plants. Hydropower facilities can be impacted by reduced water flows in drought periods.

Health

Climate change adversely affects health in multiple ways. Direct effects are those associated with extreme weather events (e.g. injuries and deaths inflicted during the storm) and indirect effects are associated with changes in ecosystems and in various sectors such as water, agriculture and economy.

Changing climate creates an environment in which disease vectors such as rodents and mosquitos can flourish. Diseases carried by the *Aedes* species mosquitos, including dengue fever and Zika, are common and may become more prevalent with increased temperatures or more standing water after rain

events. Rainwater storage systems may act as common breeding areas for *Aedes* species mosquitos unless proper prevention measures are installed. In terms of dengue fever transmission, there were 37 cases per year for the last decade with 58 % of cases occurring in 2010. This may be due to either drought conditions between October 2009 and January 2010 or episodes of high precipitation (e.g. severe floods in April 2010 or Hurricane Tomas in October 2010). Dry spells can affect air quality and increase diseases such as acute respiratory infections, influenza-like illnesses and asthma, all of which are common among SVG residents.

Tourism

Tourism is one of the key industries in SVG, especially in the Grenadines. It is primarily driven by the natural beauty, pleasant climate, tourism-specific infrastructures and facilities. Because beach experience is central to tourism, most hotels and resorts are close to the ocean and are low-lying. The transportation, energy and water infrastructure critical to a thriving industry are vulnerable to sea level rises and increased storm threats. The increased frequency of droughts leaves the tourism industry vulnerable to water shortage. Large-scale coral bleaching caused by rising ocean temperatures would make the country a less desirable destination for divers and snorkelers.

References

Caribbean Climate Smart Agriculture Forum. (2017). *Country Profile. St Vincent & the Grenadines. Climate Change and Agriculture. Policies, Strategies and Actions.* http://repositorio.iica.int/bitstream/11324/7052/1/BVE18040212i.pdf

CARIBSAVE Partnership. (2012). *CARIBSAVE Climate Change Risk Profile for St. Vincent and the Grenadine.* https://www.researchgate.net/profile/Mark_New/publication/272791668_Climate_Change_Risk_Profile_for_Saint_Vincent_and_the_Grenadines/links/55fa74f708ae07629e007648/Climate-Change-Risk-Profile-for-Saint-Vincent-and-the-Grenadines.pdf

IPCC. (2018). *Summary for Policy Makers. In Global Warming of 1.5°C.* https://www.ipcc.ch/sr15/chapter/summary-for-policy-makers/

World Bank. *Climate Change Knowledge Portal. St Vincent and the Grenadines*. https://climateknowledgeportal.worldbank.org/country/st-vincent-and-grenadines

World Bank. (2018). Climate Risk Profile. Eastern and Southern Caribbean. https://www.climatelinks.org/sites/default/files/asset/document/2018-26-Feb_CadmusCISF_Climate-Risk-Profile-ES-Caribbean.pdf

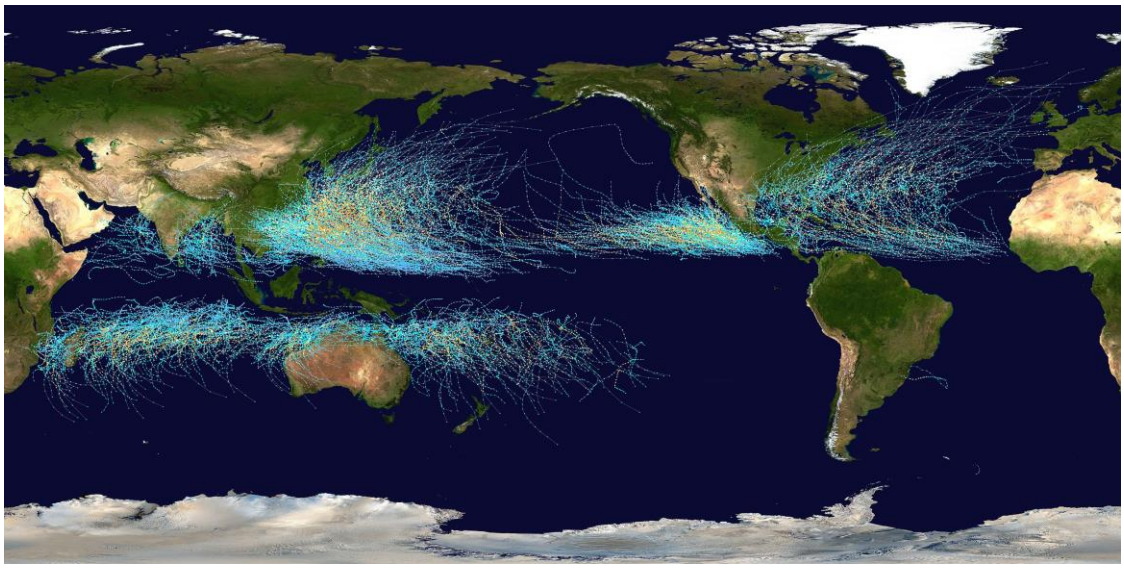
USAID. (2012). *Barbados and the Eastern Caribbean. Climate Vulnerability Profile.* https://www.climatelinks.org/sites/default/files/asset/document/barbados_eastern_caribbean_climate_vulnerability_profile_jan2013.pdf

Case Study 2: SVG and Hurricanes

Why do hurricanes happen in St Vincent and the Grenadines?

Hurricanes are tropical cyclones - storms that rotate counter clockwise with wind speeds in excess of 90kph. Most hurricanes that affect St Vincent and the Grenadines form over the warm seas of the Atlantic near the equator. They are created when the sun heats the Atlantic Ocean surface, causing heated water vapor to rise, condense and form clouds. These clouds begin to spiral as the earth rotates, causing air to be pulled underneath and a large vortex to be formed.

The graphic below illustrates the tracks of all tropical cyclones formed worldwide from 1985 to 2005 and indicates why they occur



Tropical Cyclone Tracks (Nilfanion)

This list of hurricanes and tropical storms that have affected SVG indicates that such events have become more common in recent decades:

- Windward Islands hurricane1898
- Hurricane Hazel 1954
- Hurricane Janet 1955
- Hurricane Abby 1960
- Hurricane Allen 1980
- Tropical Storm Danielle 1986
- Hurricane Lenny 1999
- Tropical Storm Jerry 2001
- Hurricane Lili 2002
- Hurricane Ivan 2004

- Hurricane Emily 2005
- Hurricane Matthew 2007
- Hurricane Tomas 2010
- Hurricane Harvey 2017

Since 1900, St. Vincent has been hit by 13 named storms, the strongest being Hurricane Allen (Category 4 on the Saffir-Simpson 5 point Scale, see below), which passed between St. Lucia and St. Vincent in 1980. Prior to that, Hurricane Hazel, a Category 1 storm passed some 38 km south of St. Vincent in 1954. SVG was also severely affected by Hurricane Lenny in 1999, a Category 4 storm.

Categories of Hurricane (Saffir-Simpson Scale)

Category	Central Pressure Means (millibars)	Winds mph(km/h)	Surge (ft)	Damage
1	980 or more	74-95mph (119 - 151km/h)	4-5	Damage mostly to poorly constructed signs, trees, foliage, and unanchored homes, low lying coastal roads flooded, minor pier damage, etc. No real damage to other structures. ***Summary: Very dangerous winds that will produce some damage***
2	965-979	96-110mph (152-176km/h)	6-8	Tree blown down, considerable damage to shrubbery, poorly constructed signs, mobile homes, roofing material, windows, doors and piers. NO major damage to buildings but evacuation of some coastline residences will be likely. ***Summary: Extremely dangerous winds that will cause extensive damage***
3	945-964	111-130mph (177 - 209km/h)	9-12	Practically all poorly constructed signs destroyed, foliage torn from trees, large trees blown down, damage to roofing materials and structural damage to small buildings. Serious flooding at coast, with many smaller structures near coast destroyed. Evacuation of residences near shoreline required. ***Summary: Devastating damage will occur***
4	920-944	131 - 155mph (210 - 248km/h)	13-18	All signs down, shrubs and trees blown down, extensive damage to roofs, windows and doors. Major damage to lower floors of structures near shore due to flooding and battering by waves and floating debris. Major erosion of beaches, flat terrain 10 feet or less above sea level flooded inland as far as 6 miles. Massive evacuation of all residences within 500 yards of shore and of single story residences within 2 miles of shore. ***Summary: Catastrophic damage will occur***
5	Less than 920	more than 155mph	more than	Complete failure of roofs on many residences and buildings, severe damage to windows and doors and

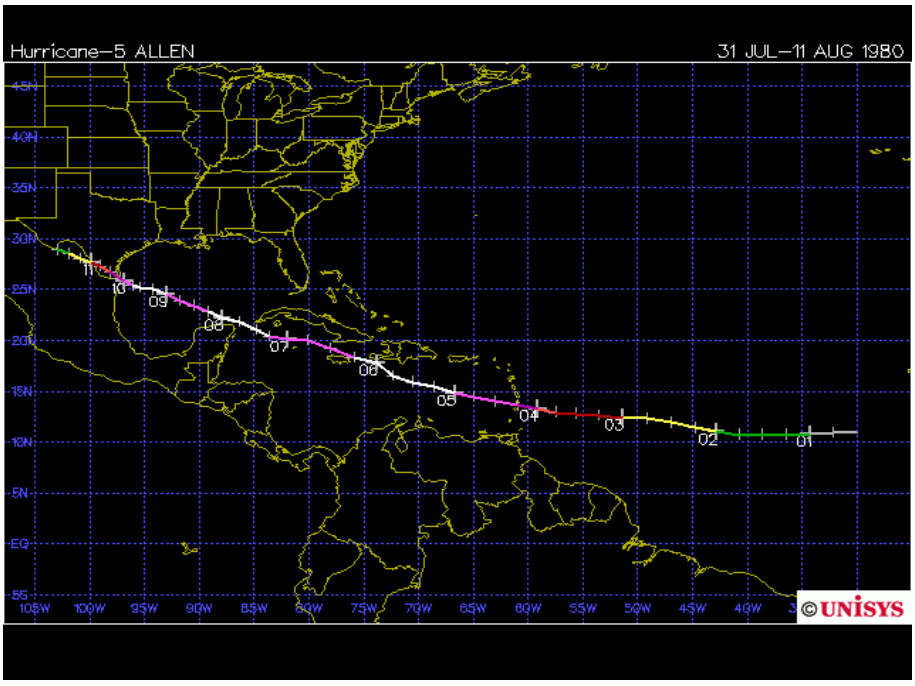
	(248km/h)	18	glass structures, some complete building collapse. Low lying escape routes cut by flooding, massive evacuation of residential areas on low ground within 5-10 miles likely. ***Summary: Catastrophic damage will occur***

How do hurricanes effect St. Vincent and the Grenadines?

St. Vincent and the Grenadines is part of the island group located in the southern portion of the Atlantic Hurricane belt. The hurricane season lasts from 1 June to 30 November. There is typically more rain during this period, even if a hurricane does not develop. The country last suffered hurricane damage from Hurricane Ivan in 2004.

Hurricane Allan, 1980

Hurricane Allen was a rare and extremely powerful hurricane that struck the Caribbean, eastern and northern Mexico, and southern Texas in August 1980. It was the first named storm and first tropical cyclone of the 1980 Atlantic hurricane season and was one of the strongest hurricanes in recorded history at that time. It was one of the few hurricanes to reach Category 5 status on the Saffir–Simpson Scale. It spent more time as a Category 5 than all but two other Atlantic hurricanes. Allen is the only hurricane in the recorded history of the Atlantic basin to achieve sustained winds of 305 km/h.



The path of Hurricane Allen (Source: UNISYS)

Allen was a hurricane that originated from a tropical wave that previously moved off the African coastline on July 30, 1980. The system developed as it

moved westward, becoming a tropical depression on August 1. However, the National Hurricane Center did not initiate advisories on Allen until almost 24 hours later, when it was centered 2,100 km east of the Windward Islands. By early on August 2, as the depression moved towards the Caribbean, it had intensified.

As Allen approached the Caribbean Sea, gale warnings and a hurricane watch were issued. Hurricane warnings were raised for Barbados, St. Vincent, St. Lucia, Martinique, and Dominica from the early afternoon of August 3 until the late morning of August 4. All of these states suffered from flooding, bridge damage and loss of buildings. No one died on St Vincent, largely due to the warnings.

Hurricane Tomas, 2010

Hurricane Tomas was the twelfth named hurricane of the 2010 Atlantic hurricane season, Tomas developed from a tropical wave east of the Windward Islands on October 29 2010. As the storm quickly intensified into a hurricane, it moved through the Windward Islands and passed over Saint Lucia and SVG. The National Emergency Management Organization (NEMO) issued warnings that a tropical system was approaching the country. As for SVG there were no deaths but two persons sustained serious injuries while trying to effect repairs to house roofs. NEMO declared all areas from Park Hill to Owia on the eastern side and all areas from Belle Isle to Fitz Hughes on the western side to be disaster zones. The agriculture sector sustained over US$25 million worth of damage. Over 1200 people sought refuge in hurricane shelters. 600 houses lost their roofs. As with other storms there were a lot of downed power lines and trees. In places along the coast landslides made roads impassable.

Hurricane Harvey, 2017

Hurricane Harvey of 2017 is tied with 2005's Hurricane Katrina as the costliest tropical cyclone on record. Harvey developed from a tropical wave to the east of the Lesser Antilles, reaching tropical storm status on August 17. The storm crossed through the Windward Islands on the following day, making landfall in the south of Barbados and a second landfall on St. Vincent. Upon entering the Caribbean Sea, Harvey began to weaken, and degenerated into a tropical wave north of Colombia, late on August 19. Overall, nine homes were flooded on SVG and four others experienced wind damage. Also, a tree fell on a school, damaging the building. Most damage occurred in Port Elizabeth where blocked drains caused 15 businesses to become flooded. 15 people were housed in shelters after the storm.

What have been the responses to hurricanes?

In the past ten years, there has been a range of responses aimed at making the SVG community more resilient to the effects of hurricanes:

- **Rehabilitation and hurricane retrofitting:** New schools have been designed to also be emergency shelters. Older schools and community

centers have been retrofitted with critical improvements, including roof repairs, hurricane-resistant windows and gutters, and emergency water supplies.

Fairhall Primary School on SVG also acts as an emergency shelter (Photo: S. Pike)

- **Road repair and river defense works:** There is an ongoing program of repairs to roads and river defences across SVG. This includes a rechannelling of the largest rivers, such as at Georgetown where the Windward Highway and rivers have been improved.

- **Increasing the government's risk mapping capabilities:** The government has invested in the use of digital mapping to map out risks, it is likely this technology will be used in the case of future hurricanes.

The Hurricane Work of the National Emergency Management Organization

NEMO works to prepare people in SVG to prevent, mitigate against and be better prepared for disasters, including hurricanes. If a hurricane strikes, NEMO ensures people can respond effectively to save lives and property and to rebound in the shortest time afterwards. For hurricanes NEMO does the following:

- Informing people through the dissemination of information, to improve the capability of the individual or the private organisation to cope with hurricanes, such as providing lists of items for disaster kits.
- Warning people by forecasting the nature and possible impact of hurricanes.
- Co-ordinating organisations and people to enable resources to be effectively applied in emergencies, such as repairs to buildings, roads, power lines and bridges; also the provision of disaster supplies, when otherwise unavailable.
- Providing and maintaining the extraordinary resources as well as the diversion of normal resources to meet emergency needs.

References

BBC. (2010). Hurricane Tomas lashes Caribbean. https://www.bbc.com/news/world-latin-america-11660080

NEMO. http://nemo.gov.vc/nemo/index.php/hazards/hurricane

NOAA. (2010). Hurricane Tomas. https://www.nasa.gov/mission_pages/hurricanes/archives/2010/h2010_Tomas-Atlantic.html

Wikipedia. (2019). Hurricane Allen. https://en.wikipedia.org/wiki/Hurricane_Harvey

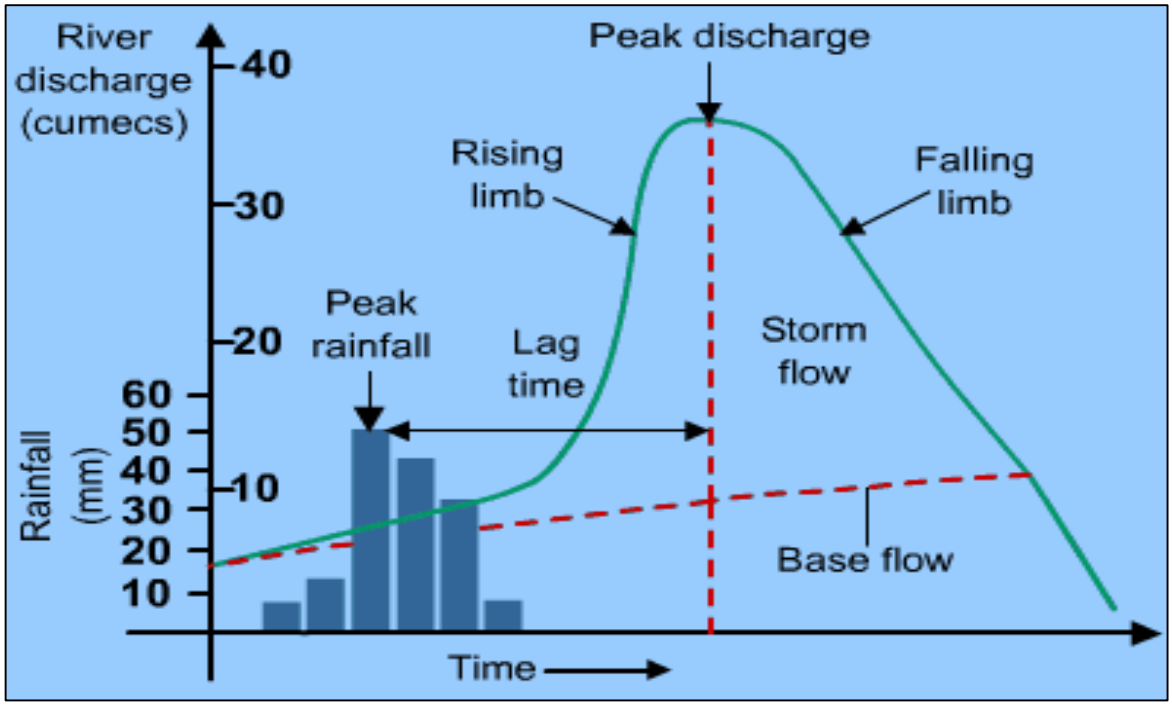
Wikipedia. (2019). Hurricane Harvey. https://en.wikipedia.org/wiki/Hurricane_Allen

CDEMA. We Ready. http://weready.org/hurricane/

Case Study 3: The 2011 Georgetown Floods

On 11 and 12 April 2011, heavy rainfall fell in St. Vincent. The heavy rainfall meant that natural flood channels such as streams and rivers, as well as artificial channels such as gulleys and storm drains could not cope with the flow of water, resulting in floods. This is demonstrated in the diagram below with the peak discharge in a river happening some period of time after peak rainfall.

