Vulnerability Assessment of the Agricultural Sector Of Saint Vincent and the Grenadines

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1.0 Introduction

The Inter-American Institute for Cooperation on Agriculture (IICA) is the implementing agency of a project entitled "***Reducing the Impact of Climate Change on Agriculture: Institutional Capacity to Promote and Support Climate Smart Agriculture in the Caribbean Region***". The project has its genesis in the recognition that the Caribbean region is extremely vulnerable to climate change and its associated effects. According to the project document: ". Six of the 20 countries with the highest mortality risk from multiple hazards are in the Caribbean, and between 1991 and 2010, nine of the top 20 greatest losses to natural disasters worldwide (measured as a percentage of GDP) were also in the region. Losses from disaster are likely to be exacerbated by the region's vulnerability to the effects of climate change, including sea level rise and increases in extreme high and low rainfall events, hence, Climate Change (CC) resilience needs to be built systematically into new policies, strategies and projects."
The need for adaptive mechanisms for climate change adaptation will be required in all areas of the Caribbean. However, it can be argued that the urgency for these mechanisms in the agriculture sector is a greater priority than the other sectors because of its contributions to the Gross Domestic Product (GDP) of the countries, local employment and food security. The project therefore recognizes this need and seeks to address this situation by utilizing funds towards the development and execution of national and regional climate change adaptation policies to limit the adverse impacts of changes in the micro climate.

The project has the involvement of six (6) participating countries namely: Dominican Republic, Dominica, Grenada, Jamaica, St. Lucia, and St. Vincent and the Grenadines.
Component 2 of the project proposes to develop the *"institutional capacities of both public and private agriculture related institutions in improving the enabling environment to promote and support Climate Smart Agriculture."* In fulfilling this component's results, a vulnerability study on the agricultural sector of the participating countries was conducted. The study is focusing on the vulnerability of the selected priority agriculture subsectors and the institutional capability to effectively promote national adaptation to climate change.

In Saint Vincent and the Grenadines (SVG) the vulnerability assessment study began in March 2014 and concluded in May 2014. SVG does not have a national climate change strategy for agriculture nor any formal programs or policies to address the issue directly. There are however some programs and activities within its overall programs and plans that intersect with climate change response, mainly in the forestry sector. In addition, there are several other studies, especially work done by and for the Ministry of Health and Environment that addresses the overall impacts of climate change on the local environment and biodiversity of SVG. Among the climate change documents are the National Communications on Climate Change documents, the Fourth National Biodiversity and Strategic Action Plan.

With limited quantitative data on the impacts of climate change on the sector, a qualitative assessment was done on the three main sectors (agriculture, forestry and fisheries). A further assessment and sensitivity test was conducted on the priority sub-sectors within the agriculture

sector that comprises the crop and livestock subsectors. The vulnerability assessment results are presented herein. This document will contribute to Component 2 of the project and aid in meeting the general objective of the project.

1.1 Saint Vincent and the Grenadines: An Environmental and Economic Profile

St Vincent and the Grenadines: An Environmental Profile:

Saint Vincent and the Grenadines (SVG) is an archipelago nation consisting of approximately 32 islands and cays. Only the major islands are inhabited namely, St Vincent, Bequia, Canouan, Mustique, Mayreau, Palm Island, Petit Saint Vincent and Union Island. The total land area is approximately 389 square kilometers. Saint Vincent at 344 square kilometers is the largest island and is usually considered the mainland.

The terrain of SVG is very rugged with steep slopes and ridges. Fifty per cent of the slopes are 30 degrees or more and another 20 per cent less than 20 degrees (Baker 1981 cited in CCA 1991). The volcanic origin of the island is the main geological determinant of the terrain and resulted in a central north-south mountain terrain which ends in the north with the La Soufriere volcano.

The climate of the island is one of a tropical nature with average monthly temperatures of 26.7 degrees Celsius. Most of the rainfall occurs on the windward side of the island. The climatic conditions of the island give rise to a forest cover of upper and lower Montane forests. The forest cover is linked to a number of diverse watersheds.

Watersheds are an important component of the physical landscape of the island. There are 13 main watersheds which generate the country's fresh water supply. These 13 main watersheds yield approximately 12,000,000 (cu.m/yr) of water (John 2006). In addition to providing water for domestic use, commercial purposes and the generation of electricity, the watersheds also play many important environmental and ecological functions. Watersheds are integral to the maintenance of the forest cover and essential in soil and slope stability. It's also on these watersheds that the agricultural sector depends for the cultivation of crops and rearing of livestock.

SVG's biodiversity consists of several endemic island flora and fauna species. The island's endemic flora and fauna consist of more than 150 species of birds. The St Vincent Parrot (Amazona guildingii) has been the major symbol for the protection and conservation of the rainforest in Saint Vincent. The Whistling Warbler ((Catharopeza bishopi) is another species endemic to the island's fauna. Other species of birds include: Flycatcher (Myiarchus nugator) and Lesser Antillean Tanager (Tangara cucullata) restricted to St Vincent and Grenada, Rufous-throated Solitaire (Myadestes genibarbis sibilans), a subspecies of House Wrens (Troglodytes aedon musicals).

In addition to the avian wildlife, the island also boasts a number of mammalian species such as rats, mongoose, three species of snakes including one specie that is endemic. Plant life on the islands of SVG consists of more than 1,150 species of flowering plants, 163 species of ferns, 4 species of amphibians, 16 species of reptiles and 15 species of mammals.

The island's biodiversity is under threat from a number of sources, including habitat fragmentation, over-use of agro-chemicals, and introduction of new species, hunting, exotic pests and diseases and the expansion of urban areas.

1.1.1 Saint Vincent and the Grenadines: Social and Economic Profile

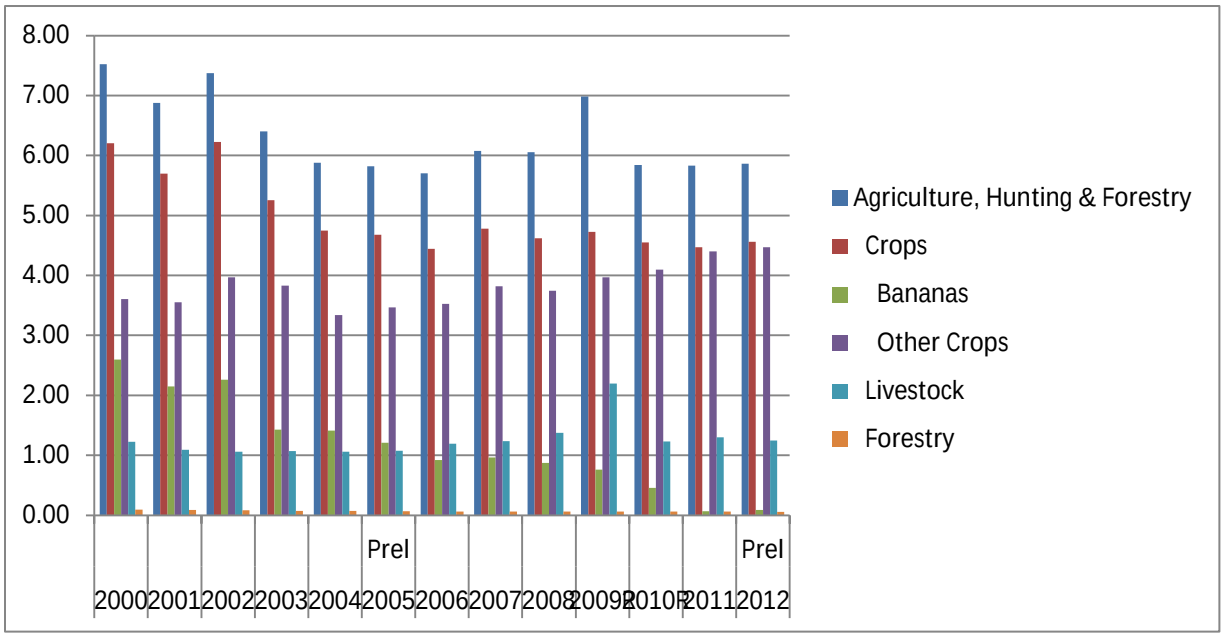
According to the Caribbean Development Bank (CBD) (2013) SVG has an estimated population of 103,537. With an estimated GDP of 1.264 billion USD the country is considered a middle income country. Economic growth in 2011 and 2012 was recorded at 0.4% and 1.5 %, respectively (CDB 2013). The economy of the country is mainly based on construction, tourism, agriculture, mining and quarrying. SVG's economy has been threatened for the last four years by the global recession (GOSVG 2013). Tourism has emerged as the leading sector of the economy, contributing to employment creation, incomes and tax revenues. The country is heavily dependent on capital flows from foreign direct investments, grants, loans and remittances.

Poverty level indicators for the country in 2008 were at an Index of 30.2, Indigence Levels of 2.9 and a Vulnerability Index of 48.2. The country also recorded a Poverty Gap Index of 7.5 and a Gini coefficient of inequality of 0.402 (KAIRI 2008). In 2013 the country was ranked 83 out of 187 countries in the United Nations Human Development Index.

St Vincent is plagued with high levels of unemployment and a large informal sector. Unemployment is especially high in rural areas with the decline of agriculture as the dominant economic sector. Higher levels of rural unemployment have forced many individuals to opt out of the formal economy and pursue alternative activities including marijuana production in the forested areas of St Vincent. (KAIRI 2008).

1.2 SVG Agricultural Sector

The Ministry of Agriculture, Draft Policy, Framework, and Strategic Plan for Agricultural Development 2010-2020 identifies the vision of the agriculture sector as: An agriculture (farming, forestry, and fishing) sector that is innovative, internationally competitive and efficient in the management and use of all resources for the long-term benefits of citizens. (Ministry of Agriculture, Forestry and Fisheries 2009. p. 5). The policy focus for the sector is its diversification around the declining banana industry and increase production and exports of root crops, fruits and vegetables. The emphases are on agricultural entrepreneurship and the conservation of national resources.