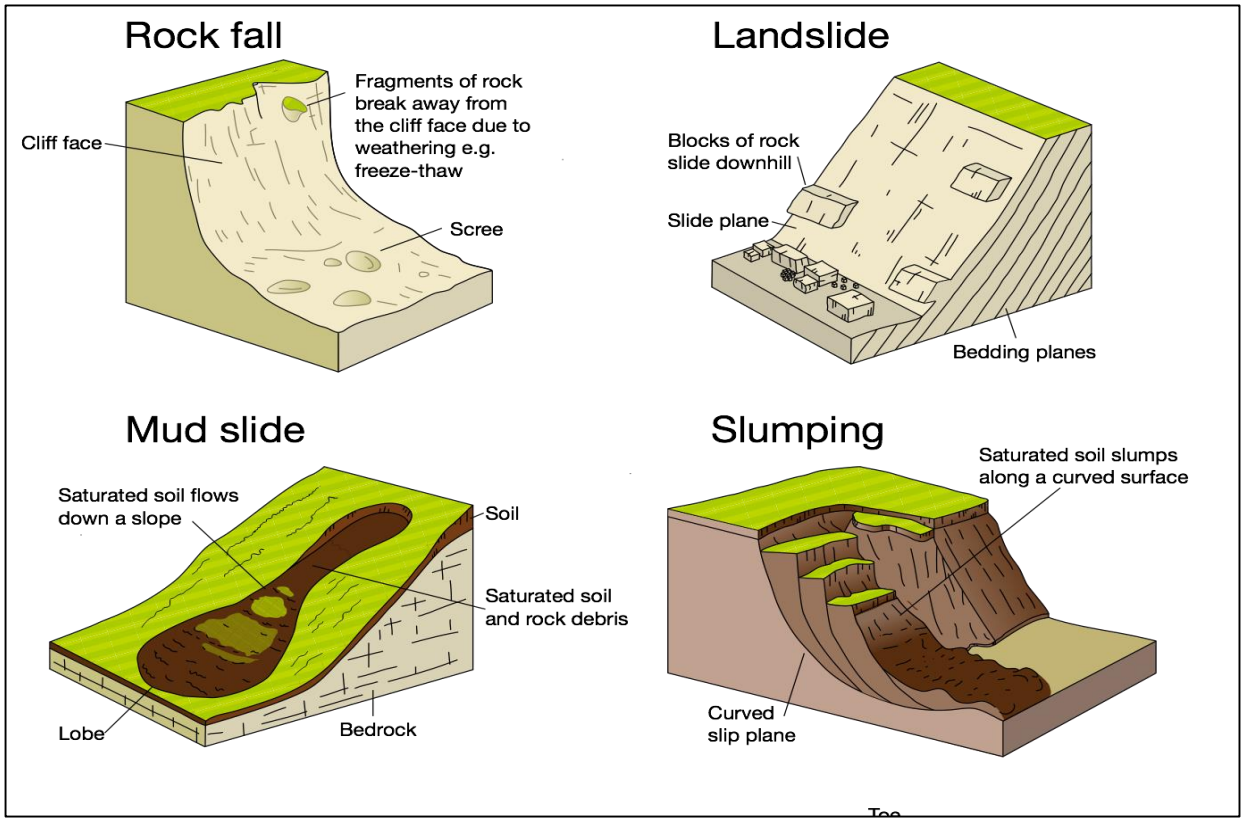
The image below is of a flood hydrograph, showing the relationship between rainfall and peak discharges into streams and rivers.



Flood hydrograph (Cool Geography)

What were the effects of the Georgetown floods?

The amount of water held on slopes after rainfall can cause movements of land. Landslides are defined as the movement of a mass of rock, debris, or earth down a slope. After the heavy rainfall there were a number of landslides, mud slides and land slumping, as shown in the graphic below. Landslides had blocked the Windward Highway at several points, from Biabou up to Sandy Bay. The Mount Young River, Sandy Bay River and other rivers in Georgetown had overflowed their banks, washed away vehicles, damaged a number of houses and flooded others.



Types of landslide (Internet Geography)

In the case of the 2011 floods, the bulk of the damage was in the Georgetown area where landslides caused secondary damage, such as washed away fallen trees from the mountains, blocking rivers and causing flooding in nearby areas. Major damage was seen in Mount Young, where the bridge was impassable because of rushing waters and blockage by huge tree trunks. Other bridges, including that at the Georgetown Market, were blocked for a period of time, while the bridge in Basin Hole, Langley Park, collapsed under the weight of the water and debris.

The agricultural sector was significantly affected as overflowing rivers caused crop damage and loss of livestock. Food prices rose as the supply of local food dropped. Tourism was affected to a limited extent due to roads being closed by trees. Service infrastructures were affected, with power lost for two days in many areas. Potable water infrastructure in the Georgetown area sustained severe damage. The main water catchments and pipes that deliver water to households were severely damaged alongside the treatment and filtration plants.

Approximately 55 households were directly affected and up to 20,000 persons were affected due to the lack of potable water. A number of people sought

refuge in organized collective centres while others found refuge with friends and relatives. Several individuals received minor injuries during evacuation.

What were the responses to the floods?

The National Emergency Management Office (NEMO) led the assessment to determine damages caused to water and sewage systems, electricity services, and to the agriculture, tourism and housing sectors, and to identify the most urgent needs of the affected population. The Red Cross and local church and neighbourhood groups worked with authorities, providing basic items and food to meet their needs and enable them to return to everyday life as quickly as possible. Many of the affected families cleaned the mud and silt from their own homes; however, some affected families lacked cleaning equipment. In the longer term flood gates were built on the sea front, these could be closed when high tides and rainfall were forecast.

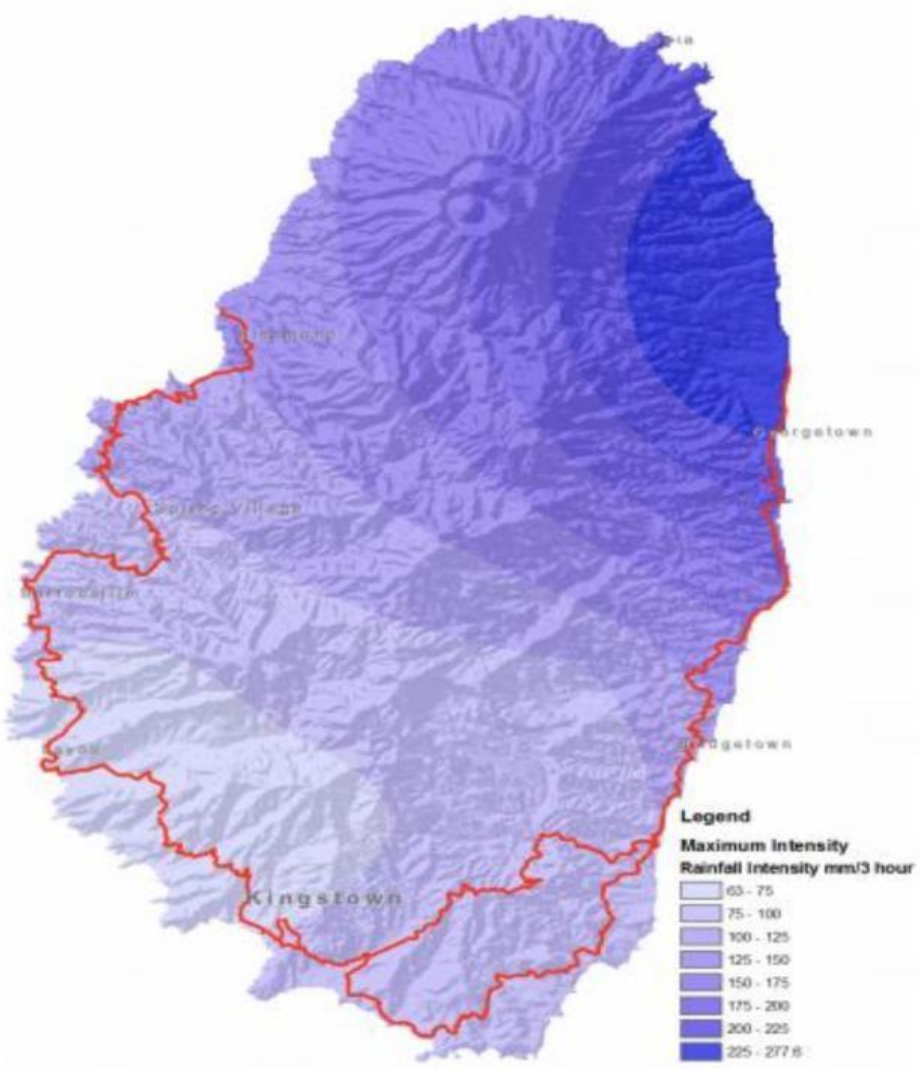
References

Red Cross. (2011). *Saint Vincent and the Grenadines: Floods*. https://reliefweb.int/sites/reliefweb.int/files/resources/fullreport_11.pdf

The Watchers. (2011). *Major damage in St Vincent from flash flooding.* https://watchers.news/2011/04/19/major-damage-in-st-vincent-from-flash-flooding/

Case Study 4: The Flash Floods of 2013 in St. Vincent and the Grenadines

Overnight torrential rains on Christmas Eve 2013, caused by a tropical trough system, led to rapid and intense flash flooding in St. Vincent and the Grenadines. Between 200mm and 310mm of water fell in less than 3 hours on the north windward side of the island and up to 153 mm on the north leeward side.



Map of the precipitation distribution published in the St. Vincent and the Grenadines December 2013 Flood Disaster Report (2014).

A review of the rainfall curves for the region suggest that the 3 hour rainfall intensity was 'in excess of a 1 in 100 years event', according to the official *Flood Disaster Report*. Rainfall intensity resulted in rivers overflowing their banks in Chateaubelair, Buccament, Vermont, O'Brien's Valley, Clare Valley and South Rivers. In addition the saturation levels of the surface soils caused by the previous normal rainfall followed by the unusual intensity of the storm caused unprecedented losses and damages.

Bridges and roads flooded, families were trapped in their homes due to floodwaters, and electricity and water infrastructure was severely damaged. As a result, nine people were confirmed dead with three more missing. The impact particularly hit areas focusing mostly on agriculture and fishing and/or with high levels of poverty. Even though there is no way to fully determine the social impact of the disaster, it is known that approximately 44% of those affected by the flooding were people living in poverty.

Locations	Impacted Population[9]	%	Poverty Ratio (2008)[10]	Main Economic Activity[11]
Spring Village, Rose Bank and Dark View on the Leeward Side (including the villages of Pitit Bordel, Chateaubelair, Fitz-Hughes, Richmond Vale, Spring Village, Gordon Village, Cumberland, and Troumaca)	5,731	34%	43.1%	Agriculture and Fishing
The Vermont Valley, all the way down to Buccament Bay (including the villages of Francois, Retreat, Vermont, Dubois, Hog Hole, Cave Vale, and Pembroke).	4,684	28%	32.4%	Agriculture and Fishing, Construction and Services
Sandy Bay, Owia, Fancy	3,856	23%	55.6%	Agriculture and Fishing
O'Briens Valley and Spring Village Georgetown	1,401	8%	55.6%	Agriculture and Fishing
South Rivers	1,213	7%	40.2%	Agriculture and Fishing
Total Number of Impacted Persons	**16,885**	**100%**		

Summary of the people affected by the Flash Flooding, published in the St. Vincent and the Grenadines December 2013 Flood Disaster Report (2014).

Updates on the widespread damage as well as emergency service and volunteering efforts were posted on social media. For instance, the National Emergency Management Organization (NEMO) constantly posted updates on their Facebook page. However, there were no significant advance warnings. According to the SVG Meteorological Service the weather changed so rapidly that there was almost no time to issue a flood warning and the officer in charge only managed to alert the population through a bulletin three hours after the rainfall started. One of the main difficulties in getting an official weather report out was that the E.T. Joshua Airport, where the Meteorological Office is based was also flooded.

The next day, 26 December, the Prime Minister acting as Chair of the National Emergency Council declared a Level 2 Disaster in accordance with

the National Disaster Response Plan. The PM made an announcement on national television, later published in local newspapers. The immediate emergency response efforts focused on rescuing people, restoring water and electricity, and clearing away landslides. Information was gathered across sectors to determine the damage and the needs across the island in order to identify and prioritize the recovery and reconstruction activities.

According to the official *Flood Disaster Report* the extreme weather event caused damages and losses of $108.4 million USD. Whereas damages are defined as the monetary value of destroyed assets, losses are considered the changes in the flows of goods and services until recovery and reconstruction occurs. Loses also account for the costs of humanitarian, emergency and assistance activities.

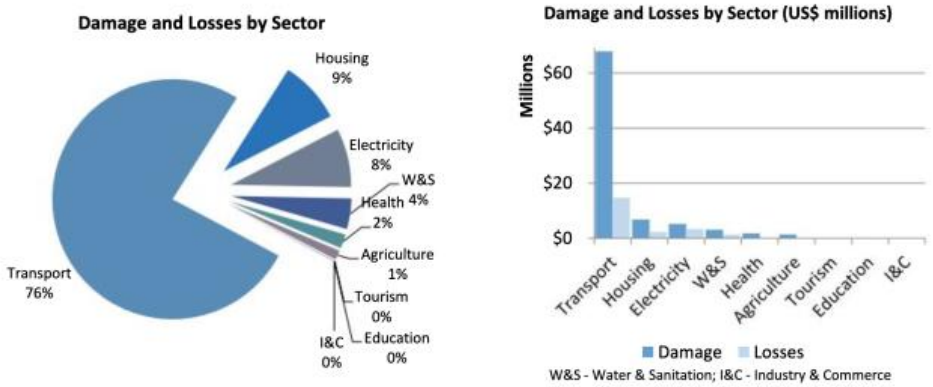


Chart of the ratio of damages and losses by sector and bar graph with the total value for each one published in the St. Vincent and the Grenadines December 2013 Flood Disaster Report (2014).

A recovery and reconstruction plan was drawn up emphasizing not only the need for short-term actions but also medium to long-term proposals. Some of these actions included the development and update of river basin flood risk maps and landslide susceptibility maps to include risks such as floods, rockslides, mudslides and changes in river course. Other actions were the putting in place of hazard and risk assessments, the strengthening of disaster monitoring and early warning systems and the overall improvement of data collection systems. An important consideration within the plan was the focus on the operation and maintenance of and investment in public infrastructure to act as a preventative mechanism for recurrent, future disaster events. Finally, public education on risk management and hazard avoidance – including flood awareness - was considered an essential component of long-term strategy.

Reference

https://issuu.com/poeteconomist/docs/svg_rapid_dala_report_0/2

Case Study 5: The Long Drought 2009-2011

What is drought?

Drought is a reduction of precipitation from the long-term average that extends over a given area for a specific period of time. This has impacts on people and places in a range of ways. Statistics on weather and climate show that drought episodes have become more widespread and prolonged in many parts of the world. St. Vincent and the Grenadines experience rainy and dry seasons and are variously vulnerable to drought, landslides and coastal flooding. Within these seasons, total precipitation each year is predicted to fall. The Grenadines are more susceptible to drought, as there are no rivers, and rainwater harvesting and the introduction of desalination plants are the main source of water.

What was the Long Drought in St. Vincent and the Grenadines?

A period of drought in 2009-11 had a significant effect on the agricultural sector and in addition, fuelled further land degradation and loss of critical coverage in the forest sector due to the increased incidence of fires. In addition, when the rain does come its intensity is increasing which contributes to increased erosion and land slippages in many areas.

What were the effects of the Long Drought in St. Vincent and the Grenadines?

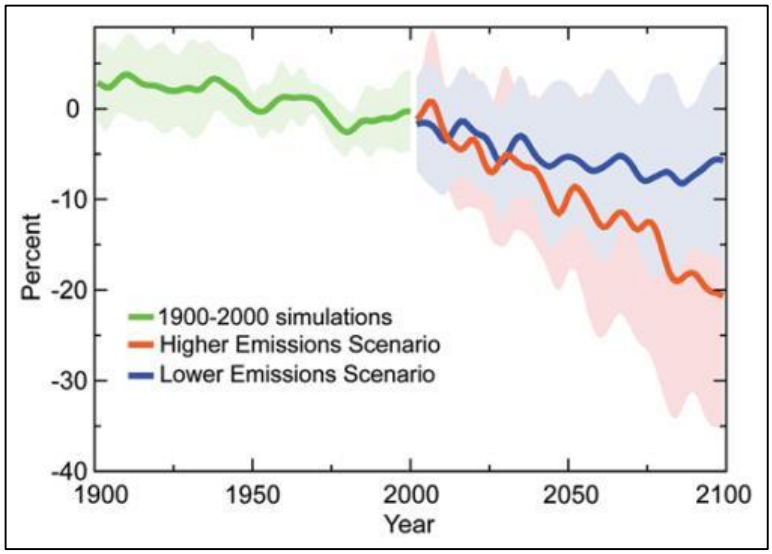
In 2009 there was a water shortage resulting from drought conditions. Many residents in Georgetown working in agriculture and as farmers suffered losses from reduced crop production that year. This caused secondary effects; food prices rose and produce had to be imported from other islands to supplement the limited supply in St. Vincent. By March 2010, on St. Vincent and the Grenadines, agricultural production was 20% lower than the previous year. Concerns were also raised over the reduction in output from the energy sector, as drought impacts reduced the potential for hydro-power. In 2010 hydro-power's contribution to total electricity production fell over 50% during the year.

Cattle shelter in trees during drought

What is likely to cause future droughts in St. Vincent and the Grenadines?

Future droughts will be caused by a combination of climatic conditions and human actions. These include large scale changes such as climate change, changing ocean temperatures and higher temperatures, overlaying which is poor water management. For example, on St. Vincent, many water conflicts stem from over extraction upstream, such as for irrigation, that impacts on the availability of potable water on the Grenadines, and damming for hydroelectric power plants on the island of St. Vincent. In instances of low water availability, downstream users become very vulnerable, affecting many facets of society. Watersheds have been affected by land degradation due to squatting, mono-cropping with poor agricultural techniques, shifts in global weather patterns (i.e. changes in rainfall distribution, drought and elevated atmospheric temperatures), deforestation and excessive use of agrochemicals.

Precipitation falls are predicted in the Caribbean.



Precipitation Prediction in the Caribbean (US Global Change Program)

What is the likely future for St. Vincent and the Grenadines in relation to drought?

Climate models suggest that the country will experience more dry periods, and this was the case in 2014 and 2016. Further projections by USAID for Caribbean climates are that there will be:

- Changes in precipitation, that are projected to vary throughout the region, but in all areas precipitation is likely to reduce.
- An increase in average annual temperature of 0.9 -1.3°C by 2050.
- An increase in hot days, with projections indicating that hot days will occur on 25% - 65% of days annually by the 2060s.
- In island nations, the disappearance of cold weather by 2060.

- Increase in frequency of category 4 and 5 hurricanes expected (25% to 30% increase).

If there are further reductions in rainfall it will severely impact the water supply of rivers and streams in St. Vincent. On the Grenadine islands, falls will be even more significant due to the very high dependence on catching rainwater for freshwater supply. There may also be an increase in the intensity of rainfall in the fewer rain days. It is likely the country will be vulnerable to both droughts and torrential rains, with secondary effects such as landslides and contamination of water supplies.

What preparations are taking place for possible droughts in St. Vincent and the Grenadines?

In the past governments and agencies have provided emergency response to affected populations in the form of food, animal feed and new water supplies. While important for alleviating starvation and saving lives, this approach is currently known to have several limitations and a more pro-active approach to drought, based on the principles of risk reduction is being implemented. It is hoped this will build greater societal resilience to drought impacts.

References

Caribbean Institute for Meteorology and Hydrology, St. James, Barbados and Land and Water Division. (2016). *Drought Characteristics and Management in the Caribbean.* Rome: FAO. http://www.fao.org/3/a-i5695e.pdf

Singh, A. (2010). *National Environmental Summary Saint Vincent and the Grenadines - United Nations Environment Programme*. UN. http://www.pnuma.org/publicaciones/FINAL%20NES%20St%20Vincent%20and%20Grenadines%20Nov%202010-%20edited.pdf

United Nations. (2009). *Prevention Web*. Accessed from: http://www.preventionweb.net/english/countries/statistics/?cid=146

USAID. (2010). *Climate Risk Profile Eastern and Southern Caribbean*. Washington: USAID.

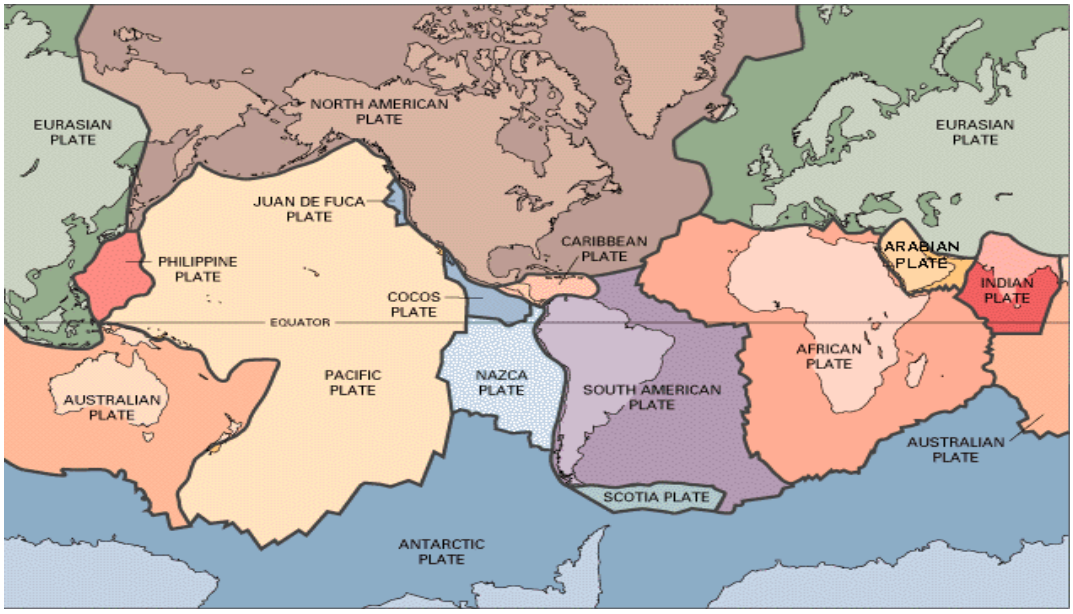
Case Study 6: Earthquakes

Earthquake hazard is classified as medium in St. Vincent and the Grenadines. This means that there is a ten percent chance of a potentially-damaging earthquake happening in the country in the next 50 years. Earthquake tremors are regularly felt and recorded in the country. For this reason, earthquakes need to be considered in planning and building work.

Earthquakes happen in St. Vincent and the Grenadines because of its location above the Caribbean tectonic plate. The Earth's surface is composed of fragmented blocks (tectonic plates) that are in constant movement. These plates can move in different ways:

- Spreading: when plates are spreading or separating from each other, we call the movement 'divergent'
- Colliding: when plates are colliding, or pushing into each other, we call the movement 'convergent'
- Sliding: when plates are sliding past each other we call this movement 'lateral'

The movement of plates causes an accumulation of pressure and energy that can result in a sudden movement of the ground, an earthquake.



It is estimated that about 500,000 earthquakes occur per year, although only one in five of these can be felt by humans. The magnitude of an earthquake is usually measured using the Richter scale, from 1.0 to 10.0. An earthquake measuring 2.0 on the richter scale would not be felt, but can be detected by special equipment. An earthquake measuring 9.0 would cause serious devastation, toppling buildings. An alternative scale used to measure

earthquakes is the Mercalli scale. This focuses on the effects caused by the earthquake, going from I, where it is not felt, to XII, where it causes enormous destruction.

In July 2015, a series of earthquakes occurred which were felt in St. Vincent and the Grenadines and other Caribbean states. The first earthquake occurred around 7am on the morning of the 16 July 2015 and was registered at a magnitude of 5.9 on the Richter scale. This was followed by a 6.4 magnitude earthquake shortly after 11am and three other events measuring 4.1 and 5.3 and 3.8 respectively. The 6.4 magnitude earthquake was felt in SVG as well as Barbados, Dominica, Saint Lucia, Grenada, Guyana, Suriname and Trinidad and Tobago.

Earthquakes cause particular destruction in populated areas damaging roads, bridges, houses and buildings and causing the deaths of people and animals. In January 2010 for example, Haiti experienced a devastating earthquake. It measured measured 7.0 on the Richter scale and with its epicentre only 25 kilometres from Haiti's capital city it caused catastrophic loss of life and damage to livelihoods. Around 9,624 people died worldwide in 2015 as a result of earthquakes. In 2010, the year of the Haiti earthquake, this number reached over 225,000 people.

Country	Year	Magnitude
El Salvador	2001	7.7
Nicaragua	1992	7.7
Ecuador	1979	7.7
Puerto Rico	1943	7.7
Venezuela	1800	7.7
Costa Rica	2012	7.6
Costa Rica	1991	7.6
Ecuador	1958	7.6
Honduras	2018	7.6
Antigua and Barbuda	1974	7.5

Map and table showing biggest earthquakes near the Caribbean and Central America from https://earthquaketrack.com/v/caribbean/biggest.

If earthquakes occur in the oceans they can trigger the formation of tsunamis. As the earthquake displaces water, it creates a series of long waves,

tsunamis. When they hit coastal areas they can cause enormous destruction (see *Case Study 9*). Because tsunamis can travel for many kilometers across open oceans, this can occur hours after the earthquake itself. Whenever an Earthquake occurs therefore, there is always a risk of Tsunami. In 2017 for example when an earthquake, measuring 7.3 on the Richter scale, occurred on the north coast of Venezuela, warnings were issued for fear that tsunamis might result along the coast. The 2017 Venezuelan earthquake was the largest recent earthquake felt in St. Vincent and the Grenadines.

Other secondary effects of earthquakes include floods, land slips into dams and rivers and fires due to damage to electric power structures and landslides.

Efforts are being made to develop buildings which are better designed to withstand earthquakes. Designing buildings which have greater flexibility means they are less likely to crumble in the event of an earthquake. Buildings and structures can be created with additional strategically placed beams to help transfer the energy of the sway of the building during a quake to the base of the structure and the surrounding earth. Specially designed foundations for buildings and structures can also help limit damage. Given the risk of earthquakes to St. Vincent and the Grenadines it has been recommended that local building design responds to this risk.

As earthquakes cannot be predicted, it is important to know what to do should an earthquake occur. Being prepared for an earthquake includes: selecting a safe place under a piece of furniture or against an interior wall; practicing what to do if an earthquake occurs; keeping a flashlight and sturdy shoes by the bed; making sure homes are securely anchored to their foundation and bolting down water heaters, gas appliances, bookcases, china cabinets, light fixtures, and any other tall furniture. During an earthquake it is safest to drop to the ground, take cover under a piece of heavy furniture and hold on. It is advised to stay inside and away from windows or, if outside to find a clear area and drop to the ground.

After an earthquake it is necessary to be prepared for an aftershock, landslide or even a tsunami. Anyone near the ocean should leave immediately for higher ground. Care should be taken in checking for damage in and around the home, i.e. in opening closets and cabinets doors, in approaching fallen power lines and broken gas lines and going close to damaged areas and buildings.

The National Emergency Management Organisation (NEMO) on St. Vincent and the Grenadines provides useful information on what to do before, during and after an earthquake. Also, the Seismic Research Centre of the University of the West Indies records earthquake activities in the Caribbean. For NEMO see *Case Study 22.*

References

https://www.statista.com/statistics/263108/global-death-toll-due-to-earthquakes-since-2000/

http://nemo.gov.vc/nemo/index.php/hazards/earthquake

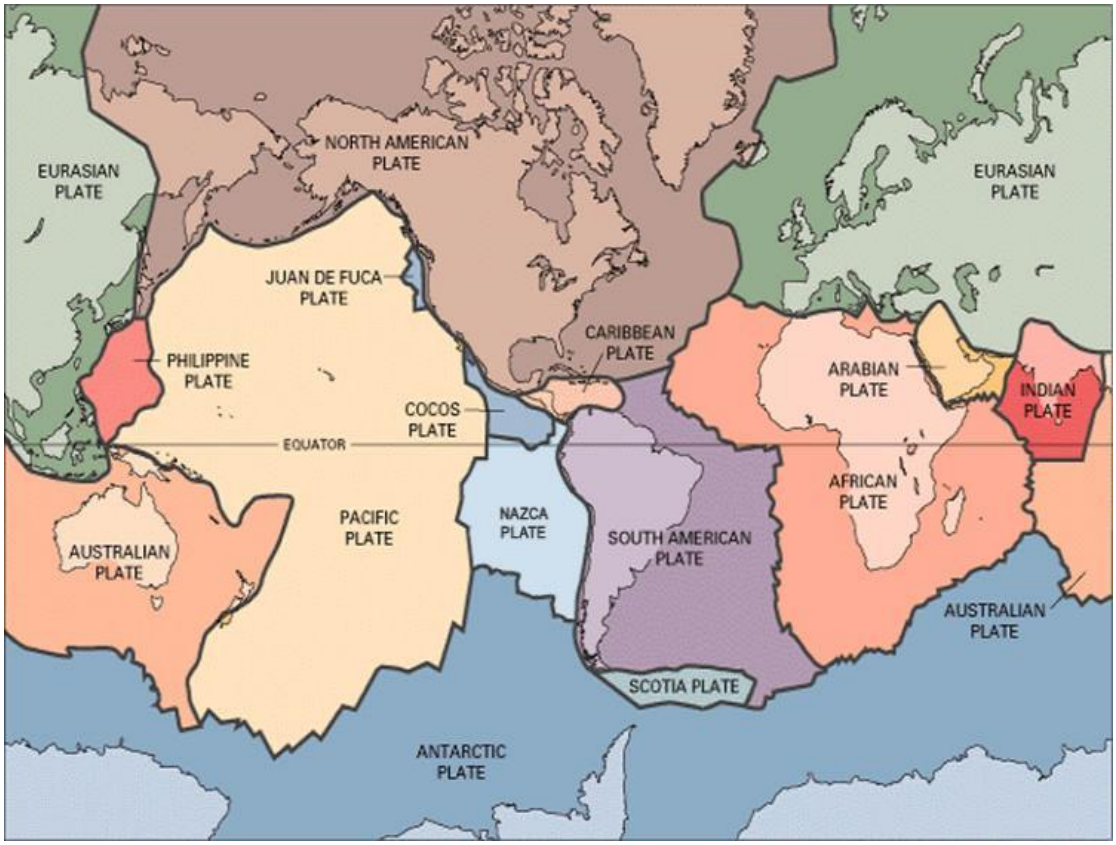
http://uwiseismic.com/

http://uwiseismic.com/NewsDetails.aspx?id=636

Case Study 7: Volcanoes and Volcanic Eruptions on St. Vincent and the Grenadines

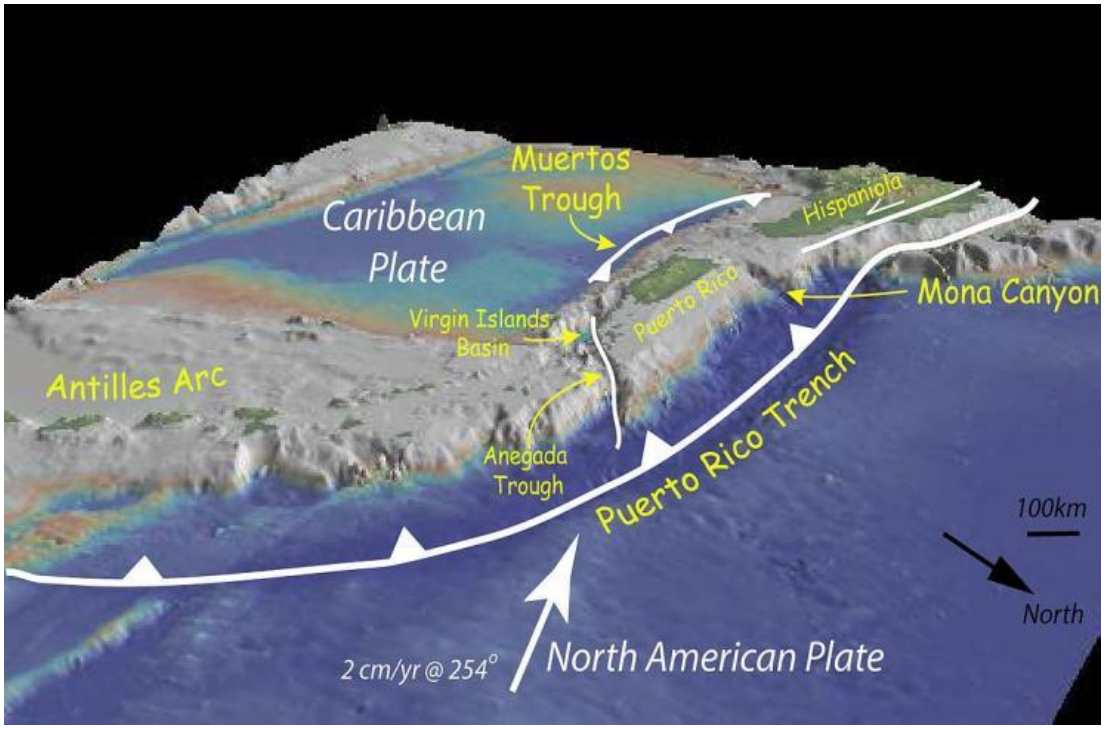
How were the volcanic features on St. Vincent formed?

The world's crust is made up of tectonic plates.