PERCENTAGE OF CONTRIBUTION OF GROSS VALUE ADDED BY ECONOMIC ACTIVITY AT BASIC PRICES IN CONSTANT 2000 – 2012 (X-axis > YEAR) (Y-axis > PERCENTAGE)

Source: **http://www.stats.gov.vc/** *

SVG once depended heavily on agriculture, which was the basis of the economy for several decades. However, similar to most islands of the Eastern Caribbean, this situation changed due to two main factors; the decline of the banana industry, mainly due to the loss of the preferential market access in Europe and the national shift to tourism and services as the focus of economic development. In 2002, agriculture contributed 6.96 percent to the GDP. Over the next 10 years the contribution fluctuated to a slight decline of 6.77 percent in 2012[1]. Despite the declining contribution of agriculture to the national economy, the sector continues to play a significant role in the country in terms of food security, rural employment and social stability and in the case of

[1] (Central Statistical Office, Ministry of Finance and Planning)

the forestry sector, important ecological services (which are not measured in the calculation of GDP).

The agriculture sector is divided into three main sub-sectors: 1) Agriculture (Crop Cultivation and livestock), 2) Forestry, 3) Fisheries.

The SVG agricultural sector is characterized by small farm size holdings. According to FAO 2008, 27 percent of the farms were under 2.0 ha, 23 percent between 0.4 and 1.0 ha, 49 percent between 1 and 2 ha. Farms in size between 20.2 and 40.5 ha were 0.25 percent. Farms above 40 ha were 0.12 percent. There is a high percentage of ownership of farms at 73 percent. Farms rented were 22 percent and a small percentage came under various other agreements. Whilst at first glance farm ownership appears to be very high the figure may also comprise incidences of undocumented ownership as well as land that is considered "family" lands (Ministry of Agriculture (2009).

In SVG 4101 ha of land is presently under cultivation of a total agricultural area of 10,000 ha (FAO (2008). Despite the under-utilization of the agricultural lands there are some concerns of the loss of agricultural lands to other activities particularly housing development.

Bananas, vegetables and fruits, root and tuber crops and arrowroot are the main crops under cultivation. Food security is good for root crop (FAO 2008). Vegetable supply was seasonal. Arrowroot production is on the increase and there is also an overall increase in yam, dasheen and eddoe production with the highest production increases in plantain. As is expected, banana has steadily declined.

Livestock production continues to be challenged in some areas. The country is self-sufficient in pork and egg production. Despite increase organization in the poultry sector, the sector continues to under-produce and is unable to meet the needs of national consumption. Livestock production is semi-commercial with mostly small producers of ruminants. The production of ruminants is threatened by loss of farmlands to housing, praedial larceny and high levels of stray dog attacks on animals on the island (Ministry of Agriculture 2008).

SVG exports crops and livestock to regional markets, including Trinidad and Tobago and Barbados. In addition, exports of seafood and agricultural products are made to northern markets, including the United States and United Kingdom. Bananas produced under the Fair-trade facility continue to be exported to European markets.

The SVG agricultural sector is challenged by a number of factors that affect production. Praedial larceny of crops and livestock continues to be high and a source of frustration for farmers. The lack of irrigation facilities is also an issue for farmers. The irrigation facilities and feeder roads were poor prior to 2010. In 2010, Tropical Storm Thomas battered the irrigation infrastructure and the feeder roads. The irrigation facilities and roads further suffered under the Christmas trough system on 25th December 2013. The limited feeder roads pose a problem of access to farm lands. The agro- sector continues to face crop pests and diseases. Among the diseases are black sigatoka leafspot of bananas, tannia burning disease, pink mealy bug, mango seed weevil, and grubs in sweet potatoes among others. The limited research and extension capabilities of the Ministry of Agriculture constrain its ability to respond to the many challenges faced by the sector.

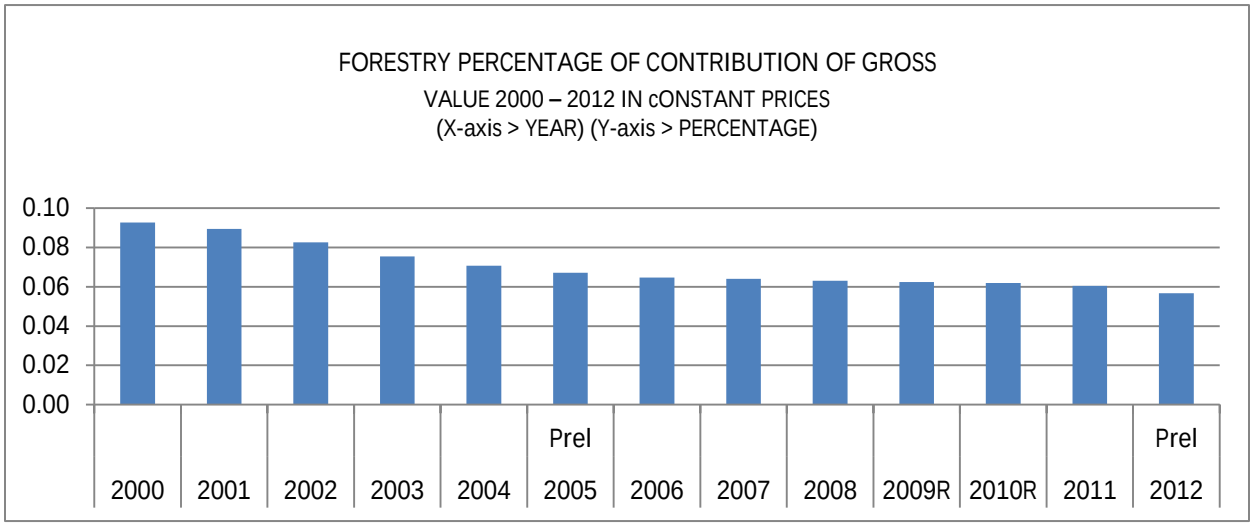
The high cost of agricultural inputs, limited availability of skilled labour, limited processing ability to create value added products and lack of access to agricultural credit and crop insurance are further problems that plague the sector. With regard to credit, in 2014, the Ministry of Agriculture has implemented a credit scheme that allows farmers to access loans to a maximum of 20,000 Eastern Caribbean Dollars (XCD) for farming activities.

1.2.1 Forestry Sub-Sector

SVG is covered by 25-30 percent forests. The forest cover has steadily declined over the years as a result of mainly human impacts. There are several forest types: Montane Rainforest, Coastal Dry-woodlands, littoral forest and Elfin Woodlands. Whilst forests do contribute to the national economy, its contribution is small compared to other sub-sectors. There are some commercial forest species such as Blue Mahoe and Mahogany. However, forests main contribution is that of ecological services which are not quantified economically. The forest cover is linked to the watersheds, natural sites that are used for tourism activities, soil health, irrigation, clean air and hydro-electricity generation.

The forests are also a source of livelihoods for a significant proportion of the population and especially persons in rural area. It is estimated that approximately 5000 persons in St Vincent are involved in marijuana cultivation in the forest highlands (GOSVG DATE). Livelihood activities that are dependent on the forests include charcoal production, local eco-tourism, and hunting and illegal crop production.

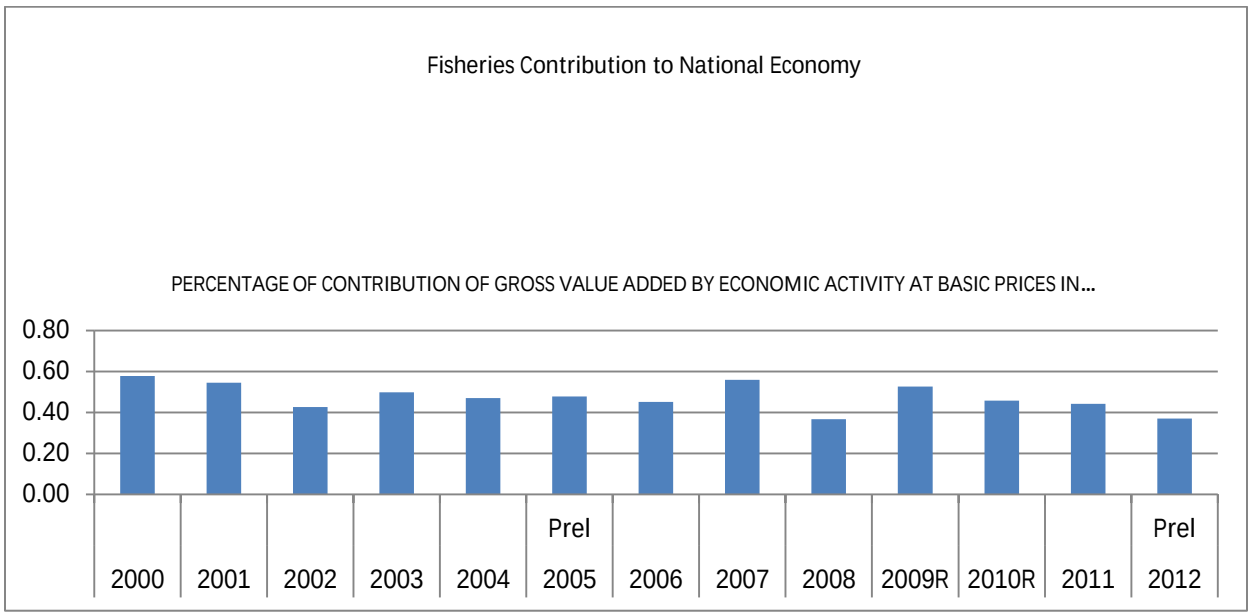
There is a general concern for the human impact on the forests which will be exacerbated by the variability of climate change. SVG has steadily lost forest cover over the past 10 years to less than one – fifth of its landmass and the trend seems to be continuing. The rapid loss of forest cover is mainly due to encroachment for mainly marijuana cultivation and other livelihood activities. Coastal forest types including mangroves are also impacted by settlement development in the coastal areas and pollution from the associated activities.