Tectonic plates (www.geology.com)

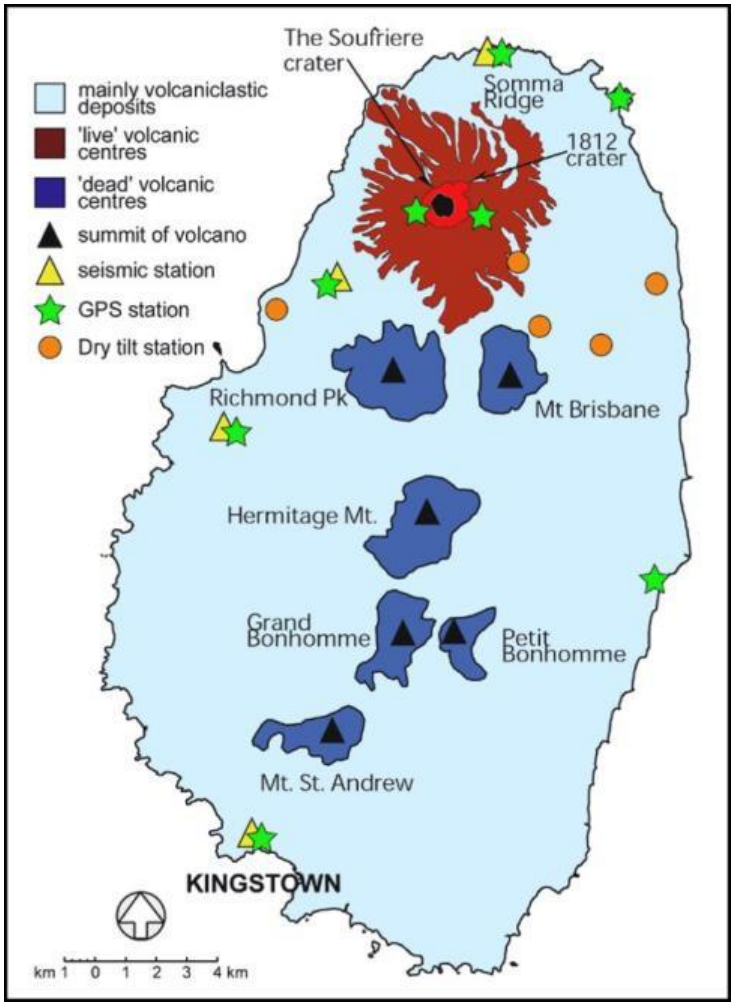
The Caribbean Plate underlies Central America and the Caribbean Sea off the north coast of South America. It borders the North American Plate, the South American Plate, the Nazca Plate and the Cocos Plate. The islands comprising the Lesser Antilles are located where the American Plate is moving underneath the Caribbean Plate (a process known as subduction). This subduction zone forms the volcanic islands of the Lesser Antilles Volcanic Arc from the Virgin Islands in the north to the islands off the coast of Venezuela in the south. Along this boundary are seventeen active volcanoes, including the Soufriere volcano on St. Vincent.



The Caribbean and North American Plates (NOAA)

What are the volcanic features of SVG?

The entire island of St. Vincent is composed of volcanic rock, showing that the island has a volcanic history beginning as far back as 2.7 million years ago. There are at least 3 extinct volcanic centres on the island located to the south of the La Soufrière volcano, the live volcano lying in the north of the island. These are the South-East volcanic centre, the Grand Bonhomme centre and the Morne Garu centre and represent the early geological evolution of the island of St. Vincent.



Volcanic features on St. Vincent (Smithsonian)

When and how did the Soufrière volcano erupt?

La Soufrière volcano has had two types of eruption in the past:

- **Explosive eruptions:** Examples are the 1902-03 and 1979 eruptions, highly explosive eruptions of magma (know as magmatic eruptions) usually preceded by frequent, strong earthquakes. They involve the ejection of large volumes of ashfalls from eruption columns and as fast-moving current of hot gas and volcanic matter (known as pyroclastic flows).

- **Nonexplosive or Effusive eruptions:** Example are the 1971-72 eruptions. This type of eruption is smaller and slower (known as effusive), and is unaccompanied by earthquakes.

Sketch map of the summit crater of the Soufrière of St. Vincent in 1784 (Frederick Nodder, from a sketch by J. Anderson)

What have been the impacts of La Soufrière Volcano eruptions?

1718: The only written record of the eruption was gathered from the descriptions of European mariners, and published anonymously in a pamphlet that declared, over-pessimistically, 'the entire desolation of the island of St. Vincent', and that 'the island was no more'.

1812: In the north of St. Vincent there was significant, but short-lived damage to sugar plantations. Fifty-six deaths were reported, although there are no details available of when, or how, these occurred. Reports suggest that many people from the Carib communities living nearby died.

The Eruption of the Soufrière Mountain in the Island of St. Vincent, 1812 (JMW Turner, © University of Liverpool Art Gallery & Collections, UK.)

1902-3: During the eruptions of 1902-3, in which about 1600 people were killed, extensive records of official and other communications were made during both the immediate crisis and subsequent relief and recovery efforts. Eyewitness accounts of the build up to the eruption again suggest that

significant numbers of people from communities living on the flanks of the volcano evacuated spontaneously during the 24 hours before the eruption reached a climax.

Richmond, 1902 (www.georgetownsvgrevisited.co.uk/la-Soufrière -1902-eruption)

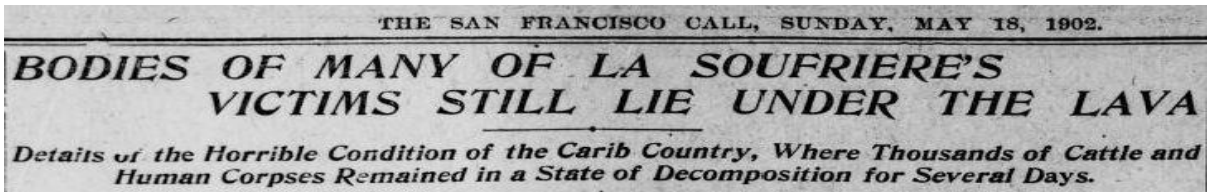
1979: On 13 April 1979 La Soufrière Volcano erupted once more. The first eruptions were so powerful that it caused ash to fall on Barbados, 180 km to the east. The volcano remained active into early June. At each eruption the mushrooming clouds reached up to 2800m, visible from Kingstown. Each explosion was followed by the deposition of a thin layer of ash over the entire island, heavier in the northern part. Ash would fall for several hours, resembling light snow.

How did people respond to the eruptions?

There are few accounts of the responses to the earlier eruptions of the La Soufrière volcano. The cultural heritage of the Soufrière area includes the ruins of the historic Lasham Sugar Plantation, which was covered by the lava and ash during the eruptions of the volcano in 1812 and 1902.

1902: The 1902 eruption began a series of explosions on May 6, after approximately 15 months of significant seismic activity. The climax phase of the eruption started around noon on 7 May and lasted until approximately 5am on 8 May. Sporadic explosions continued until April 1903 when the eruption ended. The longer term effects of the 1902 eruption were not in every case negative, as it ensured that new planned settlements were completed.

Below is the San Francisco newspaper headline following 1902 eruption:



THE SAN FRANCISCO CALL, SUNDAY, MAY 18, 1902.

BODIES OF MANY OF LA SOUFRIERE'S VICTIMS STILL LIE UNDER THE LAVA

Details of the Horrible Condition of the Carib Country, Where Thousands of Cattle and Human Corpses Remained in a State of Decomposition for Several Days.

(www.georgetownsvgrevisited.co.uk/la-Soufrière -1902-eruption)

1979: With a six hour eruption warning, evacuation of the areas north of the Rabacca and Wallibou rivers was completed in time. Later Chateaubelair and Georgetown also had to be evacuated. A total of around 20,000 people were relocated to the south of the mainland. The total population in the centres was estimated to be 15,000 with a further 3,000 displaced persons living in other homes. Evacuation centers were started in schools, churches and government buildings; these did not have adequate facilities. Sanitation problems were noted in most of the centres. Water was available but through a limited number of outlets, while facilities to boil water scarcely existed. Personal hygiene and garbage disposal also caused problems mainly because of lack of facilities.

Eye witness accounts of the 1979 eruption have been filmed and put online (via YouTube):

> The eruption
>
> *'Then you see the big smoke tumbling over the hill, big ball of smoke, then after that you start to see fire.'*
>
> *'The thunder crack, I thought the whole earth [would] open.'*
>
> The responses
>
> *'Many people around us just ran out of their houses, and kept running.'*
>
> *'The radio came on and they said the Soufriere was erupting, and that people should go to the school.'*

Current Monitoring and Plans

NEMO ensures that all the SVG population is better able to mitigate against, prepare for and respond to disasters, including volcanic eruptions. In relation to volcanic eruptions, NEMO targets school students throughout communities that are likely to be impacted by an eruption of La Soufriere. In enacting the SVG *National Volcano Emergency Plan* a number of activities are ongoing, including community and school training and awareness events as well as simulation exercises.

Links

Accounts of the 1902 and 1979 eruptions with photographs and video: www.georgetownsvgrevisited.co.uk/

Accounts of the 1979 eruption**:** www.youtube.com/watch?v=iJ_lLwiB_h8

Volcanoes in art: www.theguardian.com/artanddesign/gallery/2010/aug/01/art-volcano-warhol-turner

NEMO Facebook pages www.facebook.com/nemosvg

References

Gooding, T.C. (2019) *Geogretown Revisited*. www.georgetownsvgrevisited.co.uk/la-Soufrière.php

Pyle D.M. (2017). What Can We Learn from Records of Past Eruptions to Better Prepare for the Future?. In: Fearnley C.J., (eds) *Observing the Volcano World. Advances in Volcanology*. Springer, Cham.

NEMO. (2019). About Us. http://nemo.gov.vc/nemo/index.php/about-us/vision-mission

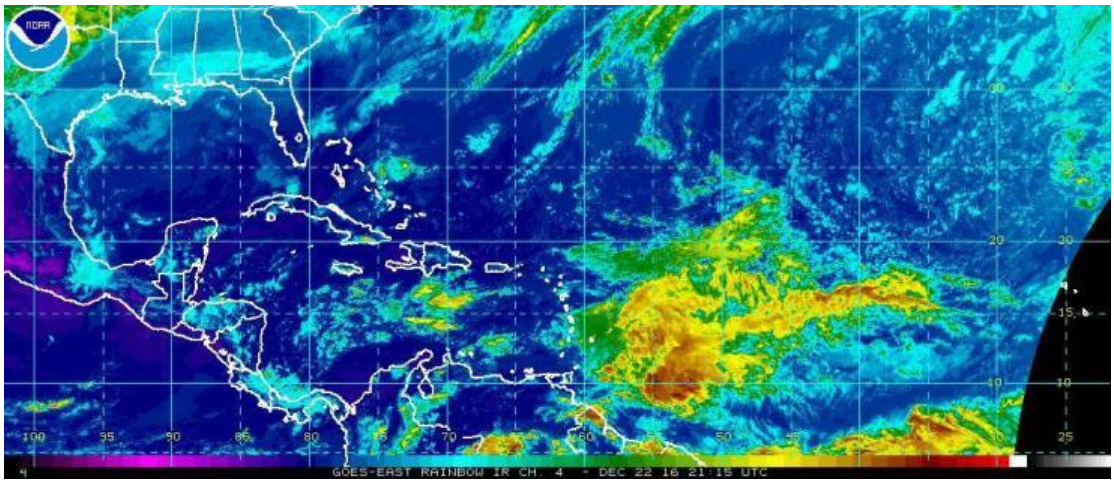
Smithsonian Institution (2019) *Global Volcanism Program: Soufrière St. Vincent.* https://volcano.si.edu/volcano.cfm?vn=360150

United Nations (2019) *The La Soufrière National Park.* https://whc.unesco.org/en/tentativelists/5751/

Case Study 8: Trigger Floods and Landslides of 2016 in St. Vincent and the Grenadines

In the fall of 2016, several islands in the Eastern Caribbean were severely affected by heavy rain, flooding and landslides due to a slow moving trough of low pressure. St Vincent and the Grenadines was one of the most affected islands with at least two major flooding events in just one month. The flooding destroyed fifteen houses and damaged 70 more. Some people lost their subsistence crops and livestock while thousands of Vicentians did not have access to water, electricity and sanitation services.

Learning from previous disaster events, the National Emergency Management Organisation (NEMO) issued a flood watch that upgraded to a warning with the hazard imminent. Using satellite and radar imagery it was possible to predict the pockets of showers and periods of rain. Some of the information was made available to the public via social media.



Satellite image of the Eastern Caribbean shared by the National Emergency Management Organization (NEMO) of St Vincent and the Grenadines posted on November 2016.

NEMO issued several warnings asking residents of landslide prone areas and areas along riverbanks to exercise extreme caution and remain on the alert. As the flooding progressed, government officials asked residents to not wait until rivers had started to overflow before evacuating to higher ground. They also pleaded with people that did not have to be on the road - for instance students and non-essential workers - to stay at home and away from flooded areas.

Unlike previous recurrent disaster events in the island, there were significantly fewer reports of dead or injured people as a result of the floods and landslides. Disasters managers worked to provide shelter for evacuated people and to report damage in specific areas. Also radio stations, newspapers and TV broadcasting services helped disseminate flood warning tips to the population, reminding individuals and communities what they ought to do and not to do; for instance, ensuring that they had their emergency supply kits, turning off water, electricity and gas supplies, disconnecting all

electrical devices and storing important documents in plastic bags and in areas where the water level was not expected to reach.

The Disaster Relief Emergency Fund operation by the International Federation of Red Cross and Red Crescent Societies (IFRC) lasted for three months after the flooding. In the final report, the IFRC reported aiding at least 400 families with approximately 2,000 affected individuals. The operation sought to meet basic needs for shelter, health, water and sanitation.

Crews removing debris from a main road in Sandy Bay.
Source: SVGRCS

References

https://reliefweb.int/disaster/fl-2016-000130-vct

https://reliefweb.int/sites/reliefweb.int/files/resources/MDRVC003do.pdf

Case Study 9: Tsunami Threat

Artist's image of a Caribbean tsunami (St Lucia News Online)

What is a tsunami?

Tsunami are giant waves caused by earthquakes or volcanic eruptions under the sea. Out in the depths of the ocean, tsunami waves do not dramatically increase in height. But as the waves travel towards land, they build up to greater and greater heights as the depth of the ocean decreases. The speed of tsunami waves depends on ocean depth rather than the distance from the source of the wave. Tsunami waves may travel as fast as jet planes over deep waters, only slowing down when reaching shallow waters. While tsunami are often referred to as tidal waves, this name is discouraged by oceanographers because tides have little to do with these giant waves.

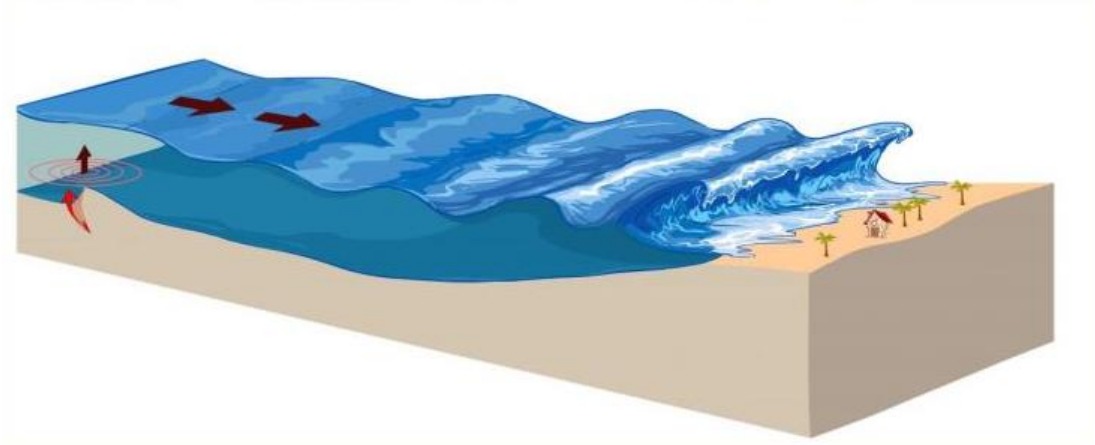
What are the tsunami threats to SVG?

There are two ways tsunami could occur:

- Earthquakes and underwater volcanos occurring within the region which may generate local tsunami (by local is meant that only nearby islands are affected).
- Distant earthquakes occurring outside of the region may generate tele-tsunami.

In St. Vincent and the Grenadines tsunami hazard is classified as medium according to information currently available. This means that there is more than a 10% chance of a potentially-damaging tsunami occurring in the next 50

years. The areas at risk from tsunami will increase as the global mean sea level rises.



The structure of a tsunami (Internet Geography)

Kick 'em Jenny is an active submarine volcano or seamount on the Caribbean Sea floor, located 8 km west of Ronde Island in the Grenadines. Kick-'em-Jenny rises 1,300m above the sea floor. In 1939 an eruption broke the sea surface, sending a cloud of steam and debris 275 m into the air and generating a series of tsunami around two metres high when they reached the coastlines of the southern Grenadines. There has been no activity from the volcano in recent years.

Kick 'em Jenny Volcano (www.geology.com)

What are the effects of tsunamis?

The effects of a tsunami on a coastline can range from the unnoticeable to the devastating. Effects depend on the characteristics of the seismic event that generated the tsunami. Small tsunami happen almost every day as a result of minor earthquakes and other events, often being observed as a strong and fast-moving tide. Larger tsunami last longer periods and can overcome obstacles such as gulfs, bays and islands. Larger tsunami arrive as forceful rapid increases in water levels that results in violent flooding. The largest tsunami devastate property and cause loss of life.

What are the impacts of tsunami?

The amount of energy and water contained in a huge tsunami can cause extreme destruction when it strikes land. Most of the damage is caused by the huge mass of water behind the initial wave front, as the height of the sea keeps rising fast and floods powerfully into the coastal area. It is the power behind the waves, the endless rushing water that causes devastation and loss of life. When the giant breaking waves of a tsunami batter the shoreline, they can destroy everything in their path. Destruction is caused by two mechanisms: the smashing force of a wall of water traveling at high speed, and the destructive power of a large volume of water draining off the land and carrying all with it, even if the wave did not look large. Large objects such as ships and boulders can be carried several miles inland before the tsunami subsides.

What are the impacts on people?

One of the biggest and worst effects of a tsunami is the cost to human life because unfortunately escaping a tsunami is nearly impossible. Hundreds and thousands of people are killed by tsunami. As the water rushes towards land, it leaves very little time to escape.

Disease

Tsunami waves and the receding water are very destructive of structures in the run-up zone. The areas close to the coast are flooded with sea water, damaging the infrastructure such as the sewage system and fresh water supplies for drinking.

Flooding and contamination of drinking water can cause diseases such as typhoid to spread in the tsunami-hit areas.

Environmental impacts

Tsunami not only destroy human life, but have a devastating effect on insects, animals, plants, and natural resources. A tsunami changes the landscape. It uproots trees and plants and destroys animal habitats such as the nesting sites of birds. Land animals are killed by drowning and sea animals can be killed by pollution if dangerous chemicals are washed away into the sea, thus

poisoning marine life. Solid waste and disaster debris are the most critical environmental problem faced by a tsunami-hit country.

Psychological effects

Victims of tsunami events often suffer psychological problems that can last for days, years or even an entire lifetime. Special post-trauma programmes have to be put in place, including in schools to help support survivors.

How can countries recover from tsunami?

The speed of the impact of a tsunami makes recovery very difficult, as it involves short term coping as well as longer term restoration and rebuilding of destroyed assets, both economic and social. The combination of loss of capital assets, of infrastructure and of human capital is felt more in poorer countries. Mortality rates from tsunami are higher amongst poorer communities. The poor also suffer disproportionately from the loss of economic assets, such economic impacts sometimes spanning generations. School enrolment may fall as parents pull children out of school to help boost family income.

The speed of recovery matters, especially in developing countries and the quality of economic recovery also matters. Rebuilding housing and public infrastructure to higher standards of safety that reduce disaster risk is vital, remembering that better rebuilding must also be culturally consistent. The instances of new, hazard-resistant housing remaining unoccupied due to culturally unaspppropriate design are numerous.

References

Deraniyagala, S. (2016). Economic Recovery after Natural Disasters in UN Chronicle Disasters, Vol. LIII No. 1. https://unchronicle.un.org/article/economic-recovery-after-natural-disasters

NEMO. (2019). *Tsunami*. http://nemo.gov.vc/nemo/index.php/hazards/tsunami

NOAA. (2019). *Ocean Service: What is a tsunami?* https://oceanservice.noaa.gov/facts/tsunami.html

SMS – Tsunami (2019). *Tsunami: the effects.* www.sms-tsunami-warning.com/pages/tsunami-effects#.XPjfadNKgw0

University of the West Indies. (2019). *Tsunami in the Caribbean.* Accessed from: http://uwiseismic.com/General.aspx?id=20

King, H. (2019) *Kick 'em Jenny Volcano.* Accessed from: https://geology.com/volcanoes/kick-em-jenny/

Case Study 10: Bushfires

Bushfires (or wildfires) are natural vegetation fires that can also affect agricultural areas. They are very often human-caused by specific careless acts or, more broadly, by climate change drying the land. Globally, vegetated areas annually affected by fire range between 300 million and 600 million hectares (3 million to 6 million square kilometres).

The incidence of bushfires is a growing concern in SVG. They occur primarily on grassy areas, woodlands and marginal lands. In 2014 fire fighters responded to 91 bushfires. Bushfires in SVG are primarily caused by human activities, mainly by clearing land for agriculture. Many farmers use the slash and burn method that, beyond causing fires that get out of control, makes soils more susceptible to erosion.

The Aftermaths of a Bushfire in Southern St. Vincent (Kenton X. IPS)

The changing climate, i.e. increases in temperature, longer dry spells and more droughts, creates conditions that supports more frequent and more severe bushfires. Due to the nature of the vegetation on the SVG coastline, the intense dryness caused by heat in July is likely to trigger bushfires. Climate change predictions indicate an expansion of the wildfire hazard zone in SVG.

Bushfires affect the ecological functions of many ecosystems, by partially or completely burning the vegetation layers and affecting soil conditions and vegetation processes. Bushfires make the topsoil vulnerable and susceptible to soil erosion and rock falls. When overlaid by severe weather events such as flooding, there are serious consequences. For instance, Rose Bank, in northwestern St. Vincent, is one of the areas severely affected by the Christmas 2013 floods and landslides. 5 people in this community were killed when landslides slammed into their home. The three landslide locations were the same areas where bushfires had previously occurred. The soils, already loosened by bushfires, triggered the landslides when the floodwaters came.

In SVG, some bushfire awareness raising public education efforts have taken place especially focusing on areas affected by fires in the dry season. There are also awareness raising events for farmers on how to help protect and preserve the environment, the events also including the dangers of bushfire.

References

Chance, Kenton. (2019). *Poor Land Use Worsens Climate Change in St. Vincent.* http://www.ipsnews.net/2015/05/poor-land-use-worsens-climate-change-in-st-vincent/

Simmons and Associates. (2015). *Fifth National Report to the United Nations Convention on Biological Diversity.* https://www.cbd.int/doc/world/vc/vc-nr-05-en.pdf

UNEP. (2010). *National Environmental Summary: Saint Vincent and the Grenadines*. http://www.pnuma.org/publicaciones/FINAL%20NES%20St%20Vincent%20and%20Grenadines%20Nov%202010-%20edited.pdf

UNISDR. (2017). *Wildfire Hazard and Risk Assessment.* https://www.unisdr.org/files/52828_06wildfirehazardandriskassessment.pdf

http://thinkhazard.org/en/report/211-saint-vincent-and-the-grenadines/WF

Case Study 11: Sargassum Influxes

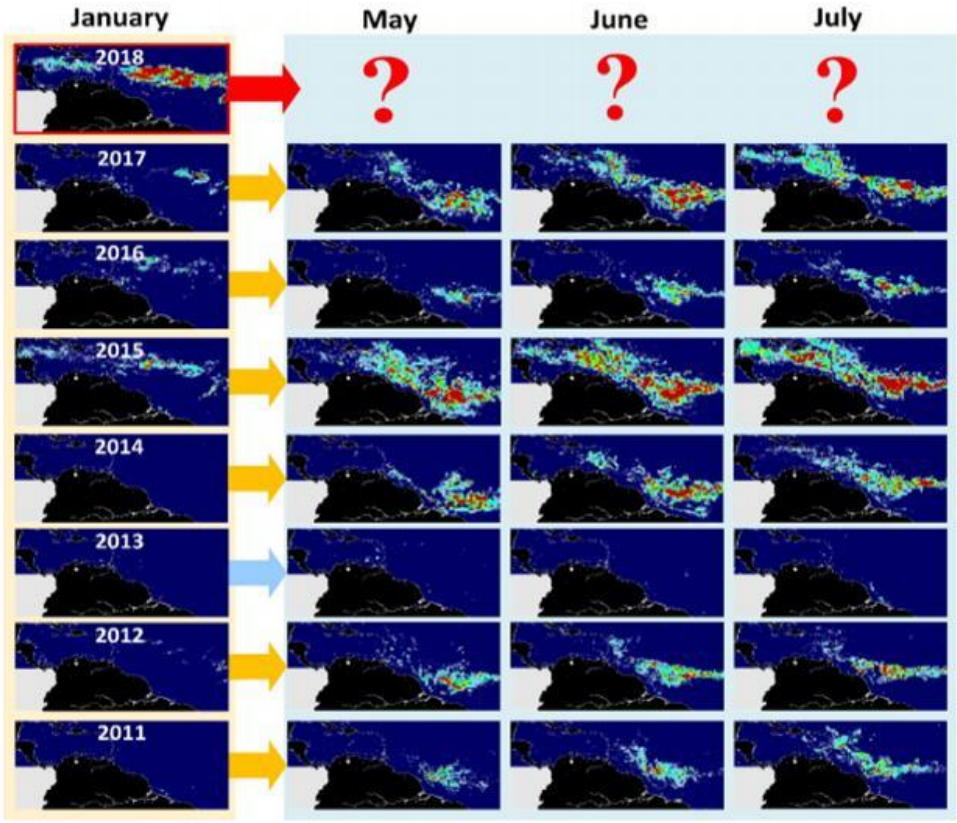
Sargassum. Windward Highway, St. Vincent
March 2019. (R.Oberman)

What is Sargassum?

Sargassum is a species of brown seaweed that floats in rafts on the ocean. It doesn't attach to the ocean floor. Scientists are tracking the movement of sargassum on ocean currents through the Caribbean, into the Gulf of Mexico and out into the Atlantic Ocean. Since 2011 there has been repeated influxes of sargassum in the Caribbean most notably in 2015 and 2018. The severity of the impact of sargassum on SVG has been measured as 'very high'.

What is causing Sargassum Proliferation?

Research is currently underway to provide a better understanding as to the cause of recent sargassum influxes. While much uncertainty remains, it is believed that global climate change may be behind the proliferation. Changes in the temperature of the oceans and in ocean circulation patterns are linked to increases in sargassum and these in turn may be a result of climate change. The UN Sustainable Development Goals are an internationally agreed set of targets for achieving a more sustainable future. Researching and addressing the impacts of the proliferation of sargassum is being discussed in the context of these goals and in particular goal 13, combating climate change and its impacts and goal 14, conserving and using oceans, seas and marine resources for sustainable development.



Satellite images showing sargassum blooms in the Caribbean sea taken from: https://optics.marine.usf.edu/projects/saws.html

Is Sargassum Ecologically Important?

Sargassum is considered an important habitat for marine species. It provides food, refuge and a breeding ground for many different fish and sea creatures including several threatened species of turtles. Photographs capturing the rich marine life living in sargassum are available at https://ocean.si.edu/ocean-life/invertebrates/world-adrift-life-sargassum. It is also seen to help nourish and conserve beaches by preventing erosion and fertilizing the plants in the coastal dune.

What problems are created by the proliferation in Sargassum?

The huge deposits of sargassum have presented a problem for SVG and other Caribbean countries.

- *Ecological concerns*: The thick proliferation of sargassum is thought to disturb marine life, smother sea grasses and coral reefs. Dead fish and sea turtles have been found during sargassum influxes and scientists believe that as sargassum decays it releases poisonous hydrogen sulphide.

- *Unsightly and foul smelling:* Sargassum blocks beaches, repelling swimmers and emitting a bad smell as it decays.

- *Bad for tourism*: Taking over beaches, sargassum influxes have had a detrimental effect on tourism. Mexico, for example, witnessed a 35% drop in tourism in early 2018. This decline was attributed to the influx of sargassum.

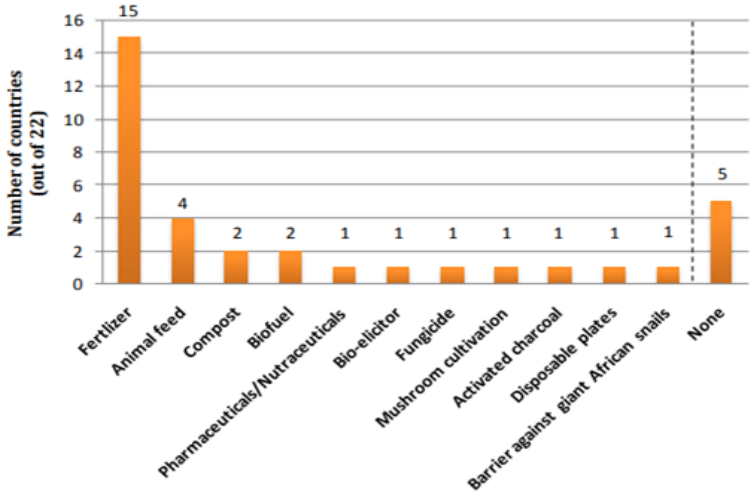
- *Difficulties for fishing*: A decline in fish numbers have been identified in sargassum years. Furthermore, it is reported that the seaweed damages fishing vessels and interferes with nets and lines.

- *Expense*: Removing sargassum requires organization and funding.

- *Damage to beaches:* The machinery used to remove sargassum can damage beaches and marine life.

Responses to Sargassum

Most countries are collecting, transporting and storing sargassum once it arrives on shore. Some efforts are being made to collect it offshore before it washes up on beaches. This management technique is thought to be cheaper and less impactful but raises concerns regarding the protection of marine life. The possibility of reusing sargassum is being researched. Different Caribbean countries are experimenting with the use of the seaweed for fertilizer, chemical compounds, biofuel and fungicide.



From: UNEP (2018) Sargassum White Paper - Sargassum Outbreak in the Caribbean: Challenges, Opportunities and Regional Situation.

References

https://optics.marine.usf.edu/projects/saws.html

http://www.cep.unep.org/cep-documents/paper_on_sargassum_side_event_at_unea-2.pdf

http://www.cep.unep.org/meetings/documents/a00d2efd429fc5ad12b3485ecacb7c33/@@download/en_file/UNEP(DEPI).CAR%20WG.40.INF.8-Sargassum%20White%20Paper%20-%20Sargassum%20Outbreak%20in%20the%20Caribbean-en.pdf

Case Study 12: Exotic and Invasive Species

An exotic or alien species is a species brought to a new location outside of its natural habitat through human activities such as travel and trade. The exotic species may displace native species through competition for limited resources. Introduced species may prey upon native species to the point of extinction, or may alter the habitat to the point that many natives can no longer survive. They may also cause damage to the environment and human health.

There are a number of exotic and invasive species posing threats to biodiversity and food security in the St Vincent and the Grenadines.

The Cuban treefrog (*Osteopilus septentrionalis*), native to Cuba, was recently discovered on the Grenadine island of Mustique. Cuban treefrogs eat a wide variety of other species including snails, millipedes, spiders, and a vast array of insects. They are predators of frogs and are cannibalistic. They are also known to eat lizards and even small snakes. This makes the Cuban treefrog a significant threat to local biodiversity. The fact that this species is nocturnal has made its management and elimination very difficult and its population continues to increase.

Cuban Treefrog
(US Geological Survey)

Plant invasions are also known on the islands. For instance, the love vine or dodder (*Cuscuta spp.)* is a parasite that is completely dependent on their host. It does not kill its host, but can substantially weaken it. Wedelia (*Sphagneticola trilobata*) is native to Central America. Cultivated as an ornamental, it readily escapes from gardens and forms a dense ground cover, preventing growth of other species. When it invades agricultural areas, it competes with crops for nutrients, light and water and reduces crop yields. The rubber vine (*Cryptostegia grandiflora*), an aggressive woody climber capable of growing over trees up to 30 m high, is of particular concern in the Grenadines, as it is toxic to livestock and often difficult to control.

Dodder (Aomorikuma)

One invasive species posing an increasing threat to marine biodiversity is the lionfish (*Pterois volitans)*. In November 2011, there was an outbreak and invasion of lionfish on the SVG coast. Lionfish are efficient carnivores that feed on a wide variety of smaller fish, shrimps and crabs, competing with native species. They also have the potential to reduce the abundance of ecologically important species such as parrotfish and other herbivorous fish that keep seaweeds and micro-algae

Lionfish (CIASNET)

from overgrowing corals. The potential for loss to commercial fishery and reef-based tourism is severe.

Options for controlling lionfish are currently very limited and haphazard, i.e. having trained dive professionals or fishermen remove them individually. They are being gathered as a food source.

References

Caribbean Invasive Alien Species Network (CIASNET). http://www.ciasnet.org

Simmons and Associates. (2015). *Fifth National Report to the United Nations Convention on Biological Diversity.* https://www.cbd.int/doc/world/vc/vc-nr-05-en.pdf

Case Study 13: Vehicle Usage

Vehicles, burning petrol and diesel, emit carbon dioxide and other greenhouse gases. These gases contribute to the greenhouse effect causing climate change. Vehicle emissions are not only a problem for the environment but also a danger to the health of individuals. Among these emissions, nitrogen oxide, for instance is toxic for humans, sulphur dioxide causes acid rain, carbon monoxide presents a range of human health concerns and ozone is linked to a wide array of respiratory problems. Reducing the number of vehicles or the distances these travel not only reduces greenhouse gas emissions but also has significant health benefits.

Kingstown, St Vincent and the Grenadines

In St. Vincent and the Grenadines, transport is the most significant cause of greenhouse gas emissions due to fuel combustion. As the table below indicates, the transport sector emits significantly higher levels of carbon dioxide, nitrogen oxide, carbon monoxide and sulphur dioxide than any other sector. Globally, the transport sector is the fastest growing contributor to climate emissions with about a quarter of global carbon emissions coming from transport.

	Emissions in Gigagrams			
	Carbon dioxide	**Nitrogen oxide**	**Carbon Monoxide**	**Sulphur Dioxide**
Energy Industries	94.1	0.3	0.0	0.3
Manufacturing Industries and Construction	3.2	0.0	0.0	0.0
Transport	107.9	1.1	7.4	0.2
Other sectors	12.2	0.0	0.5	0.0

Table showing quantity of emissions of some greenhouse gases by sector for St. Vincent and the Grenadines. Data taken from Summary of Green House Gas Emissions in 2004 published in the Compendium of Environmental Statistics prepared by the Statistical Office at the Economic Planning Division of the Ministry of Finance and Economic Planning, St. Vincent & the Grenadines

Recent studies have shown that tackling traffic jams and congestion can have a strong beneficial impact on air quality, reducing pollution. The common measurement to study the impact of traffic on greenhouse gas emissions

used to be the distance the vehicles travelled. However, current research indicates that it is not only distance, but the amount of times vehicles accelerate and brake, as well as the speed at which they travel, which determines the extent of emissions generated. Slower moving traffic, including traffic jams as well as stop-and-go traffic, emits more greenhouse gases than cars moving at a constant speed. Thus, reducing congestion and developing both speed management and traffic smoothing strategies, as well as reducing oil-run transport, could be an important aspect in climate change mitigation. The work rush hour into St. Vincent in the morning and the afternoon rush hour return, with their stop-and-go queues, engines ticking over, is evidence enough that the country has a significant traffic problem to address.

The *National Economic and Social Development Plan* (2013-2025) for SVG promotes the reduction of traffic congestion as part of its goal to preserve the environment and build resilience to climate change. The proposals include: developing a comprehensive road maintenance programme; upgrading village and feeder roads and embarking on a comprehensive drainage building programme. Efforts made to improve road infrastructure however must be accompanied by awareness campaigns and educational efforts aimed at the general public to increase understanding of the impact of vehicle usage on climate change. By doing so, individuals and communities are able to make informed decisions about their transportation that takes into consideration not only its efficiency but also the impact on the environment.