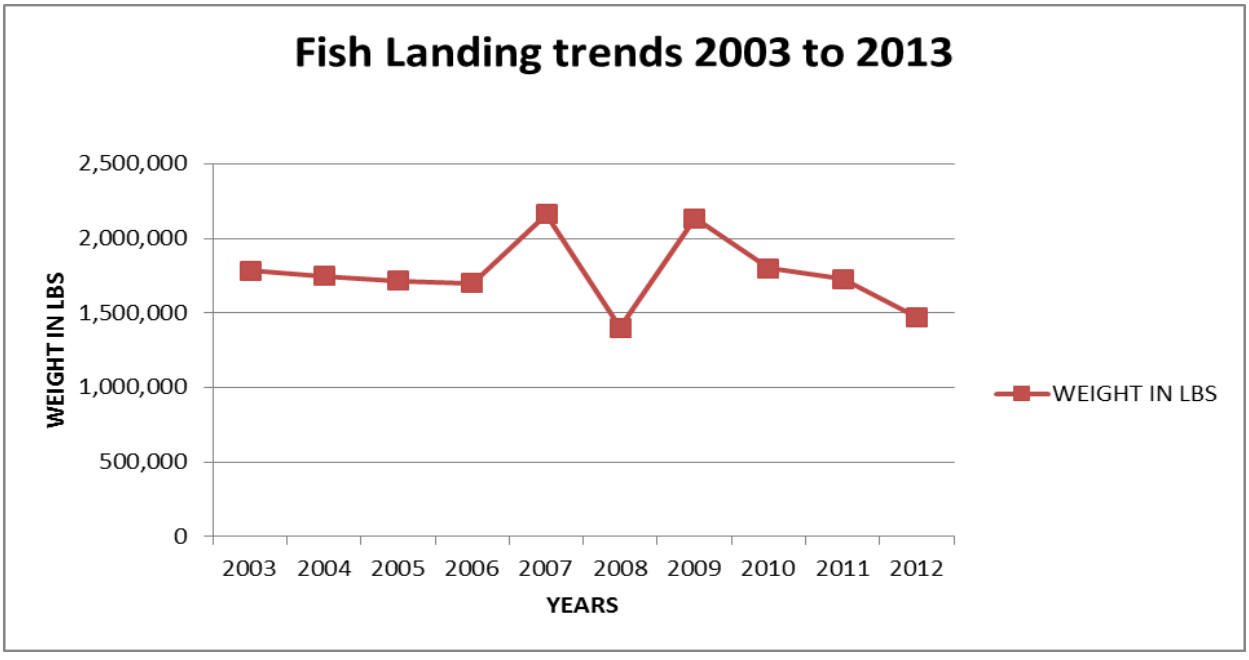


Source: http://www.stats.gov.vc/ *

1.2.2 Fisheries Sub-sector

SVG has the distinction of having more seascapes that landscape. Fishing therefore is an important part of the social and economic fabric of the country, especially the islands of the Grenadines. The country has an Exclusive Economic Zone of 27,500 Km square and a shelf area of 7,800 Km square. Fisheries sector contribution to the GDP was estimated at approximately **0.4% in 2012**.





Source: Department of Fisheries, Ministry of Agriculture

Fishing is an extremely important industry in the Grenadines and some rural communities on mainland St. Vincent.

The industry is predominantly small-scale and artisanal with most fishermen operating from small boats close to the shore. There are plans to migrate fishermen to larger boats capable of longer distances and longer stays. This move is expected to reduce pressure on the inshore fisheries and provide better returns to fishing effort. There are 36 landing sites (20 on the mainland and 16 in Grenadines), though most of these lack modern facilities for storage. These boats harvest a variety of demersal finfish and shellfish, large offshore and small coastal pelagic, turtles, mammals, crustaceans and a variety of freshwater fish. There is both an export and import market for fish, though the majority of the catch is sold locally. Export markets include the United States and Martinique.

The fisheries sub-sector is challenged by a number of issues including; pressure on inshore fisheries, pollution of marine environment due to land based activities, unsustainable methods of harvesting, safety and quality assurance for export markets and building the institutional, policy and legal frameworks of the sector, research and technical facilities and human resources. The development of marine protected areas such as the proposed South Coast Marine Park, present unique challenges of stakeholders conflict over resource use. The development of the protected areas also provides avenues for the sub-sector to collaborate with other agencies in the acquisition of resources, expertise, and technical knowledge to address some of the challenges of the sector.

The Ministry of Agriculture (2009) identified the strategic objectives of the sector as: reducing pressure on the inshore fisheries and increasing the returns to fishing effort; sustainable utilization of fisheries resources; sustainable aquaculture development; enhancing safety, quality assurance, value addition and marketing

1.3 Governance and Institutions of the Agricultural Sector

The Ministry of Agriculture Forestry, Fisheries and Industries is the primary governmental agency responsible for agriculture in SVG. The Ministry is headed by a Minister who sits in Parliament and participates in the Cabinet. The Minister is supported by a Permanent Secretary who is the administrative head of the Ministry. The Divisions of Forestry and Fisheries are headed by Directors, whilst the Agriculture Department is headed by a Chief Agricultural Officer.

As is expected the activities of the Ministry interact with a number of other governmental, non-governmental, regional and other international agencies in undertaking its mandate. Among these agencies are:

1) The Ministry of Health, Wellness and the Environment. This ministry is responsible for all environmental related matters, including biodiversity and climate change related matters. Other issues addressed by the ministry include sustainable land management, land degradation and both land and marine based pollution, health and Phyto-sanitary issues of food and food products.
2) National Emergency Management Organisation (NEMO) is the national agency responsible for disaster preparedness, management, response and relief.

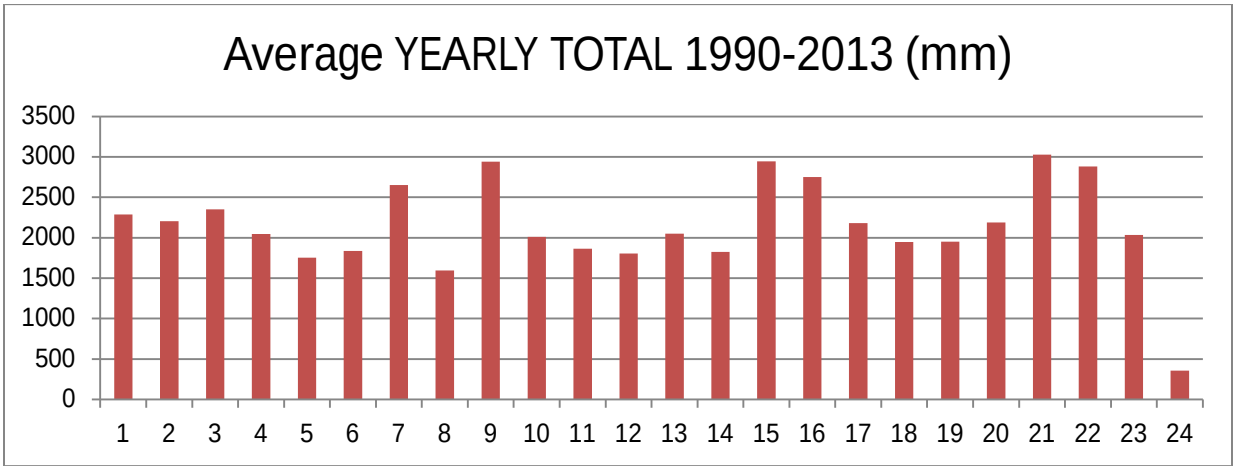
3) National Properties Ltd, which exists to assist in the development of private sector activities including managing state lands, agricultural production, agro-processing, supermarket retailing and export.
4) Winfresh is a regional association of Governments and Banana Growers Associations of the English-speaking Caribbean banana exporting countries. Its present focus is to stimulate export development of non-traditional exports.
5) WINFA is a regional association that presently administers the Fairtrade label for growers in the Windward Islands.
6) St Vincent and the Grenadines Bureau of Standards is responsible for the preparation, promotion, and implementation of national standards in relation to goods, services, processors, and practices. It supports agricultural and agro-processing by providing the laboratory testing facilities and guidelines on quality assurance and control
7) The Agricultural Input Warehouse is a governmental agency with exclusive rights to import sugar and also distributes fertilizers and other inputs to farmers. The AIW aims to reduce price volatility and prices of agricultural inputs sold to farmers.
8) Arrowroot Industry Association (AIA) -is the organization responsible for managing the industry and exporting arrowroot.
9) The Centre for Enterprise Development (CED) is a governmental non-profit company that provides business development services and training to the local private sector.
10) The Customs department manages the customs affairs of the country, including the requirements for import of agricultural inputs and export of agricultural products.
11) The Coast Guard involved in the enforcement of marine laws and especially important in the fisheries sub-sector.
12) Ministry of Housing, Informal Human Settlements, Physical Planning, and Lands and Surveys – has responsibilities for land management and tenure
13) The National Parks, Rivers and Beaches Authority (National Parks) has authority over both marine and terrestrial protected areas. It activities impacts both forestry and fisheries.
14) Ministry of Finance and Planning responsible for planning in the country, including land use planning and coastal zone planning. Planning is also the governmental implementing agency for international donor projects, for example, they are at present implementing a World Bank Funded project entitled "Disaster Vulnerability and Climate Risk Reduction Project in Saint Vincent and the Grenadines"
15) Regional institutions such as the Inter-American Institute for Cooperation on Agriculture (IICA), the Caribbean Agricultural Research and Development Institute, Caribbean Regional Fisheries Mechanism (CRFM), the Environment and Sustainable Development Unit of the OECS Secretariat all have some influence on the activities of the agricultural sector.
16) International organizations such as the International Whaling Commission (IWC) and the International Committee for the Conservation of Atlantic Tunas (ICCAT) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Literature Review Climate, Climate Variability and Climate Change

2.0 Climate of St Vincent and the Grenadines

SVG's size and location in the Caribbean region renders it susceptible to climatic influences. The island receives 219 cm of rainfall annually, making it one of the wettest islands of the Eastern Caribbean region (Ministry of Environment 2008). The island has two seasons, a wet and a dry season. The wet season occurs during the months of June to November and the dry season between December to May. The following variables are important in the climate of SVG:

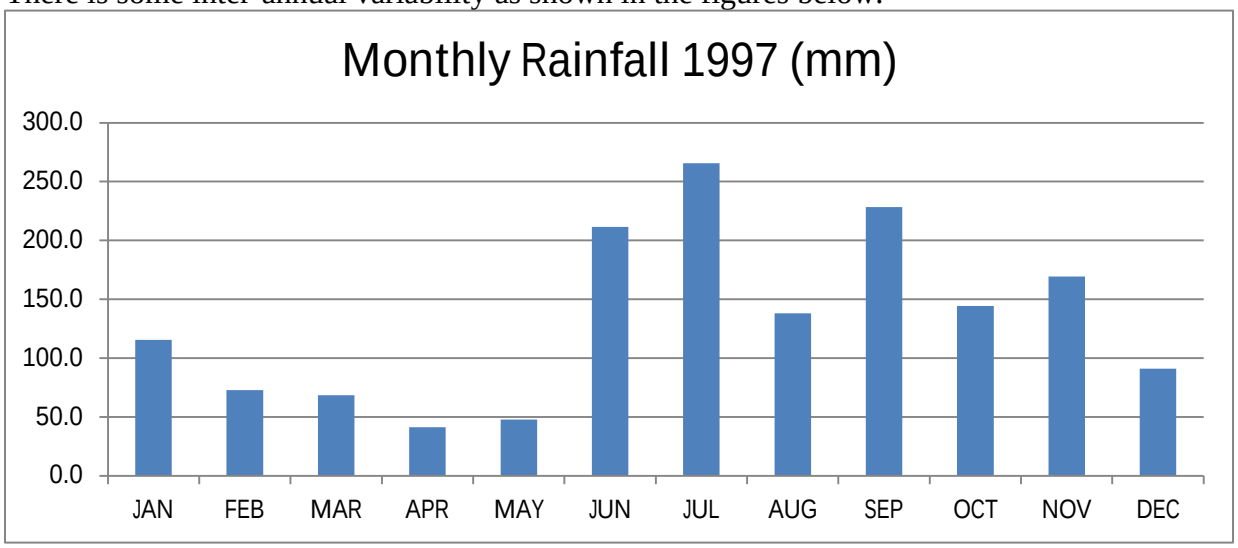
1) Precipitation

The island of St Vincent receives 219 cm of rainfall annually. The rainfall pattern is almost unimodal. The majority of the precipitation, 70 percent, occurs in the rainy season, which is also the highest period of tropical storm activity in the region (Ministry of Environment 2008).

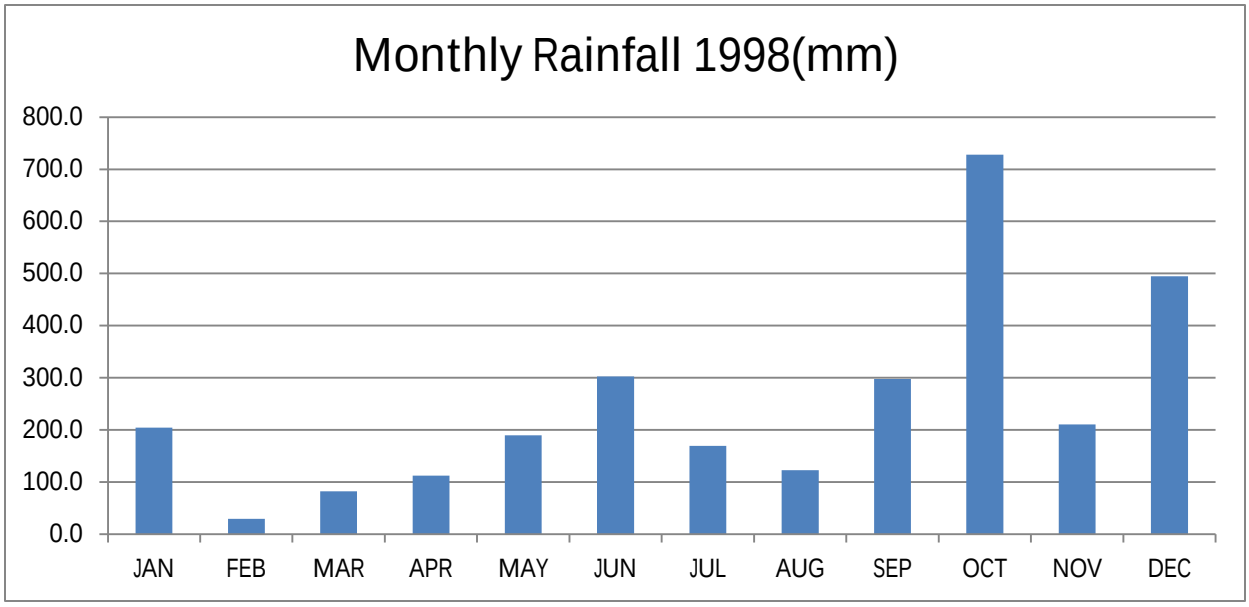


Source: Meteorological Office. Numbers represent years beginning in 1990 to 2013 Note: Only first three months of 2013 are shown.

1997 was one of the driest years on recent record followed by 1998, one of the wettest years. There is some inter-annual variability as shown in the figures below.

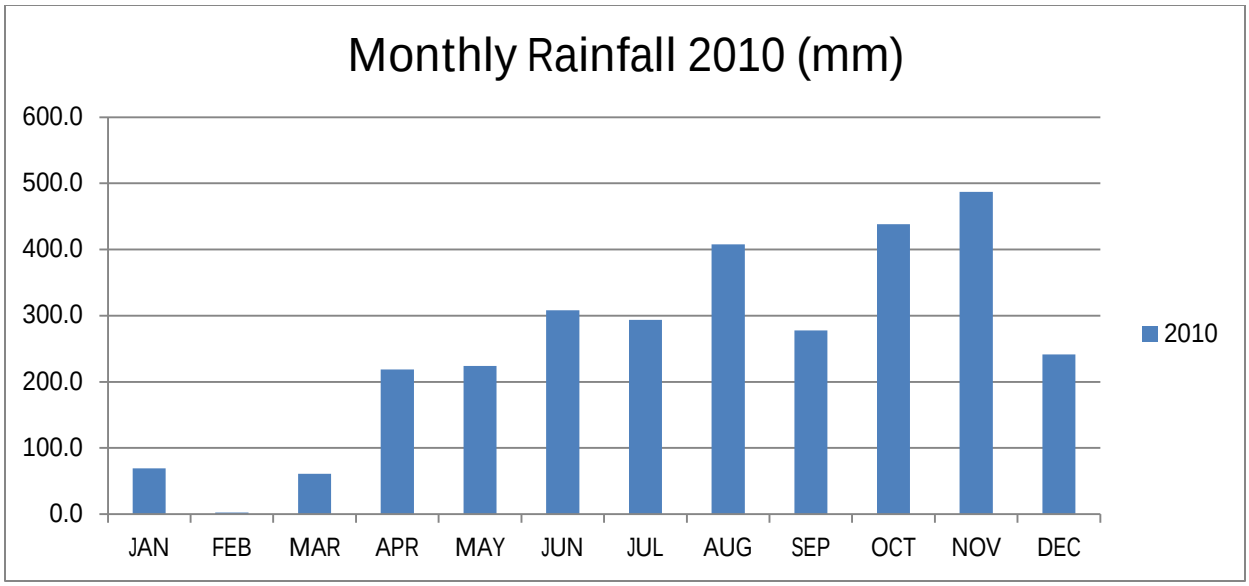


Source: Meteorological Office



Source: Meteorological Office

2010 was also a year of prolonged drought as illustrated in the graph below.

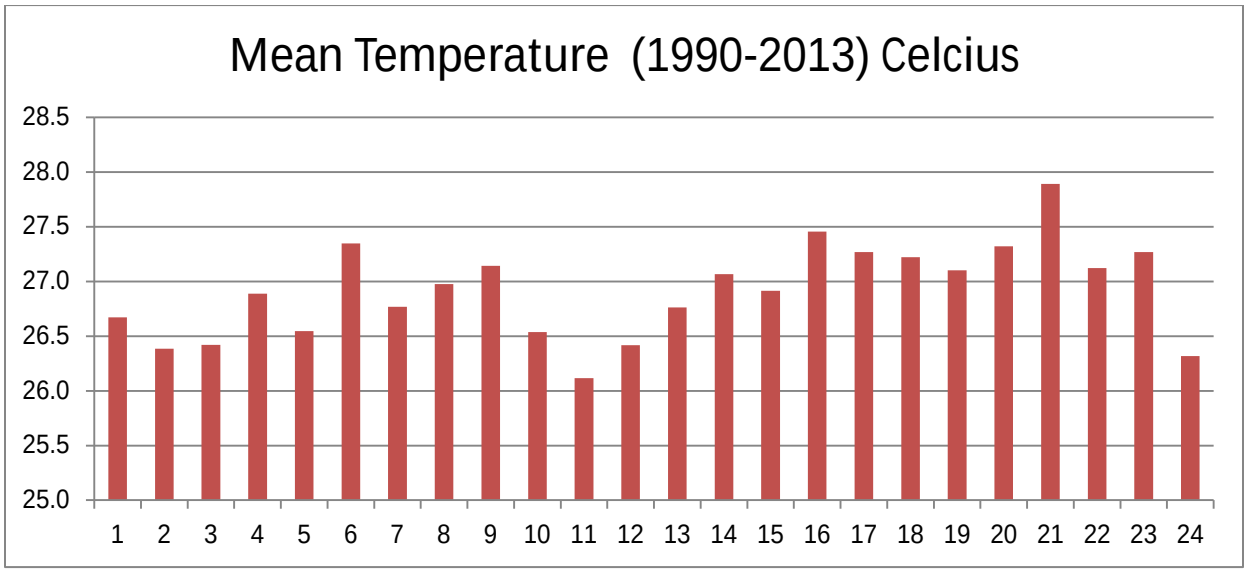


Source: Meteorological Office

The El Niño-Southern Oscillation (ENSO) or large scale gradients in the tropical Atlantic and Pacific sea surface temperatures is suspected to have some influence on the rainfall patterns.
The climate change prediction models for the Caribbean over the next 50 years shows no significant long term trend for precipitation as the climatic models spans both overall increases and decreases (Ministry of Environment 2008, CARIBSAVE 2013).