The use of electric cars has been promoted in some Caribbean countries. Electric cars are more efficient than traditional cars powered by internal combustion engines, and allow for the possibility of using solar energy. A solar-car port with charging points has been built in Kingstown, pointing the way to how sun energy could be harnessed in sunny St. Vincent.

Solar car-port Kingstown

References

Report 'Compendium of Environmental Statistics' from Saint Vincent and the Grenadines
http://stats.gov.vc/stats/wp-content/uploads/2019/06/Compendium-of-Environmental-Statistics-2016.pdf

Article: Traffic Congestion and Greenhouse Gases
https://www.accessmagazine.org/fall-2009/traffic-congestion-greenhouse-gases/
https://sustainabledevelopment.un.org/content/documents/1134247SVG%20Rio+20%20Final%20Report.pdf

https://www.theguardian.com/football/ng-interactive/2017/dec/25/how-green-are-electric-cars

https://www.who.int/sustainable-development/transport/health-risks/climate-impacts/en/

Case Study 14: Coastal Features, Projects and Threats

Why is the coastline important?

There are 32 islands and cays that make up St Vincent and the Grenadines. Nine are inhabited, including the mainland St. Vincent and the Grenadines islands of Young Island, Bequia, Mustique, Canouan, Union Island, Mayreau, Petit St Vincent and Palm Island. The coastline is where most people in SVG live and work. It is where development of industry and businesses has happened. Commercial fishing based around the coast employs around 1,500 full-time and 1,000 part-time registered fishers.

Residential areas and economic activity mainly located on the coastal strip of SVG (Photo: S. Pike)

Most residential areas in SVG are on or near the coast, largely due, on the mainland, to the mountainous interiors. The majority of tourism infrastructure and activity is based on the coast and many coasts of the Grenadines are known for high-end hotels. They are popular as sailing destinations as well as offering diving and recreational fishing. Recently larger capital projects are also taking place along the coast, such as the development of the airport and a new port facility on St. Vincent. This is coupled with increasing tourism development including the ongoing building of luxury hotels, again much of which is by the coast. For example, newly constructed Argyle International Airport, in SVG, is on the south-east coast about 8 km east from Kingstown. It is the largest of five airports in what is a multi-island nation and is the largest international gateway into the country. The coast is also where significant ecosystems, such as beaches and corals are located. Coral reefs are intrinsically valuable natural treasure, while also providing valuable benefits for local and national economies.

Kingstown with its concentration of economic activity along the coast (Photo: S. Pike)

What are the issues and threats to the coastline?

The colocation of valuable ecosystems and ongoing development raises significant issues. Threats to the coastline come from both external and internal sources.

External threats include:

- Hurricanes and tropical storms, between June and November, often causing dramatic changes in beach erosion.
- High waves during 'winter' months resulting from storms in the North Atlantic Ocean that are locally known as 'groundseas'.
- Sea-level rise, which is a long-term factor, i.e. taking place very slowly over decades, causes shorelines to retreat inland.

External threats to coastlines also include the mass build-up of sargassum Seaweed, see Case Study 11 (Photo: S. Pike)

These threats only increase with climate change, creating shifts in wave formation and actions, ocean temperatures and currents. For example, on Bequia there has been substantial coastal erosion on the south of the island. Climate change projections suggest that reefs in the area will experience thermal stress severe enough to cause bleaching every year after 2040. Other

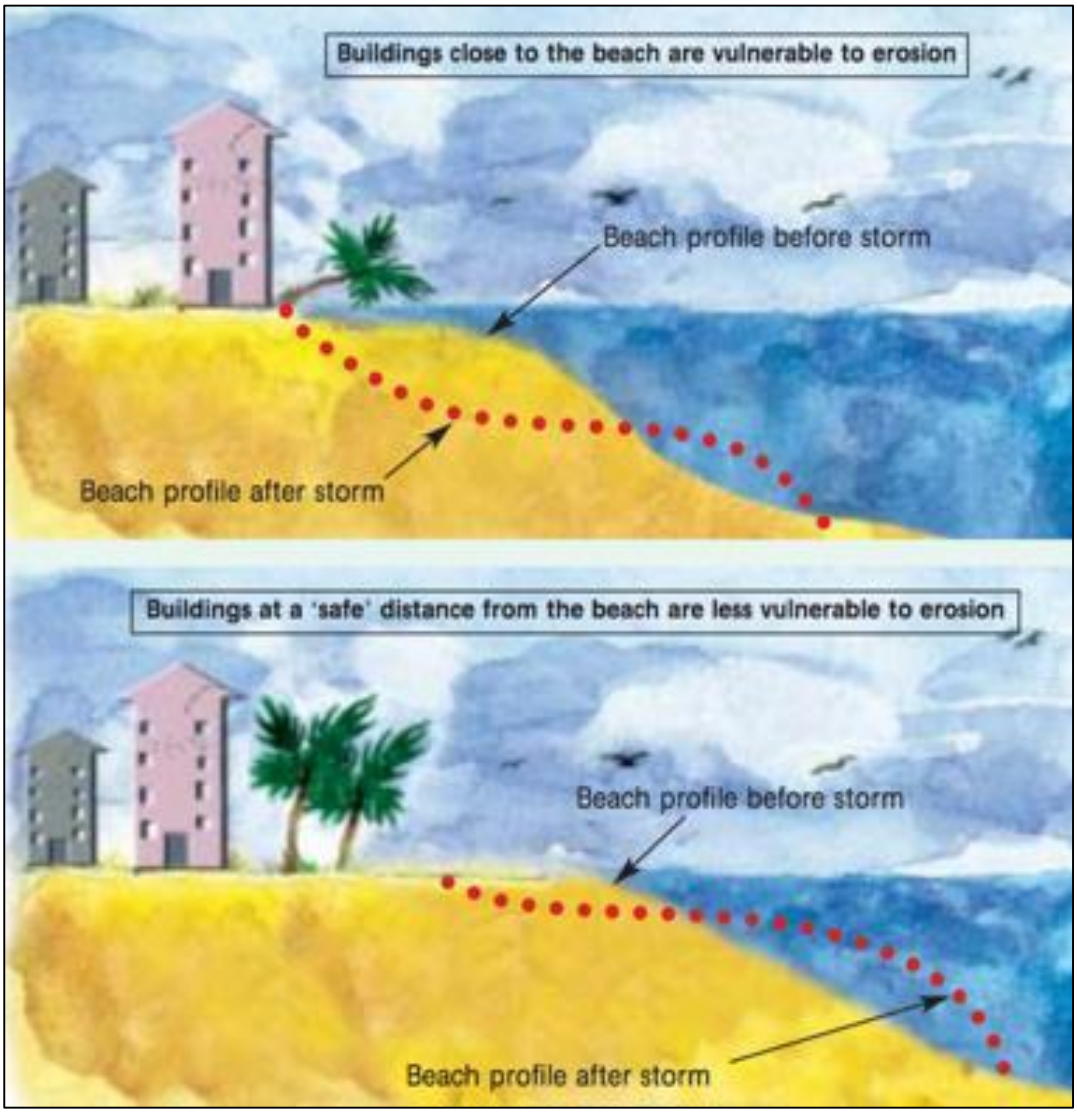
external sources of threat include air travel, commercial shipping and waste disposal.

Internal threats include:

- Removing sand and other materials from beaches and dunes for construction purposes causing erosion and the loss of beaches and dunes, so destroying the natural heritage of the coast and reducing the vibrancy of the tourism industry.
- Building too close to the beach and so interfering with the natural sand movement may impede beach recovery after a serious storm or hurricane. Overall, coastal development has a deleterious effect as it tends to lead to sewage discharge, urban runoff and construction waste.
- Badly planned sea defences perhaps causing the loss of near and neighbouring beaches.
- Pollution from human activities on the land damaging coral reefs and seagrass beds; these biological systems protect and provide sand for the beaches.
- Removing vegetation from coastal areas so destabilizing beaches, while clearing sites inland results in increased soil and dirt particles being washed offshore and smothering coral reef systems.
- Land modification causing significant run-off in terms of pollution and sediment.
- Damage from shipping also constitutes a threat as there are discharges of wastewater from cruise ships, tankers and yachts, leaks or spills from oil infrastructure, and damage from ship groundings and anchors.

In tourist areas coasts tend to be modified, including the walkway at Port Elizabeth, Bequia (Photo: S. Pike)

The most visible effects of all the above are seen on coral reefs, mangroves and beaches. While estimates vary, around half of SVG's coral reefs are under threat and many beaches have been reduced and changed their profile. For example, the removal of substantial dunes at Brighton in St. Vincent in 1995, destabilised the beach, so the coastline retreated inland a considerable distance. In addition, salt spray now penetrates much further inland. Destruction or loss of coastal mangrove swamps also reduces beach and coral reef health (see *Case Study 18*).



Good practices in coastal management through modifications of building practice (UNESCO)

What is happening to resolve these issues and threats?

As the current SVG *National Development Plan* notes, proper management and utilisation of SVG's oceans and coasts will contribute to a sustainable, 'green' economy as envisaged in the *Plan*. Although a national coastal management plan is yet to be designed, there are various initiatives aimed at

managing coastal issues. For example. ten conservation areas have been designated within territorial waters under the *Fisheries Conservation Act*. One of these is the Mustique Marine Conservation Area which creates a 1000m conservation zone in the sea using techniques that reduce erosion, improve water quality, install sewage treatment facilities, recycle and reduce waste and restore the lagoon, mangroves and reefs.

There is also significant community and youth action to protect the coastal and beach environment through the Sandwatch Project (see *Case Study 17*).

References

Bequia Community High School; SVG Ministry of Agriculture, Lands and Fisheries; University of Puerto Rico, Sea Grant College Program Caribbean Development Bank UNESCO Environment and Development in Coastal Regions and in Small Islands. (2003). *Wise practices for coping with Beach Erosion.*

https://unesdoc.unesco.org/ark:/48223/pf0000130003/PDF/130003eng.pdf.multi

Central Planning Division Ministry Of Finance And Economic Planning. (2013). *St. Vincent and the Grenadines National Economic and Social Development Plan 2013-2025.*
https://sustainabledevelopment.un.org/content/documents/1466vincentgrenadines.pdf

St Vincent and the Grenadines National Parks, Rivers and Beaches Authority. (2019). http://nationalparks.gov.vc/nationalparks/index.php/visitor-sites

Telesure (2018) *SVG Economic Growth to reach 2% in 2019*.
https://www.telesurenglish.net/news/St.-Vincent--Grenadines-Economic-Growth-to-Reach-2-in-2019-20190409-0016.html

The Nature Conservancy. (2016). *St. Vincent & the Grenadines Coral Reef Report Card.* www.issuelab.org/resource/st-vincent-the-grenadines-coral-reef-report-card-2016.html

Case Study 15: Biodiversity Loss and Conservation on St. Vincent & the Grenadines

St. Vincent Parrot

The St. Vincent Parrot is the national bird of St. Vincent and the Grenadines capturing, in its green, blue and yellow feathers the colors of the national flag. Under threat but recoiling from a slide into extinction, it still appears on the IUCN Red List of endangered birds since its numbers remain small and its range is endemic (i.e. restricted) to a single place (i.e. St. Vincent).

This iconic parrot stands as symbol of the incredibly rich biodiversity in SVG. The country has some 12,700 hectares of tropical rain forest providing a natural habitat for wildlife while around the Grenadines are bio-diverse coral reefs, mangrove swamps and sea grass beds. The *National Biodiversity Strategy and Action Plan* counts: 17 species of mammals, 190 species of birds, two endemic to St Vincent (the Parrot and the Whistling Warbler) and more than 14 endemic to the eastern Caribbean; 21 species of reptile; four species of amphibian; 1,500 flowering plants (16 endemic to SVG); and 163 ferns (4 endemic to SVG). In the marine environment there are 500 species of fauna and flora including 450 species of finfish, 12 species of whale and dolphin, 4 species of turtles, 11 species of seaweed and 30 species of coral.

The St. Vincent Parrot also stands as symbolic of the dangers facing the nation's wealth of biodiversity.

Threats to Biodiversity

There are many threats to biodiversity on SVG. There are natural threats. Hurricanes, earthquakes, volcanic eruptions and drought, singly or combined, together with the steep landscape and erosion-prone soils can have a devastating effect on fauna and flora. Hurricanes and extreme storms strip vegetation; hot volcanic ash and poisonous gases wipe out wildlife; drought shrivels flora and parches fauna.

Then, there are human-caused threats. Forest and other habitats are being lost or broken up because of agricultural clearance, squatting, charcoal burning and illegal marijuana growing. All of these activities make the land more vulnerable to natural disasters. Ecosystems are also being threatened by the introduction of alien, invasive species as a result of increasing travel and trade (see *Case Study 12*). One alien maritime or land species can disrupt an entire ecosystem and lead to the loss of several animal or plant species. Under this heading the introduction of genetically modified crops through the import of grain or animal fodder can bring about the degradation or extinction of crop species indigenous to the country.

Unsustainable agriculture is a major threat to biodiversity. Slash and burn crop cultivation involving squatter farming that moves on from one forest location to another constantly reduces the remaining area of natural diversity. Uncontrolled farming is given license by the lack of a national plan for land usage, something that is expected by 2025. Lack of a plan also permits the under-controlled sale of land for housing and commercial development. Compounding this is the lack of a comprehensive national forest policy or comprehensive national environmental policy (although there is wildlife protection, forest conservation and national parks legislation).

Although eco-tourism has the potential to positively influence biodiversity conservation (i.e. keeping nature pristine for the tourists), there are cases on SVG where it has had the opposite effect, a case in point being the marina project at Ashton Lagoon on Union Island (see *Case Study18*) that severely affected migrating and overwintering bird populations as well as rare and endangered marine organisms.

Other human practices threatening biodiversity include: overgrazing by animals; illegal harvesting of eggs and birds, including the culling of the St. Vincent Parrot for the illegal international pet trade; recurrent bushfires; pollution as caused by pesticides, fertilizers, sewage and factory and vehicle emissions. Poverty and unemployment often lead to poor communities seeking alternative sources of food and livelihood that endanger ecosystems and biodiversity. In this regard, the need for environmental education and raising awareness is fully recognized by the SVG Ministry of Education.

National Biodiversity Targets

The revised *National Biodiversity Strategy and Action Plan* of 2017 selects five particularly important national targets from the range of internationally agreed biodiversity targets agreed at Aichi, Japan in 2010 to which SVG was party. The targets are intended to be met by 2020 and are as follows:

> *National Target 1:* At least 50% of the SVG population is to be knowledgeable about the values of biodiversity and the steps they can take to conserve and relate to it sustainably

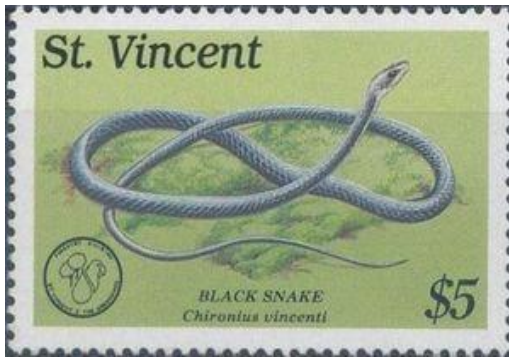
National Target 2: SVG will have completed studies to establish the status of all natural habitats and the rate of habitat loss or be in the process of developing a national strategy to reduce habitat loss.

National Target 3: Invasive, alien species and the pathways whereby they enter SVG are to be identified, and, for those species posing a priority threat, control and eradication programs are to be put in place with entry pathways managed.

National Target 4: At least 17% of terrestrial and inland water and 10% of marine and coastal areas, especially areas of biodiversity and ecosystem value, are to be conserved through connected systems of protected areas and other conservation measures.

National Target 5: Ecosystem resilience and the contribution of biodiversity to carbon storage will be enhanced as a contribution to climate change mitigation and adaptation (that will also combat desertification).

Key messages of the *Strategy and Action Plan* are captured in the acronym VITAL to be used in branding biodiversity through communication, outreach and education:



Celebrated on a St. Vincent postage stamp, the St Vincent Black Snake, endemic to SVG, is on the IUCN red list as endangered

Biodiversity is VITAL:

- **V**aluable
- **I**mportant to sustain life
- **T**hreatened - plants, animals, ecosystems
- **A**ctions can be taken to conserve and reduce loss
- **L**ivelihoods – new and sustainable

References

Birdlife International Data Zone, *St Vincent Amazon.* *http://datazone.birdlife.org/species/factsheet/22686403*

National Parks. Rivers and Beaches Authority. *Biodiversity.* http://nationalparks.gov.vc/nationalparks/index.php/conservation/biodiversity

St Vincent & the Grenadines. (2015). *Fifth National Report to the United Nations Convention on Biological Diversity.* https://www.cbd.int/doc/world/vc/vc-nr-05-en.pdf

Sustainable Development Unit, Ministry of Finance, Economic Planning, Sustainable Development, and Information Technology. (2017). *Revised National Biodiversity Strategy and Action Plan.* https://www.cbd.int/doc/world/vc/vc-nbsap-v2-en.pdf

Case Study 16: Panos Caribbean. Voices for Climate Change Education

Artwork by Jonathan Gladding

Panos Caribbean is an NGO with offices in Kingstown, Jamaica and Pétionville, Haïti. It is an organization that works to empower people who are marginalized, vulnerable and excluded across the Caribbean. Its campaign *1.5˚ to Stay Alive* is an educational response to the *Special Report on Global Warming of 1.5˚C*, produced by the Intergovernmental Panel on Climate Change in 2018. This report found that it was essential, and possible, to take measures to ensure that the global average temperature does not rise by more than 1.5˚C from pre-industrial levels.

The *1.5˚ to Stay Alive* campaign works to support and highlight local climate-smart practices by engaging local artists. Local and national singers and performers work together in multi-part workshops designed to help participants understand climate change and craft effective climate change messages. The workshops take the artists to participating communities so they can see first-hand the climate change impacts that are being confronted and how the communities are responding.

Saint Lucian poet and dramatist Kendel Hippolyte and musician Taj Weekes, have worked together to compose a new theme song for the *1.5˚ to Stay Alive* campaign, for Panos Caribbean.

The song features the voices of Linda 'Chocolate' Berthier, Bushman, Kenyatta Hill, Kendel Hippolyte, Zara McFarlane, Sidney Mills, Jafe Faulino, Razia Said, Aaron Silk and Taj Weekes. It is distributed by Jatta/VP Records, and is available online on YouTube and SoundCloud.

In releasing the song, Kendel Hippolyte appealed to artists and other concerned citizens to make their voices heard in the fight against climate change.

Campaign activities also encourage school students to use their creativity to craft climate change adaptation messages. Students in the four communities are challenged to produce 60-second video messages with prizes given for the best productions. The campaign includes a short story competition for students and a reading initiative that will introduce young readers to literature on climate change while encouraging them to read.

References

https://soundcloud.com/panos-caribbean/1pont5-to-stay-alive

http://1point5.info/en/

http://panoscaribbean.org/15-english/news-updates/jamaica-news/111-voices-for-climate-change-education-2019-campaign-calendar-of-activities

Song Lyrics

1.5 IS STILL ALIVE
(In Thanks and Praise for Our Mother)

So we have reached where we are
Some say it's too late for a turning
Poison in the air, sea and land
The body of Our Mother is burning
Our children and children of our children
Look into our eyes with a question:
How could you know what you knew
And yet still you all let it happen?
Some are saying it's just too late
Total extinction is our fate
But we've not reached the end of the rope
There's a degree, a fraction, of hope

CHORUS
1.5 is still alive
1.5 – we can survive
Spread the word, we still can thrive
The way begins at 1.5

How did we reach where we are?
1% with their lies and their power
Maintaining a system of greed
Cannibalizing Our Mother
Things and more things and more things
Is how their system keeps going
Selling us what we don't need
Feeding a giant that's growing

CHORUS

1.5 is still alive

Global matricide is what they've begun
But we're Her children - can't let it go on
Climate justice is where we start
The guilty nations must pay their part

CHORUS
1.5 is still alive
1.5 – we can survive
Spread the word, we still can thrive
The way begins at 1.5

Never have we seen it like this
Every day brings a sign and a wonder
Disasters and profits go up
People and countries go under
The order we live in must change
People must come before profit
We're greening the system for now
But sooner than later must change it
Honor The Mother, beginning and end
Fight for Her ways to guide everything
Justice and Earth-needs go hand in hand
A system that serves ALL is what we demand
(And till then)
1.5 – we can survive
Spread the word, we still can thrive
The way begins at 1.5

Case Study 17: Sandwatch on St. Vincent & the Grenadines

Now up and running in more than fifty island and coastal communities around the world, the Sandwatch project began as very much a Caribbean initiative. At a UNESCO Caribbean Environmental Education Workshop in Tobago in 1998, teachers and students from across the region lighted on the idea of using action learning to monitor and reverse the erosion, pollution and degradation of beaches and coastlines around the Caribbean. Ideas were developed and at a UNESCO workshop in St Lucia in 2001 attended by teachers from 18 Caribbean countries the Sandwatch project was formally launched. The workshop familiarized participants with methods for monitoring and measuring beach erosion and accretion, wave action and water quality as well as for determining the effect of human encroachment on beach quality. A practical manual was distributed to all teachers attending. Sufficient equipment kits were distributed to participating countries so that at least three schools in each country could be actively involved.

The aims of Sandwatch are, first, to involve primary and secondary students in scientific observation, measurement and analysis of local beaches, and, second, to support students, working in and with their communities, to critically evaluate and then act upon their findings by taking forward beach enhancement projects. The project very much adopts a 'citizen science' approach but makes links to subjects across the curriculum.

St Vincent & the Grenadines has been involved in Sandwatch from its inception in 2001, with students and teachers at Bequia Community High School to the fore. Recurring features have included the holding of training sessions for successive waves of students to ensure continuity, training for teachers and students from other schools in the Grenadines, in mainland St Vincent and from other Caribbean islands, and presentations by students and teachers at regional Caribbean Sandwatch events.

In the rolling out of the Sandwatch project on SVG there have been some landmark achievements:

- June 2005 Bequia Community High School won second prize in the UNESCO Community Sandwatch Competition (secondary section) for cleaning up a garbage-strewn drain in the village of Paget Farm. The drain rehabilitation project involved: water analysis; raising public awareness of the issue through radio and television programs and specifically using media to encourage local fishermen to stop polluting the beach and near-shore area; debris clearance; excavating mud and removing fallen trees to allow free flow of water (thus helping control the mosquito population); installing debris traps; landscaping the area and making it a recreational facility; recruiting community youth to take ownership of and maintain the area.
- In June 2006 the first edition of *The Sandwatcher* community newsletter was published, describing Sandwatch activities on SVG.
- In February 2007 the Sandwatch group began advising gravel miners who extract gravel from two small rivers flowing into beaches in the Richmond and Larikai area from the slopes of the La Soufriere volcano on how to harvest the

gravel at sustainable levels. The miners, who are largely women, were trained in Sandwatch monitoring and measuring techniques.

- In September 2007 30 Sandwatch students conducted a beach cleanup of Paget Farm beach, removing 165 bags of garbage as well as clearing away heavy duty machine and building leftovers.
- In November 2007 the Sandwatch group created history by launching the first secondary school radio station in SVG.
- From April to July 2008 students collected bottle caps from beaches as part of an anti-litter campaign and school art project and created an environmental mural from the caps. The mural's strapline was 'Bequia Sweet, keep it clean!'
- From May to July 2009 the Sandwatch group joined with the SVG Bureau of Standards in a water quality analysis project at the Bequia Fisheries Complex, Paget Farm, taking samples from the limited water sources available - sources becoming ever more limited with climate change and the increasing unpredictability of the rainy season - to determine the presence of bacteria and other harmful elements. The aim was to feed data into the technical planning of water filters for a reverse osmosis installation where water would be pumped uphill, cleaned and desalinated and then delivered by gravity to a thousand households in the village. The student initiative was described as an example of 'how students can get involved in experimental education and contribute in a big way towards determining the way forward for an entire community'.

The Sandwatch manual for 2005 reports that most teachers at Bequia Community High School were involved in integrating Sandwatch into the school curriculum; into science and social science, mathematics and English, into practical subjects such as woodworking and into information technology. Through their information technology classes, but also using in out-of-school time, students shared their activities with students around the world through the Small Islands Voice of Youth Internet Forum.

Following two years of inactivity largely caused by Sandwatch 'champions' moving on to other jobs and other places, the program restarted in December 2012. Since then training has been offered to new groups, such as the National Parks, Rivers and Beaches Authority, and to new waves of students entering Bequia Community High and the Seventh Day Adventist School. There is the sense though that the earlier momentum has not quite been regained. As the Sandwatch Coordinator put it: 'While it has been awhile since Sandwatchers in St. Vincent and the Grenadines have done anything major in terms of beach monitoring, it has never been far from the minds of those involved'. She holds the Sandwatch legacy amongst youth on Bequia to remain strong:

> Ever since the introduction of Sandwatch to our secondary students, awareness of ocean and the life within has been an important issue. The Sandwatch program allowed them to take a national pride in the upkeep of the beaches. Students were more knowledgeable in how to go about keeping not only beaches clean but also their community as a whole. What was more impressive was the fact that newfound information did not stay directly with those involved in the program, but was spilled over to family members and community personnel.

Future challenges include fully revivifying Sandwatch activities, ensuring their further take-up and spread across SVG (including into the primary school sector), and exploiting the curriculum opportunities that Sandwatch offers in a comprehensive and systematic manner.

References

Bequia Community High School. (2005). *Sandwatch/SIV Youth Project.* http://www.sandwatchfoundation.org/uploads/6/6/9/5/66958447/1._svg_competition_entry_article_1.pdf

Cambers, G. (2007). *Regional Sandwatch Symposium Conserving the Coastal Environment: Education for Sustainable Development.* http://www.sandwatchfoundation.org/uploads/6/6/9/5/66958447/3._t_t_sw_fair_article_3.pdf

Ferdinand, I. (2010). *St. Vincent and the Grenadines. Pilot Programmes for Climate Resilience (OOCR).* https://www.climateinvestmentfunds.org/sites/cif_enc/files/meeting-documents/st_vincent_ppcr_meeting.pdf

Stow, J. (u.d.). *Sandwatch Helping Bequia Go Green.* http://www.sandwatchfoundation.org/uploads/6/6/9/5/66958447/6._svg_go_green_article_6.pdf

The Sandwatch Foundation. http://www.sandwatchfoundation.org/st-vincent--the-grenadines.html; http://www.sandwatchfoundation.org/st-vincent-bequia-story.html;

http://portal.unesco.org/en/ev.php-URL_ID=15230&URL_DO=DO_TOPIC&URL_SECTION=201.html

http://www.unesco.org/new/en/archives/education/networks/global-networks/aspnet/flagship-projects/sandwatch-project/

http://www.sandwatch.ca/index.php?option=com_content&view=article&id=39:st-vincent-and-the-grenadines&catid=1:the-caribbean&Itemid=2

Case Study 18: Mangrove Restoration on St. Vincent & the Grenadines

A *mangrove* is a tropical and subtropical shrub or small tree that grows in slow-moving, salty seawater, covered at high tide but uncovered at low tide, in which muddy sediment accumulates. A coastal habitat with lots of mangroves, other shrubs and other small trees is called a *mangrove swamp* or *mangrove forest* or *mangrove ecosystem.* There are about 80 species of mangrove worldwide. The total mangrove swamp area around the world covers about 53,200 square miles spread across 118 countries and territories.

Mangrove swamps used to cover vast areas of the Caribbean coastline but they have come under serious threat from human activity. This holds true for SVG where threats to mangrove habitats include: harvesting for charcoal, sand mining, coastal dredging, pollution from sewage, overfishing, using environmentally destructive fishing gear, and destroying mangrove coastline by infilling the swamps and obstructing water flows for the purpose of building tourist facilities. Today on SVG only scattered patches of mangrove swamp remain.

It is easy to recognize a mangrove swamp with its dense tangle of exposed roots that make the trees appear to be standing on stilts above the water. The tangle of roots allows the trees to cope with the rise and fall of tides that flood the swamp twice a day. The roots also slow down the movement of tidal waters allowing sediment to fall to the bottom so building up mud levels.

Mangrove roots, Union Island, SVG

The loss of mangrove swamps has had many adverse effects:

- With the destruction of the mangrove forests there is a loss of the protection they provide against the erosion of beaches and coastal land
- Loss of mangrove forests increases vulnerability to the effects of climate change and natural disaster (storm surges, tsunamis, high tide flooding) in that a vital buffer against sea incursion is taken away
- The intricate roots of mangroves provide food, shelter and a safe breeding ground and nursery for fish so that, when the mangrove is lost, there is a decline in fish stocks and fishing catches decline

- The loss of the mangrove ecosystem means a considerable decline in species diversity with the loss of the special aquatic plants, fish, shellfish, insects, amphibians, birds and mammals that inhabit the mangrove
- The removal of the mangrove swamp also adversely affects coral reefs that have relied on the mangroves to protect their rich biodiversity
- With mangrove loss there is greater coastal water pollution in that the swamp acts as a buffer or filter stopping land-based pollution discharging into the sea
- Mangrove swamp destruction means the loss of an important carbon sink, i.e. the mangroves store a lot of carbon and help slow the rise of CO2 levels in the atmosphere
- Loss of the mangrove forests is a deterrent to ecotourism, with consequent loss of tourism revenue.

Mangrove swamps can, in many places, be restored and, given SVG's increasing vulnerability to storm surges, sea level rise and coastal erosion there is a growing commitment to their re-establishment.

Ashton Lagoon, located on the south coast of Union Island in the Grenadines offers an example of what can be done. The lagoon, the largest bay in the Grenadines was very special, containing a richly diverse mangrove and coral reef ecosystem, including a long outer reef, a protected inner lagoon, sea grass beds, tidal mud flats, salt ponds and the largest continuous mangrove habitat in the region. Because of its environmental importance it was designated a Marine Conservation Area in the 1980s.

That did not stop an outside developer going ahead in the 1990s with the development of a marina that was to include a 300-birth marina with a causeway, a recreation center on Frigate Island in the lagoon, a large condominium complex on the outer reefs and a 50-acre golf course where the mangrove stood. This was done in the face of an environmental assessment that the development would cut off water circulation in the bay and wreak catastrophic environmental damage on the area.

The development went bankrupt in 1995 but not before huge damage had been done. The causeway built across the lagoon had reduced water flow to destructive effect smothering the coral reefs in mud. The mangrove was in seriously unhealthy condition; the water stagnant and polluted; habitats destroyed. What the developer left behind was described as 'the worst environmental disaster in all of St. Vincent and the Grenadines'.

Plans for restoration were first floated in 2004 and put into effect from 2007 by Sustainable Grenadines in partnership with other non-governmental organizations and government ministries and, importantly, with enthusiastic local community involvement. The aim of the Ashton Lagoon Restoration Project is to restore life to the lagoon including the mangroves and coral reefs, provide habitats for wildlife whilst also providing sustainable livelihood opportunities for some of the 80% of the population of Union Island who are dependent on the marine and coast environment. Project outputs include:

- Actions to restore natural circulation of water through the lagoon and through the mangrove (culverts under roads, making breaches in the causeway)

- Planting of 3000 red mangrove trees
- A Climate Change Interpretative Centre as a platform for education and community outreach and involvement
- Climate change and lagoon restoration awareness activities for visitors
- Training of local guides to conduct sustainable ecotourism activities within the lagoon
- Comprehensive and sustained monitoring of restoration progress, water quality, habitat improvement and species numbers by field researchers

A primary intention is to contribute to disaster risk reduction and climate change adaptation on Union Island by offering protection against storm surges, tsunamis and high seas. Another is to ensure livelihoods for local people through sustainable tourism and the provision of other new forms of employment, such as sea moss cultivation and bee keeping.

Mangrove restoration is happening in other parts of SVG such as the South Coast Marine Conservation Area on mainland St Vincent. It is important to note how much community participation is core to such developments. A key question for SVG schools and their students is 'how can we become involved and lend our weight to mangrove restoration efforts?'

Mangrove protection and restoration is a prime example of a 'natural solution' to climate change where nature conservation and restoration allied with good land management can increase carbon storage and otherwise avoid or reduce greenhouse gas emissions. Natural solution approaches are not so much an alternative to but rather complementary to the development of renewable energy technologies as a means of combatting climate change.

References

Buckmire, T. (2014). *Report on Mangrove Assessment Visit to St. Vincent.*

Brighton Mangrove Swamp, St. Vincent and the Grenadines.
https://www.youtube.com/watch?v=0WdCE_NObvc

Dasgupa, S. (2018). *Why Mangroves Matter: Experts Respond on International Mangrove Day.*
https://news.mongabay.com/2018/07/why-mangroves-matter-experts-respond-on-international-mangrove-day/

ECOVIVA. (2016). *7 Reasons Mangroves Matter.*
https://ecoviva.org/7-reasons-mangroves-matter/

SusGren, Phillp Stephenson Foundation, USAID and TNC. (u.d.).*Ashton Lagoon Restored after 24 Years of Severe Degradation.*
https://bb.usembassy.gov/ashton-lagoon-restored-after-24-years-of-severe-degradation/

Sustainable Grenadines Inc. (u.d). *Ashton Lagoon Restoration Project.*
http://agriculture.gov.vc/agriculture/images/stories/Agriculture/pdf_documents/Ashton-Lagoon-Restoration-Project-Status.pdf

WWF. Mangrove Importance.
http://wwf.panda.org/our_work/oceans/coasts/mangroves/mangrove_importance/

Case Study 19: Alternative Sources of Energy

The National Energy Policy (NEP) aims to develop non-oil energy resources, and so avoid possible impacts from fluctuations in the supply and price of oil. At present 20% of electricity is produced by hydro electric power (HEP), although this is prone to shortages on account of droughts. Overall St Vincent Electricity Services Limited (VINLEC), is encouraging the move to renewable energy with a wind farm and small scale wind turbine developments on the drawing board.

Hydro Electric Power

VINLEC operates 5.7 megawatt (MW) of installed hydro plant, of which 3.3MW came online in 2012. While studies of the island's remaining hydro potential have been conducted, no concrete steps to construct additional plants have been taken.

Solar

The government of St Vincent and the Grenadines has implemented several tax benefits and exemptions specific to SVG residents for the purchase of solar panels. In 2019 VINLEC opened a solar plant on Union Island, which is intended to produce 32% of the electricity the island requires. The plant displaces 320,000 litres of diesel fuel per year, so will pay for itself in 6 years.

Electricity on Union Island can now be produced using solely solar photovoltaic (PV) and battery energy storage (Searchlight)

Geothermal

In 2019 the first geothermal site was built in the Soufrìere Hills, by the St Vincent Geothermal Company Limited, owned by Reykjavik Geothermal and the Government of St Vincent. The programme is supported by other countries,

including the US, UK and Japan. The plant has a 10 MW output and can supply the baseload power for the nation. This will mean 73% of the country's energy comes from renewable sources.