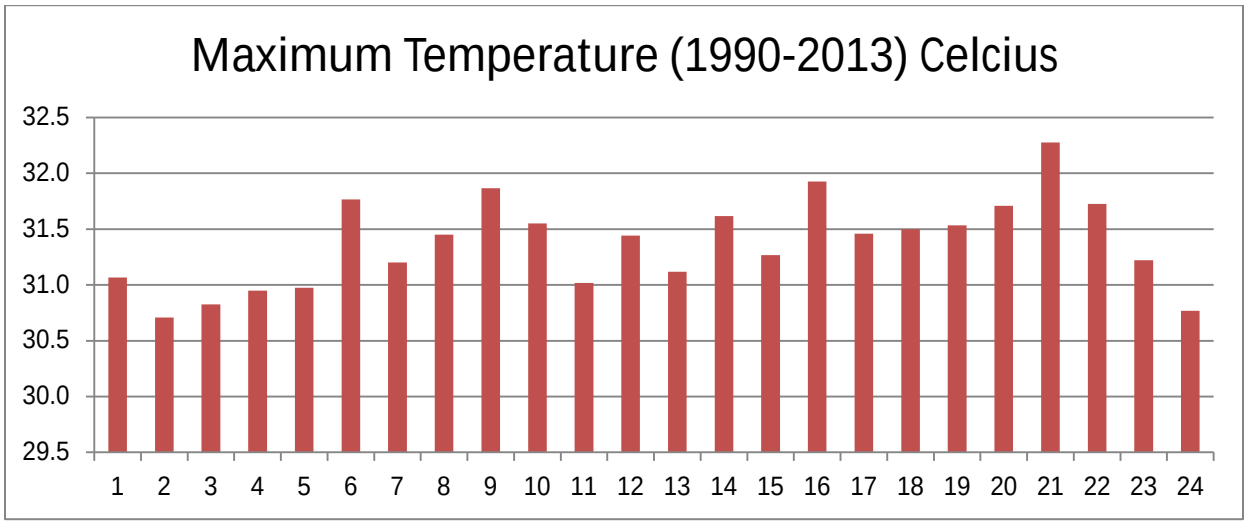
Temperature

The climate of SVG has little seasonal temperature variation. Mean temperatures vary by 2 degrees Celsius throughout the year.

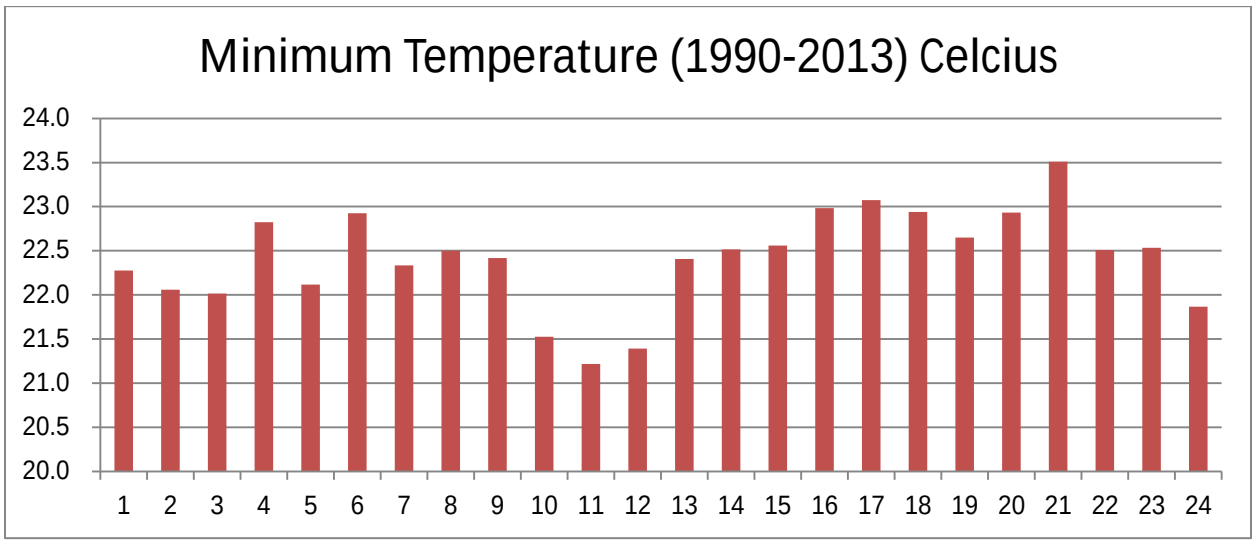


Source: Meteorological Office SVG Numbers represent years, starting 1990 to 2013

Maximum temperatures of 31 degrees Celsius have been recorded, again during the dry season and minimum temperatures of 23 degree Celsius in the month of February.

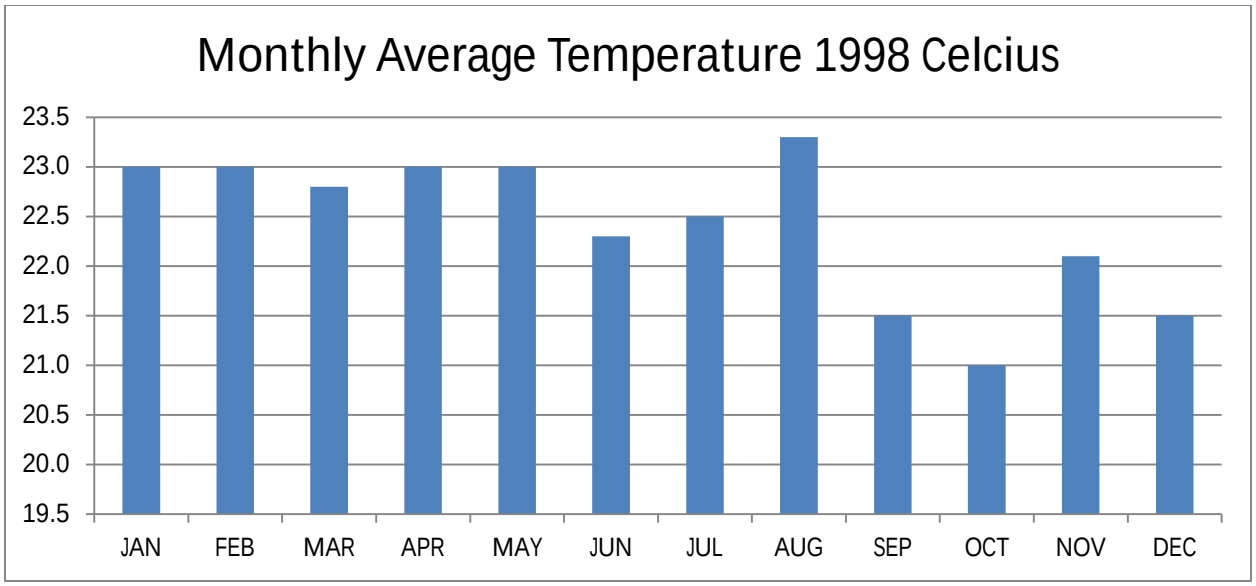


Source: Meteorological Office SVG Numbers represent years, starting 1990 to 2013



Source: Meteorological Office SVG Numbers represent years, starting 1990 to 2013

The highest temperature on record was seen in 1998 during a major El Nino event.



Source: Meteorological Office SVG

There is a slight warming trend over the past 22 years, which is consistent with global temperatures.

2.2 Other Climate Variables

The following highlights other climatic variables that influenced climatic conditions on the islands:

1) Relative humidity which tends to be high, above 70 percent, year round and highest during the rainy season.

2) Winds are a feature of the dry period and are generally E to ESE. Wind and wind speed of >9 metres per second have been recorded which also coincides with the period of the north Atlantic high pressure dominant influence over the region and strong wind gusts are also common from June to November during the passage of tropical waves, depressions, storms or hurricanes (Ministry of Environment 2008).

3) Evaporation rates are higher during the dry season and into the early wet season. As is expected this is consistent with low relative humidity which is highest in the rainy season.

2.3 Tropical Storms and Hurricanes

St Vincent and the Grenadines is situated in the lower latitudes of the Caribbean island arc, where the occurrence of hurricanes is a lower possibility, compared to the northern islands of the island chain. St Vincent and the Grenadines have seen very few hurricanes in the recent past.

Prior to the direct hit of Tomas in 2010, the last recorded hurricane, which was a close pass, was Ivan in 2004. Emily a tropical storm brushed passed the island in 2005.

However, the projections are that hurricanes and tropical storms will increase in both frequency and intensity with climate change. SVG can therefore expect more hurricanes and tropical storms and their associated impacts. It should be noted that Hurricane Tomas impacted greatly the agricultural infrastructure of the island in 2010.

2.4 Local Perceptions of Climate Variability and Climate Change

Anecdotal sources suggest that local perceptions of climate change are high. In the agricultural sector, the perception and awareness of climate change is also extremely high. Of the 30 farmers present in the focus group discussion with farmers of a farmer's cooperative, all answered yes to the question '*was there a difference in the climate now and 5 years ago?*' Among the trends noted by the local farmers are longer dry periods, shorter and more intense rainfall patterns leading to floods.

Local farmers and others have also noted the impact of the changing climate patterns on the fruiting of trees. With the changing weather and climate patterns, the fruiting seasons of the islands is believed to have also shifted.

2.5 Future Climate Change Scenarios

There are several climate change models for the Caribbean islands including SVG. The most widely used Regional Climate Model (RCM) makes the following predictions of the climate and climate variability of SVG.

Box 1

Climate Modeling Projections for St. Vincent and the Grenadines

Temperature: Regional Climate Model (RCM) projections indicate an increase, spanning 2.4-3.1˚C in mean annual temperatures by the 2080s in the higher emissions scenario.

Precipitation: General Circulation Model (GCM) projections of rainfall span both overall increases and decreases, ranging from -34 to +6 mm per month by the 2080s across 3 scenarios. Most projections tend toward decreases. Both RCM projections indicate large decreases in total annual rainfall (-30% when driven by HadCM3 boundary conditions and -22% based on ECHAM4).

Sea Surface Temperatures (SST): GCM projections indicate increases in SST throughout the year. Projected increases range from +0.9˚C and +3.0˚C by the 2080s across all three emissions scenarios.

Tropical Storms and Hurricanes: North Atlantic hurricanes and tropical storms appear to have increased in intensity over the last 30 years. Observed and projected increases in SSTs indicate potential for continuing increases in hurricane activity and model projections indicate that this may occur through increases in intensity of events but not necessarily through increases in frequency of storms.

Source: THE CARIBSAVE CLIMATE CHANGE RISK ATLAS (CCCRA) Climate Change Risk Profile for Saint Vincent and the Grenadines

3.0 Agricultural Vulnerability to Climate Change in SVG

3.1 SVG Main Agricultural Ecosystems and Biodiversity

Table 1: **SVG Main Agricultural Ecosystems and Biodiversity**

Name of Crop	Description	Distribution
Musa spp (banana and plantain	Several different cultivars of bananas and plantains are produced for domestic consumption and export.	Island wide particularly rural areas of St Vincent.
Root crops (aroids, cassava, yam and sweet potato)	Aroids –12 □ Cassava –30 □ Yam – 26 (*Dioscorea rotundata* 1, *Dioscorea cayenensis* 3, *Dioscorea alata* 20, □ *Dioscorea trifida* 1, *Dioscorea esculenta* 1) □ Sweet potato – 80	Found throughout the island under domestic and commercial cultivation
Fruit bearing vegetables (tomato, okra, eggplant, cucurbits, sweet pepper)	Large number of varieties- inclusive of hybrids, developed varieties, pure lines and landraces, are in circulation. Genetically, this is closest to the ideal situation. At the same time, it also represents one of the greatest threats to food security, especially in the unlikely event of reduced availability of a steady seed supply from overseas.	Found throughout the island Domestic and commercial cultivation
Leaves and flower bearing vegetables (Tomato, cabbage, lettuce, cauliflower, broccoli, pacchoi etc.)	Same as above No seeds available locally	Distributed throughout the island Cultivation on a mainly subsistence level
Vegetables with edible roots and tubers (carrot, radish & beet)	Most of the seeds of these crops are also imported. A similar situation exists as in the section above	Distributed throughout the island Cultivation on a mainly subsistence level

Table 1: **SVG Main Agricultural Ecosystems and Biodiversity**

Name of Crop	Description	Distribution
Fruits (Mango, coconut, citrus, pineapple, guava, avocado, wax apple, breadfruit and dragon fruit).	Many different varieties of mango exist. The mainland of St Vincent host more than 80% percent of them. Two cultivars of mango are mainly used for export to Europe and North America. Six species of pineapple are represented by about six commercial varieties. Many different types of tropical fruits	Distributed throughout the island.
The Breadfruit	10 genotypes originally brought by Captain Bligh	Distributed throughout the island No organized system of propagation
Minor crops and underutilized species (Arrowroot, medicinal herbs and spices, christophine, passion fruit, dragon fruit, wild yam, seaside grape, fat pork, star apple, dunks, pomerac etc).	There are several under-utilized fruits which are believed to have the potential for development into important industries.	The plants are commercially cultivated, produced subsistently or found in the wild Some entrepreneurs also harvest herbs in the wild, processing and selling them as herbal remedies. Arrowroot is purely commercial.

2.0 Source: Adapted from FAO 2008

The review of SVG agricultural biodiversity is mixed. The movement away from the monoculture of banana plantation has been both positive and negative. The decline in bananas has led to many plantations being abandoned, leaving large areas of abandoned cultivation which act as reservoirs for plant diseases. The decline in traditional banana cultivation is however a positive for the ecosystem and biodiversity as its intensive use of agrochemicals adversely impacted local flora and fauna and streams and watersheds. At the same time the new cultivation methods for banana, as a result of the EUREPGAP and Fairtrade standards, has led to many environmental friendly practices with positive implications for the agricultural biodiversity. The continued heavy use of synthetic fertilizers and pesticides by some farmers and the absence of a chemical register continue to be a threat to the biodiversity.

The Ministry of Health and the Environment (2008) states that within the last 10 years there have been no plant genetic resources inventory in SVG, though it is high on the priority of the Ministry of Agriculture. This is in itself a threat to the biodiversity of the agriculture sector and

limits what actions can be taken to minimize climate change threats and increase vulnerability to climate change.

3.2 Climate Variability and its Impact on Agricultural Systems

The total impacts of climate change, both aggregate and region specific, on agricultural productivity is still not fully known. FAO (2008) lists the principal variables of climate change affecting agriculture in St Vincent and the Grenadines as:

- CO2 concentrations,
- Temperature,
- Precipitation patterns and
- Solar radiation,

Carbon Dioxide Concentrations

FAO (2010) further explains the effects of elevated levels of CO2 will impact photosynthesis and respiration and secondarily impact water use, crop development and product quality. As is expected higher levels of CO2 will see a positive correlation with higher levels of dry plant-matter production. The increase of CO2 in the atmosphere will reduce water requirements by decreasing evapotranspiration per unit leaf area. This variable will affect the agricultural sub-sectors in the following ways:

Crops Cultivation and Livestock: The decrease in evapotranspiration will either increase or decrease the nitrogen fixation rates resulting in changes in fertilizer application. This is important in the SVG context as farmers have already applied high quantities of synesthetic petrochemical based fertilizer to their crops. Fertilizers also represent a major cost in the inputs of crop cultivation.

Forestry: Increase or decrease in nitrogen fixation rates will affect the overall production levels of biomass of the forest. Decrease water requirements by decreased evapotranspiration per unit leaf area will also affect forest cover positively if temperatures are to increase.

Fisheries: Increased CO2 levels will affect the acidity of the marine environment which will affect negatively mammals and some fish species disrupting food chains and causing imbalances. This will affect negatively the livelihoods of the persons that depend on fisheries for a living.

Increased Temperatures

Another major variable of climate change is global warming and increase in local and global temperatures. Higher temperature gradients are expected in the region and according to anecdotal and climatic data temperature is not only increasing, but the number of seasonal hot days is also increasing (Knights et al 2010). This variable will affect the agricultural subsectors in the following ways:

Crops Cultivation and Livestock: Increased temperature will affect positively plants that have temperature and radiation tolerance (FAO 2008). The migration of native species is also identified as an impact on small island environments. With certain crops being affected by the increase in temperature and the decrease in rainfall, a shift in crop types may be required to adapt to this variable. It will also require changes in agricultural cultivation techniques, seed varieties, and water management techniques.

Forestry: Increased temperature will affect positively some forest species. The migration of native species is also a concern. Drought resistant species and vegetation is not usually of a commercial variety hence livelihoods may also be affected. There is also the increased risk of forest fires and the need for human resources to address this issue.

Fisheries: Increased in atmospheric temperatures will cause an increase in sea temperatures and this will negatively affect some important species in the food webs and chains ultimately affecting commercial and ecologically important species and livelihoods. Higher sea temperatures are also related to sea level rise as water expands when heated. Overall, it has the potential to affect negatively the sub-sector.

Precipitation

Precipitation patterns are expected to be impacted by climate change. The model indicates both an increase and decrease in precipitation with a disruption in the established patterns. This will impact the agricultural sector of SVG in the following ways:

Crops Cultivation and Livestock: Anecdotal reports and climate and weather data indicate changes in the precipitation patterns of the island. The year 2014 saw a longer than usual dry season on the island with many farmers waiting anxiously for the start of the wet season. The low use of irrigation techniques and water harvesting methods on the island will see cultivation and livestock being affected negatively. Precipitation will also affect yields and increase cost of farm inputs. Increased precipitation, especially over a short period of time can result in flash floods, soil erosion and movement, damage to crops, damage to livestock and crippling of the infrastructure.

Forestry: Decreased precipitation will affect forest cover and the general health of the forest. In addition, this will encourage the flourishing of drought resistant species such as lemon grass and increased likelihood of forest fires. Increased precipitation, especially in the northern part of the island can cause flash flooding which will cause further damage to forest cover by erosion and soil slippage.

Fisheries: Increased precipitation can lead to increase non-point source pollution from the land negatively affecting coastal vegetation such as mangrove and also marine species.

Solar Radiation

Is related to temperatures and will affect the sub-sectors in more or less the same manner.

3.3 Approaches to Addressing Climate Vulnerability of the Agriculture Ecosystems

The FAO (2008) argues that the general approach to anticipating agricultural vulnerability to climate change is to develop simulation models and offers the International Benchmark Sites Network for Agrotechnology Transfer – International Consortium for Application of Systems Approaches to Agriculture (IBSNAT-ICASA) as a framework for evaluating and estimating agricultural vulnerability. The IBSNAT-ICASA model predicts crop yield as a function of

factors that include genetics, climatic variables (maximum and minimum temperature, solar radiation, and precipitation), soils, and management approach. Similarly, the SPUR2 model estimates grassland and livestock productivity from plant growth, soils/hydrology, domestic animals, wild animals, and grasshopper submodels (USCSP, 1996 in FAO 2008). There is no climate change simulation model using this method for SVG. However, a model done for Antigua and Barbuda using the FAO computer model Crop Wat showed "… All the crops were shown to undergo a significant decline in productivity with temperature increase and precipitation decrease. Substantial decreases in productivity also occurred when only precipitation was decreased, at levels up to 20 percent. Under dry weather conditions, planting dates become important and irrigation water becomes still more necessary to maintain adequate crop yields (Kentish and Lewis, 1997)."

Knights et al (undated) identifies the significant impact of climate change on the biodiversity of the forests of SVG. In addition to the variables identified above, they included salt water intrusion from rising sea as a variable that will affect the forests of SVG. FAO states that "Climate change with associated changes in precipitation and atmospheric CO2 will result in changes in altitudinal zonation, species type, and vegetation type and location." Page 21

Knights et al (Undated) noted that the impact on the biodiversity of the forest cover of SVG, which will be significant, will in turn further affect the agricultural system. In the case of forestry the subsector is already vulnerable due to non-related climate change factors. The FAO (2010) identified the major threat to the forests of SVG as poverty. Poverty manifests itself in the encroachment on forest reserves for livelihood activities, housing, and the cultivation of marijuana. These activities have fragmented the forest and forest reserves, affected negatively the habitats of wildlife and polluted the associated watersheds due to point and non-point sources of pollution. In addition to the human-related threats, resource competitors, predators, parasites, disease and disturbances such as fire and storms are adding pressure to the forest and increase its vulnerability (Knights 2008).

4.0 Methodological Approach

The vulnerability assessment was conducted using primarily qualitative data supplemented by limited quantitative climatic data. The lack of data collection by the various ministries and agencies, especially the Ministry of Agriculture, severely limited the possibility of any significant quantitative analysis.