Geothermal Plant, La Soufrière Hills
(Photo: S. Pike)

References

Caribbean Dev Trends. (2019). *Saint Vincent and the Grenadines' Energy Market.* https://blogs.iadb.org/caribbean-dev-trends/en/saint-vincent-and-the-grenadines-energy-market/

Searchlight. (2019). *Historic day on Union-Island*. www.searchlight.vc/searchlight/press-release/2019/04/16/historic-day-on-union-island-with-electricity-produced-solely-from-solar/

Think GeoEnergy. (2019). *Preparation started on drill site for geothermal project in St. Vincent and Grenadines*. www.thinkgeoenergy.com/preparation-started-on-drill-site-for-geothermal-project-in-st-vincent-and-grenadines

World Data. (2019). *Energy consumption in Saint Vincent and the Grenadines*. www.worlddata.info/america/stvincent-grenadines/energy-consumption.php

Case Study 20: Climate-Smart Agriculture

Agriculture is one of the major economic activities on St. Vincent and is vital to the livelihoods of many poorer rural populations. This is in contrast to the Grenadines where agricultural practice is limited on account of geological and environmental conditions. On St Vincent the agriculture sector is largely based on banana production, but with additional crops of arrowroot, sweet potatoes, eddoes, tannias, yams and coconuts.

The agricultural sector is highly vulnerable to the changing climate, especially extended periods of drought, unevenly distributed rainfall patterns and increasing natural disasters. The changing climatic conditions have been affecting the productivity and quality of crops. The reliance on just one crop and the small-scale of the farms leaves the sector economically vulnerable. Small farmers typically have little or no insurance and are ill equipped to deal with the impacts of climate change.

While conventional agricultural and development interventions tend to treat food security, climate change mitigation and adaptation and livelihood improvement separately, more integrated approaches have been developed, the most common of which is called climate-smart agriculture (CSA). CSA seeks to transition toward more climate-resilient production systems and more sustainable livelihoods in the context of climate change. According to the UN Food and Agriculture Organization (FAO), the three pillars of CSA interventions are intended to:

- Sustainably increase agricultural productivity and income (i.e. strengthen livelihoods and food security, especially of smallholders)
- Adapt and build resilience to climate change
- Reduce and/or remove greenhouse gases emissions, where possible and where appropriate.

In SVG, climate-smart agricultural strategies, practices and techniques have been employed and promoted by the Richmond Vale Academy (RVA). RVA is a non-profit educational institution that seeks to train local and international youth and farmers in climate change, food security and poverty reduction through on-farm education. It is located on 30 acres of farmland the leeward coast of St. Vincent.

Sustainable agricultural techniques employed at RVA include the following:

- *Organic production and diversification*: From 2012 to 2016 the use of chemicals at RVA was gradually eliminated. A variety of herbs and flowers (e.g. rosemary, thyme, chives, aloe, marigolds) have been planted along the boarder of the vegetable beds to deter pests. Non-fossil fuel based bio-repellents (e.g. cayenne, garlic) are applied to plants with a spray can. Some crops are being introduced as pest repellants, while other crops are being cultivated to assist in nitrogen fixation in the soil. Livestock graze in specific and strategic areas to assist with weed removal, this also allowing for the spread of manure as organic fertilizer to revitalize and maintain the pH balance of the soil.

- *Integrated farming*: A system of continuous intercropping is used, mixing up different plant families within each bed. These are planted in a guild system by which species of plants are grouped together to provide mutual benefits to the group as a whole. Benefits of guild planting include protecting species from potential pest problems and improving nitrogen levels in the soil.

- *Renewable energy*: RVA has introduced an off-grid photovoltaic solar panel system so as to become energy self-sufficient and to remain operational especially in the event of a central system electricity failure due to climate change events or other hazards as well as to reduce the Academy's fossil fuel footprint.

- *Erosion control:* New swales (i.e. shallow trenches dug along the land's contour line horizontally) have been constructed in the areas prone to erosion damage. The swale slows run-off water whilst recharging ground water and providing extra nutrients and water for trees and other productive and support species planted along the swale.

- *Water harvesting, recycling and management*: RVA has a rainwater harvesting system that collects rainwater from the roofs of the Academy and stores it in a 150,000-liter capacity pool. Four gravity-fed mega tanks have been constructed to allow for the reuse of water from showers, washing machines and sinks at RVA. Recycled water is channeled to irrigate specific crops.

- *Agroforestry*: Trees have been incorporated into the farming system to help sequester (i.e. capture) carbon and other nutrients, such as nitrogen, and to improve soil health. The orchard is being converted into a thriving food forest by increasing diversification in layers and enhancing productivity. An organic banana patch on half an acre, where gliricidia trees existed, has been established. The gliricidia branches are periodically cut and dropped to enhance the soil around the bananas. The plan is to add vanilla and cacao trees, together with other support species, so biodiversity in the field is increased.

Organic banana patch with gliricidia trees (Richmond Vale Academy)

- *Mulching and composting*: Dry leaves and other organic matter (gliricidia leaves and vetiver grass) are left to decompose on agricultural beds, and help to increase soil fertility and composition. This, combined with other practices, optimizes nutrient flow through the production system. This helps ensure that the crops cultivated can grow and be nurtured without the use of chemicals,

while the continuous enrichment of the humus layers creates a buffer against harsh climatic conditions. Erosion from heavy rainfall is avoided and soil moisture is maintained during dry conditions.

RVA's efforts have helped farmers increase awareness and knowledge of sustainable and climate-smart agricultural practices, which leads them to enhance their productivity and increase their income while protecting and conserving their environment.

References

Caribbean Climate Smart Agriculture Forum. (n.d.) *County Profile St. Vincent & the Grenadines. Climate Change and Agriculture: Policies, Strategies and Actions* http://repositorio.iica.int/bitstream/11324/7052/1/BVE18040212i.pdf

CARIBSAVE Partnership. (2012). *CARIBSAVE Climate Change Risk Profile for St. Vincent and the Grenadine.* *https://www.researchgate.net/profile/Mark_New/publication/272791668_Climate_Change_Risk_Profile_for_Saint_Vincent_and_the_Grenadines/links/55fa74f708ae07629e007648/Climate-Change-Risk-Profile-for-Saint-Vincent-and-the-Grenadines.pdf*

Richmond Vale Academy. https://richmondvale.org/en/

Richmond Value Academy. (u.d.). *Climate Smart Agriculture in St. Vincent and the Grenadines: A Brain-Stormed Organic Approach to Agriculture.* http://repiica.iica.int/docs/B4154i/B4154i.pdf

Case Study 21: Youth Action on Climate Change and the Environment

The Caribbean Youth Environment Network (CYEN), founded 2010, is an organisation which focuses on empowering young people and their communities to develop programmes to address socio-economic and environmental issues. The organisation works especially with young people aged 15-29 years and is the largest youth environmental group in the Caribbean. It includes organisational and individual members from across the Caribbean including from St. Vincent and the Grenadines. CYEN's programmes aim to address issues such as poverty alleviation, youth employment, health, climate change, disaster resilience, integrated water resources management, waste management and other natural resource management issues in the context of sustainable development. Their projects include educational, capacity building and entrepreneurship projects focussed on climate change and related environmental issues. They particularly work to ensure youth participation in decision making relating to climate change and environmental issues. CYEN is a member of Climate Action Network, an international network of organisations taking action on climate change.

Students of Bishops College Kingstown planning seeds

One of the projects run by the CYEN is the Caribbean Youth Climate Change Mitigation Project. This project seeks to foster Caribbean youth who are knowledgeable about climate change, competent advocates and lobbyists for climate change mitigation and who have also developed entrepreneurial skills to the extent that they can capitalise on business opportunities related to climate change. The project utilises the media and other innovative communication methods such as popular cultural activities to raise awareness and increase actions on issues relating to climate change mitigation. CYEN has also ensured youth representation in different international fora. Other initiatives have facilitated youth environmental action including for example in Earth day activities, in tree planting and in beach clean-ups. Paget Farm Government Primary School in Bequai for example, has been involved in regular community beach cleaning actions. Similarly, the Sandwatch programme has brought together school students, teachers and local communities to monitor their coastal environments; identify and evaluate the threats, problems and conflicts facing them; and develop sustainable approaches to address them. [See *Case Study 17*]

Greta Thunburg in August 2018 outside the Swedish parliament, holding a sign that read "Skolstrejk för klimatet" ("School strike for the climate").

At an international level, young people have been at the forefront of efforts to bring about urgent climate action. The School Strike for Climate, also known as Fridays for Future, is an international movement of school students demonstrating to demand action on climate change. The movement was inspired by the protest of the 15-year-old Swedish girl Greta Thunberg. In August 2018, Greta Thunberg sat in front of the Swedish parliament every school day for three weeks, to protest against the lack of action on the climate crisis. She publicised her actions using social media. From September 2018 Greta continued her protest by striking every Friday and calling on the Swedish government and other leaders to take action on climate change.

Inspired by Greta Thunberg strikes have been organised by student groups around the world on a regular basis, since November 2018. On 15 March 2019, school strikes, urging adults to take responsibility and stop climate change, took place in over 2000 cities. An estimated number of more than a million people in about 130 countries demonstrated at about 2200 events worldwide.

Climate strike in Wellington, 2019

The strikes have been widely supported by climate scientists. Thousands of researchers from across Europe have signed open letters in support of the young protesters.

Transcript of speech made by Greta Thunberg to the UN Climate Change COP24 Conference in December 2018.

My name is Greta Thunberg. I am 15 years old. I am from Sweden. I speak on behalf of Climate Justice Now. Many people say that Sweden is just a small country and it doesn't matter what we do. But I've learned you are never too small to make a difference. And if a few children can get headlines all over the world just by not going to school, then imagine what we could all do together if we really wanted to.

But to do that, we have to speak clearly, no matter how uncomfortable that may be. You only speak of green eternal economic growth because you are too scared of being unpopular. You only talk about moving forward with the same bad ideas that got us into this mess, even when the only sensible thing to do is pull the emergency brake. You are not mature enough to tell it like it is. Even that burden you leave to us children. But I don't care about being popular. I care about climate justice and the living planet. Our civilization is being sacrificed for the opportunity of a very small number of people to continue making enormous amounts of money. Our biosphere is being sacrificed so that rich people in countries like mine can live in luxury. It is the sufferings of the many which pay for the luxuries of the few.

The year 2078, I will celebrate my 75th birthday. If I have children maybe they will spend that day with me. Maybe they will ask me about you. Maybe they will ask why you didn't do anything while there still was time to act. You say you love your children above all else, and yet you are stealing their future in front of their very eyes.

Until you start focusing on what needs to be done rather than what is politically possible, there is no hope. We can't solve a crisis without treating it as a crisis. We need to keep the fossil fuels in the ground, and we need to focus on equity. And if solutions within the system are so impossible to find, maybe we should change the system itself. We have not come here to beg world leaders to care. You have ignored us in the past and you will ignore us again. We have run out of excuses and we are running out of time. We have come here to let you know that change is coming, whether you like it or not. The real power belongs to the people. Thank you.

Environmental activists in the Carribbean are now linking with the youth organization, Extinction Rebellion through its International Solidarity Network. So far, SVG youth have not been directly involved.

References

http://cyen.org/

http://www.climatenetwork.org

https://www.fridaysforfuture.org/

https://www.schoolstrike4climate.com

https://en.wikipedia.org/wiki/School_strike_for_climate

https://www.bequiatourism.com/green.htm

Case Study 22: National Emergency Management Organisation (NEMO)

Launched in 2002 and statutorily constituted by the *National Emergency and Disaster Management Act of 2006*, the National Emergency Management Organisation (NEMO) is a governmental department in the Ministry of National Security, Air and Sea Port Development. NEMO is the central agency for disaster management administration and coordination within the network of management and governance systems established by the *Act*.

NEMO works to raise disaster risk awareness, prevent and mitigate disasters, to respond effectively to save lives and property during disasters and to help recovery from the impact of disasters in the shortest time possible during the post-disaster or post-emergency phase. NEMO is an executive body with core staff (as of June 2019, 11 members) and has year-round functionality in national disaster management.

Key organizational structures of NEMO include the following:

Key Organizational Structure of NEMO (NEMO)

- *National Emergency Council (NEC)*: Chaired by the Prime Minister and consisting of Ministers of key government agencies, NGO officers, the private sector and other specialist groups, it oversees the entire disaster management of the country.

- *National Emergency Executive Committee (NEEC):* Chaired by the Director of NEMO and consisting of ministerial representatives and other key stakeholders, it plays a supervisory role and works through a network of ten sub-committees to ensure disaster prevention, mitigation, preparedness, response and recovery initiatives at all levels.

- Ten national sub-committees, with reporting responsibilities to the NEEC and with special functions, include: Rehabilitation and Reconstruction; Shelter and Reconstruction; Public Information, Training and Education; Emergency Supplies; Emergency Communication; Transport and Road Clearance; Damage and Needs Assessment; Health Service; Voluntary Services; Search and Rescue Source.

- The *National Emergency Operation Centre (NEOC):* During a disaster alert or disaster, ENOC is convened and becomes the hub of initial relief activity coordination.

The SVG *National Emergency Management Plan* of 2005 further defines NEMO's role in the following six activity categories:

- *Training:* Identifying skills necessary to implement a national disaster management program and sourcing appropriate trainers
- *Informing:* Developing and disseminating information packages to help individuals, government entities and the private sector to better cope with emergencies
- *Warning:* Analysing and forecasting potential hazards
- *Coordinating:* Coordinating disaster preparedness, response and rehabilitation and enabling resources to be effectively applied during and after a disaster
- *Warehousing:* Providing and maintaining extraordinary resources and stocks to meet emergency needs
- *Evaluating:* Conducting annual performance reviews and designing performance improvement measures

In addition to the coordination of disaster management activities with government agencies and bodies, NEMO integrates non-state actors (charitable, religious, private sector and volunteer organisations) into disaster management in SVG.

NEMO has several programs involving schools. For instance, they organize awareness raising activities such as a Volcano Awareness Week and offer the school and community Tsunami Awareness program. In 2019 they have offered an earthquake simulation exercise. NEMO officers go to schools to talk about hazard-related topics upon invitation. Their range of awareness raising activities goes from pre-school levels to community and tertiary education levels and to teacher training.

Activities involving students during the Volcano Awareness Week in 2018 (above) and 2019 (below) (NEMO)

NEMO conducts awareness raising activities focus on different hazards in different months throughout the year: tsunamis in February and March, volcanoes in April, hurricanes and hydro/meteorological hazards from May to November and earthquakes in October.

References

NEMO. http://nemo.gov.vc/nemo/

NEMO. (2005). *St. Vincent and the Grenadines: National Emergency Management Plan*. http://www.sela.org/media/266330/t023600004180-0-st_vincent_and_the_grenadines_national_disaster_plan-_2005.pdf

National Emergency and Disaster Management Act 2006. https://www.preventionweb.net/files/9606_NATIONALEMERGENCYANDDISASTER.pdf

Case Study 23: Central Water and Sewerage Authority (CWSA)

Established in 1970, the Central Water and Sewerage Authority (CWSA) is a statutory body under the SVG Ministry of Health, Wellness and the Environment. Its mission is to 'provide its customers with the highest quality water supply, sewerage and solid waste management services in an efficient and affordable manner.'

The Central Water and Sewerage Authority Act No.17 of 1991 lays out the function of CWSA: to investigate the water resources of St. Vincent and the Grenadines and to advise and make recommendations to the Minister relating to the improvement, preservation, conservation, utilization and apportioning of these resources. The Act also indicates that CWSA will control water usage for irrigation, agriculture, industrial and commercial purposes. CWSA's responsibilities also include production and distribution of potable water on St. Vincent (98% water supply coverage).

CWSA's Engineering Department focuses on major capital projects, operations and maintenance of the water supply system, water resource management, geographic information systems management, laboratory provision for testing requirements and sewerage management.

CWSA employees and volunteers repairing water pipes in the Buccament Bay area (The Vincentian)

CWSA's National Water Resource Management Unit (WRMU) operates and maintains a water monitoring network which includes 26 rain gauges, 10 water level sensors, 5 climate stations and 25 groundwater sampling points. A wide range of hydrological and meteorological monitoring parameters are used in the upper and lower watersheds. The parameters include rainfall, evaporation, relative humidity, solar radiation, barometric pressure (i.e. the force per unit area exerted by the weight of the atmosphere), wind speed, maximum and minimum temperature, soil temperature, water level and oxygen content. Some data can be downloaded from the CWSA website: http://www.cwsasvg.com/wrmu.html

In terms of solid waste management, the Solid Waste Management Unit (SWMU) of CWSA is responsible for providing waste collection and disposal services to its domestic, commercial and institutional customers. There are five disposal sites in SVG, two on St Vincent and three in the Grenadines.

Waste Volume Statistics in 2015

Disposal Site	Location	Total Volume of Waste(m^3)
Diamond Landfill	St. Vincent	124,120
Belle Isle Landfill	St. Vincent	16,223
Raintree Landfill	Bequia	6,470
Taffia Landfill	Canouan	17,853
Clifton Landfill	Union Island	1,972

Household waste collection continues as a weekly service on mainland St. Vincent and as a twice-weekly service in Grenadines. In 2011 SWMU started free island-wide white goods collection service twice a year. 'White goods' refers to household appliances and furniture such as fridges, cooking stoves, washing machines and chair sets. This service aims at preventing illegal dumping of such household items. To reduce the volume of littering and illegal damping, SWMU promotes collection, processing and export of plastic bottles and other recyclables. Recyclable scrap metal is stockpiled at Diamond Landfill for processing through the SWMU scrap metal program. SWMU's also supports compost production.

CWSA's Public Relations and Marketing Department offers public awareness and education activities focusing on water, waste management, environmental protection and disaster preparedness through radio (NBC Radio, WE-FM), TV, community outreach programs, social and printed media, school programs, summer programs for children, an annual Water Week, an annual National Waste Management Symposium and local clean-up activities

Students from the Vinsave Summer Program (CWSA)

A CWSA sponsored clean-up (CWSA)

References

CWSA. http://www.cwsasvg.com/index.html

CWSA. (2012). *Annual Report 2012.* http://www.cwsasvg.com/financials/CWSA%20Annual%20Report%202012.pdf

CWSA. (2014). *Annual Report 2014.* http://www.cwsasvg.com/financials/CWSA%20Annual%20Report%20-%202014.pdf

CWSA. (2015). *Annual Report 2015*. http://www.cwsasvg.com/financials/2015%20CWSA%20Annual%20Report.pdf