The following methods were used to collect data and information for the vulnerability assessment:

1) **Rapid Literature Assessment**
2) **Collection and Analysis of Primary Climatic Data**
3) **Interviews with Key Personnel**
4) **Focus Group Discussion**

Literature Assessment

There are few specific studies on climate change and the agricultural sector of SVG. The Ministry of Agriculture does not collect specific climatic data or data on the impact of climate change. The majority of the data on climate change influences on the sector exists for the forestry and fisheries departments. The literature review focus therefore was broadly on climate change and disaster impacts on SVG. Information on the agricultural sector was then extrapolated and implications for the sector were deduced. Literature on climate change impacts on other Eastern Caribbean islands was also reviewed and conclusions were made on the implications for SVG. A total of 25 documents were reviewed of which more than 20 were related specifically to SVG and the others were regional documents. A detailed assessment of these reports, documents, online sources of data and project outcomes of climate change and its impact on SVG was then completed.

Primary Data Collection

Some primary data were collected from the Meteorological Office of SVG. The climatic data were supplemented by several online sources of temperature and rainfall data. The data set from the Meteorological office is complete and allowed for analysis of trends and patterns in rainfall and temperature.

Interviews with Key Personnel

Interviews were conducted with the key personnel of the Ministry of Agriculture, including the Chief Agricultural Officer, the Agricultural Engineer with responsibility for irrigation and the Director of Forestry. An interview was also conducted with the Fair Trade Association of SVG. The Fair Trade Association of SVG is a major part of the push towards a new method of banana cultivation in SVG and part of its requirements for international certification requires the adoption of certain environmental practices and methods of cultivation. The focus of the interviews with key personnel was to garner what are the specific policies, programs, projects, plans and actions in place to address climate change impacts on the agricultural sector.

Focus Group Discussion

A focus group discussion was held with farmers on the Windward side of the island. The farmers were mostly from a single marketing cooperative, although there were also other farmers present. The focus group discussion which consisted of approximately 30 farmers provided valuable information on local knowledge and perceptions of the impact of climate change and climatic extremes on the local environment as well as adaptation efforts at the micro levels. The guide for the discussion is available in Appendix 1.

5.0 Degree of Vulnerability and Adaptive Action Needs

5.1 Impacts of Climate Change on the Agriculural Sector

The climate change impacts on the agricultural sector of SVG from the data collected from the various methods above were analyzed using the following simple format adapted from the GTZ Climate Change Information for Effective Adaptation: A Practioner's Manual (2009)

Table 3: Impacts of Climate Change on the Agricultural Sector of SVG

Main Climate Stimulus	Observations	Impacts Direct= Physical Indirect=Socio-economic	Sources
Temperature	An increase in average atmospheric temperature. Regional Climate Model (RCM) projections indicate an increase, spanning 2.4-3.1˚C in mean annual temperatures by the 2080s in the higher emissions scenario.	Direct: impacts on certain crops through increase evapo-transpiration and photosynthesis adversely affecting yield, impact on water availability, Indirect: increase in food prices, threatened livelihoods, impact on food security, loss of incomes, reduction of the sector's contribution to the GDP	Caribsave 2012
Precipitation	General Circulation Model (GCM) projections of rainfall span both overall increases and decreases, ranging from -34 to +6 mm per month by the 2080s across 3 scenarios. Most projections tend toward decreases. Both RCM projections indicate large decreases in total annual rainfall (-30% when driven by HadCM3 boundary conditions and -22% based on ECHAM4).	Direct Impacts: Flooding, droughts, destruction of local infrastructure, loss of soil, loss or reduction in biodiversity Indirect: Loss of crops and livestock, increase cost of production, threatened livelihoods, negative impact on food security, loss of income, reduction of agriculture's sector	Caribsave 2012

Table 3: Impacts of Climate Change on the Agricultural Sector of SVG			
Main Climate Stimulus	**Observations**	**Impacts Direct= Physical Indirect=Socio-economic**	**Sources**
		contribution to GDP	
Increase in Storms/ Hurricanes	North Atlantic hurricanes and tropical storms appear to have increased in intensity over the last 30 years. Observed and projected increases in SSTs indicate potential for continuing increases in hurricane activity and model projections indicate that this may occur through increases in intensity of events but not necessarily through increases in frequency of storms.	Direct: damage and loss of crops and animals, damage and destruction of physical infrastructure, Indirect: Impact on GDP, impact on livelihoods, impacts on food production and food security	Caribsave 2012
Sea Surface Temperature	GCM projections indicate increases in SST throughout the year. Projected increases range from +0.9˚C and +3.0˚C by the 2080s	Direct: degradation of coastal and marine ecosystems, increase vulnerability of coastlines to other impacts of climate change, Indirect: Sea Level rise, resulting in flooding, loss of coastal vegetation, increase pollution of the marine environment	Caribsave 2012
Sea Level Rise	Regional rise expected to be between 0.17 m and 0.24 m by 2050	Direct: destruction of coastal infrastructure, degradation of coastal and marine ecosystems, increase vulnerability of coastlines to other impacts of climate change, inundation of crops and livestock, loss of agricultural land due	(IPCC 2007).

Table 3: Impacts of Climate Change on the Agricultural Sector of SVG			
Main Climate Stimulus	**Observations**	**Impacts Direct= Physical Indirect=Socio-economic**	**Sources**
		to salt water intrusion, Indirect: increase expenditure on coastal infrastructure, loss of crops and livestock,	

5.2 Vulnerability Analysis

Following the assessment of the direct and indirect impacts of the variables of climate change on the agricultural system, a climate sensitivity analysis was carried out on the impacts. Noveral et al (2010) defines sensitivity as "… the degree to which a built, natural, or human system is directly or indirectly affected by changes in climatic conditions (e.g. Temperature and precipitation) or specific climate change impacts (e.g. Sea level rise, increased water temperature). If a system is likely to be affected as a result of projected climate change, it should be considered sensitive to climate change" (P.68). In analyzing the degree of sensitivity, the authors further advised that the following questions should be considered:

1. **How exposed is the system to the impacts of climate change**
2. **Is the system subject to existing stress?**
3. **Will the climate change impacts cause the demand for a resource to exceed its supply?**
4. **Does the system have limiting factors that may be affected by climate change?**
5. **For plant and animal species, is a species of concern in your system currently located near the edge or the lowest elevated portion of its range?**
6. **What is the "impact threshold" associated with the system?**

Using the following questions as a guide a sensitivity and vulnerability assessment was carried out for the agricultural sector of SVG. The sensitivity analysis is below:

Sensitivity Analysis of the Agricultural Sector of SVG to Climate Change Impacts

Table 4: **Sensitivity Analysis of the Agricultural Sector of SVG to Climate Change Impacts**

Sector	**Current and Expected Stresses to the Systems**	**Known Climate Conditions Relevant to the Systems**	**How Known Climate Conditions Currently affect Systems**	**How Known Climate Conditions are Projected to Change**	**Projected Impact of Changes to Systems**	**Projected Change in Stresses to Systems (without preparedness Action)**	**Degree of System Sensitivity to Climate Change**
Agriculture Crop Cultivation and Livestock	Loss of preferential markets Ageing farmers New Exotic Diseases Ageing Infrastructure Lack of proper irrigation systems Poor land use practices	Temperature Precipitation Sea Surface Temperature Storms and Hurricanes Sea level rise	Low Crop yields Change in Planting patterns Post-Harvest Damage Damage to infrastructure Loss of crops Low Water availability	Temperatures are projected to increase. Precipitation is expected to increase and decrease, leading to floods and droughts. Patterns of precipitation are also projected to change Storms and hurricanes will increase in frequency and intensity Sea surface temperature is expected to	Increase in food prices, threaten livelihoods, impact food security, loss of incomes, reduction in the GDP	Exacerbate poor land use practices (Likely to get worse) Increase in exotic pests and diseases Further damage and ageing of infrastructure Further inability to diversify the sector Further damage to poor irrigation systems	**High**

Table 4: **Sensitivity Analysis of the Agricultural Sector of SVG to Climate Change Impacts**

Sector	Current and Expected Stresses to the Systems	Known Climate Conditions Relevant to the Systems	How Known Climate Conditions Currently affect Systems	How Known Climate Conditions are Projected to Change	Projected Impact of Changes to Systems	Projected Change in Stresses to Systems (without preparedness Action)	Degree of System Sensitivity to Climate Change
				increase Sea levels are expected to rise			
Forestry	Loss of forest cover due to human activity: deforestation, land developments, removal of coastal forests, bushfires,	Temperature Precipitation Storms and Hurricanes Sea level rise	Changes in forest dynamics, e.g. Fruiting patterns Affects the delivery of ecosystems goods and services of the forest Salt water intrusion affecting coastal vegetation such as mangroves Storms and hurricanes damage trees due to toppling, foliage damage and wind snap further reducing function of the forests	Temperatures are projected to increase. Precipitation is expected to increase and decrease, leading to floods and droughts. Patterns of precipitation are also projected to change Storms and hurricanes will increase in frequency and intensity	The projected impacts are likely to strain the forest's ability to deliver its ecosystem services affecting further water availability, habitats, biodiversity. This system could be considered to be at its natural threshold. Loss of livelihoods Loss of incomes in other sectors such as tourism	All of the stress is highly likely to increase, leading to a strain on the system.	Very High

Table 4: **Sensitivity Analysis of the Agricultural Sector of SVG to Climate Change Impacts**

Sector	Current and Expected Stresses to the Systems	Known Climate Conditions Relevant to the Systems	How Known Climate Conditions Currently affect Systems	How Known Climate Conditions are Projected to Change	Projected Impact of Changes to Systems	Projected Change in Stresses to Systems (without preparedness Action)	Degree of System Sensitivity to Climate Change
			No known species range that will be affected Disruption of diurnal patterns of certain species that are sensitive to temperatures such as the iguana				
Fisheries	Pollution and degradation of marine ecosystems Overexploitation and under-protection of marine resources Loss of marine habitats Use of inappropriate technology Changes in water quality due to human	Sea Surface Temperature Storms and Hurricanes Sea level rise	Increase the degradation of coastal and marine biodiversity Beach erosion Damage to property from storms and hurricanes Coral bleaching affecting habitats of some species of fish	Sea Surface Temperatures will increase Storms and hurricanes will increase in intensity and frequency Sea level rise will increase	Increase the degradation of coastal and marine biodiversity Increased damage to property by storms and hurricanes Increased Coral Bleaching Reduction of fisheries contribution to	All of the stresses are highly likely to increase	High

Table 4: **Sensitivity Analysis of the Agricultural Sector of SVG to Climate Change Impacts**

Sector	Current and Expected Stresses to the Systems	Known Climate Conditions Relevant to the Systems	How Known Climate Conditions Currently affect Systems	How Known Climate Conditions are Projected to Change	Projected Impact of Changes to Systems	Projected Change in Stresses to Systems (without preparedness Action)	Degree of System Sensitivity to Climate Change
	activity and climate change High operational costs Lack of and poor infrastructure for property		Sea temperature affects seasonal movements of pelagics Threaten livelihoods		GDP Loss of livelihoods		

From the sensitivity analysis above, the agriculture sector of SVG is highly vulnerable to the impacts of climate change. Of the three departments of the sector, forestry is the most vulnerable, followed by crops cultivation and livestock production. The sub-sector fisheries is also assessed as being highly vulnerable, but of the three this seems to be the least likely affected. The impact on the fisheries sector is also long term and therefore may be difficult to assess adequately

5.3 Adaptation Capacity Analysis and Requirements for Adaptation

Table 6: Adaptive Capacity Analysis and Requirements for Adaptation				
Planning Sector	**Ability of the Systems in this Planning Sector to Accommodate Projected Impacts with Minimum Disruptions or Costs**	**Policy and Plans Presently addressing Mitigation and Adaptation**	**Adaptive Capacity of the Planning Sector**	**Requirements for successful Adaptation**
Agriculture (Crop and Livestock)	Low,	No specific policy or plans. Plans and policies are reflected in the general plans of the sector Town and Country Planning Act (45 of 1992) United Nations Convention on Biological Diversity (CBD 1992): United Nations Framework Convention on Climate Change (UNFCCC 1992) National Biodiversity Policy	Low requires specific policies and plan and a general climate proofing of the sector	**Technical Assistance** **Development of human resources in the technical knowledge** **Budget line to address the issue** **Knowledge transfer** **Climate Change Portal** **Knowledge dissemination to lower levels where needed** **Specific Climate Change unit with human resources** **Small grants for demonstration and pilot projects on mitigation and adaptation** **Micro and medium credit facilities for innovation**

Forestry	Low	No Specific Policy or Plans General Policies: Forest Resource Conservation Act of 1992 The National Protected Areas Act Town and Country Planning Act (45 of 1992): United Nations Convention on Biological Diversity (CBD 1992): United Nations Framework Convention on Climate Change (UNFCCC Convention on Trade in Endangered Species (1989)		**Development of human resources in the technical knowledge** **Budget line to address the issue** **Knowledge transfer** **Outreach programs** **Climate Change Unit (can be one unit for three sub-sectors)** **Small grants for mitigation and adaptation pilot projects** **Programs to address threats and stresses outside of climate change**
Fisheries	**Low**	Fisheries Act of 1986 The National Protected Areas Act Beach Protection Act of 1981		**Development of human resources in the technical knowledge** **Budget line to address the issue** **Knowledge transfer (international and regional**

		United Nations Convention on the Law of the Sea (UNCLOS 1982 International Convention for the Prevention of Pollution from Ships (MARPOL 1973) Basel Convention on the Control of Trans boundary Movement of Hazardous Waste and their Disposal (1989		**agencies)** **Outreach programs for fishermen** **Climate Change Unit (can be one unit for three sub-sectors)** **Small grants for mitigation and adaptation pilot projects** **Credit facility for innovations and adaptation measures** **Programs to address threats and stresses outside of climate change**

5.4 Conclusions/Recommendations

There is a noted absence of a specific focus on climate change mitigation and adaptation in the Ministry of Agriculture. There are no specific programs or projects to address the issue at the policy or implementation levels. In the departments of forestry and fisheries there are and have been several projects that addressed specific aspects of climate change impacts on forestry. However, these projects are often externally driven and managed from outside of the Ministry by international agencies and local and international non-governmental organizations.

The Ministry of Agriculture Draft National Agricultural Policy and Strategic Plan for the years 2010-2020 has as its overall goal: the promotion of agricultural entrepreneurship and conservation of natural resources. Despite this ambitious goal the policy and plan does not address the issue of climate change and adaptation to those impacts. In fact, the document only once mentions the possible impacts of natural disasters on the agricultural plans and recommends that the ministry should address it by crop selection and the necessary research.

Discussions with officials of the Ministry during interviews of key personnel confirm that there are no new or immediate plans and /or policies to address climate change impacts.

There is a deficiency in the Ministry of Agriculture in the collection and storage of data relating to climate change and disaster impacts on the sector (as well as data in general). At present there is a very limited central depository of agricultural data and information within the Ministry. General and broad agricultural data and statistics are collected by the ministry and its departments and fed to the Central Planning department. This information is not nuanced enough to be used in the assessment of vulnerability risks and to build mitigation efforts. The lack of data on the sector hampers quantitative assessment of the vulnerability of the sector and will also affect meaningful adaptation efforts both at policy and implementation levels.

It can be argued that SVG's greatest vulnerability of the agricultural sector to climate change is the changes in water availability, and its consequences, which are already being felt on the island. At present, most of the farmers on the island practice little or no water harvesting. In reality the majority of the farmers obtain their water from the potable water supply system. There is therefore an urgent need to address the projected limited water availability. Agriculture competes with households, industries, and the tourism sector for water. Irrigation systems that existed prior to hurricane Thomas and the storm of December 25th, 2013 have been damaged and continue to be in a state of disrepair. The impacts of climate change and humans on the declining forest cover of the island will definitely be affecting the country's watersheds and will also influence overall water availability.

The variables of temperature and precipitation will affect the cultivation of crops and livestock. There will therefore be a need to move to new crop selection, add new varieties of present crops and protect the germplasm of traditional species which are adapted to local conditions. Farmers will need to be advised by Extension Officers and others on new tropical crop varieties.

Recommendations

Recommendation 1: There is a need for more direct attention from the Ministry of Agriculture to address the issue of climate change impacts on the sector. There is a need for climate change mainstreaming in the plans and policies of the Ministry. The climate change policies should aim to address the following:

1) Zoning and planning of production areas to minimize risk and vulnerability.
2) Enforcement of present land use laws and guidelines. The disregarding of local land use laws has increased the vulnerability of production areas in SVG
3) Consultation with hazard maps in the planning of adaptation to climate change.
4) A number of adaptation measures that are short, medium and long term and culturally relevant to SVG. A focus particularly on water conservation and harvesting methods since water availability will be severely impacted. There are also many traditional practices that can be revived to assist in vulnerability reduction and climate change adaptation. In addition, these measures need to be integrated with the activities of other agencies, for example the watershed management programs of the National Parks, Rivers and Beaches Authority and the Community Disaster Risk Reduction efforts of the National Emergency Management Organization (NEMO)

5) The present focus on agricultural entrepreneurship and conservation of natural resources should be expanded to include a focus on sustainable livelihoods and the exploration of the use of non-traditional agricultural resources. It should also include the promotion of a switch away from traditional crops to other crops that are climate resilient and nutritionally superior to the present ones, e.g. Naturopaths and functional foods.
6) A comprehensive extension education program for farmers across the island on adaptation measures to climate change. The program should be demonstrative and include the use of non-traditional methods of disseminating information such as SMS. This can also be supplemented with a climate change portal for agricultural policy makers, technical staff and farmers.
7) The Ministry of Agriculture should seek every effort to collaborate with other Ministries, especially the Ministry of Health and the Environment, under whose mandate climate change mitigation falls, in the implementation of its programs to avoid duplication of efforts and resources. There is a need for a comprehensive matrix integration of all of the agencies that intersect with the issues. Present and future programs as well as impacts should be identified. There is also the need to implement active and parallel policies that match/complement mitigation and adaptation to climate change.

Recommendation 2: There is a need to begin the collection of local climate data, irrigation data, local knowledge and perceptions of climate change information, and information of adaptation efforts at all levels. The Ministry, again, needs to collaborate with the National Emergency Management Organization and the Ministry of Health, Wellness and the Environment in this endeavor. The collection of scientific data on local climate will also allow for the building of local climate change projection models.

Recommendation 3: There is a need for a comprehensive plan to address the water needs of the island in light of climate change. All of the major sectors, Ministries and agencies such as the Central Water and Sewerage Agency should be part of the national strategic plan. For the agricultural sector specifically, conservation methods need to be implemented immediately. These conservation measures should be coupled with intensive education at the local levels to educate farmers on conservation methods and water harvesting. Demonstration projects can be adapted from methods used in other islands and locally. The Grenadines islands, for example, have been successfully harvesting water for domestic use. Some of these local methods can be adapted for the agricultural sector on the mainland.

Recommendation 4: The current programs in the National Action Plan 2010-2020 to increase and strengthen crop production should be expanded to include appropriate tropical crop types and varieties to specifically address the issue of crop adaptation to climate change. Local seed banks driven by farmers should be initiated in an attempt to save local genetic material.

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Appendix 1

Guided Questions Focus Group with Farmers' Cooperative on local Perceptions of Climate Change

3.1 Perceptions of changes in the onset and offset of seasons

- What are the main seasons in SVG?
- Are you experiencing any change in the seasons?

3.2 Perceptions of changes in duration of seasons, temperature, droughts and floods

- Any noticeable changes in the duration of season?
- Any perceptions of the changes in temperature?
- Any changes in the number and frequency of droughts and floods?

3.3 Perceptions of causes of climate change

- What do you think are causing these changes?

3.4 Perceptions of positive effects of climate change

- Are there any good to increase in temperature, drought, flooding etc.?

3.5 Perceptions of negative effects of climate change

- What are the negative impacts/effects of the change in temperature, drought, flooding etc.?

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3.6 **Perceptions of conservation agriculture as an adaptation strategy**

- What have you done so far to deal with the change in seasons?

3.7 **Perceptions of assistance available**

Are you aware of any programs to assist in dealing with the impacts of the changes in the seasons?

3.8 Perception of actions needed

- What can be done by persons in authority?
- What can you do as an individual, group or community level?

Appendix 2: List of persons interviewed

1. Lesly Grant, Chief Agricultural Officer
2. Conrad Simon, Engineer and Irrigation Specialist
3. Fitzgerald Providence, Director, Ag. Forestry
4. Edwin Bob, WINFA, FAIRTRADE