Global RApid Post-Disaster Damage Estimation (GRADE) Report

Hurricane Beryl 2024
Saint Vincent and the Grenadines

(Report as of July 26, 2024)

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Abbreviations

CDEMA	Caribbean Disaster Emergency Management Agency
COPERNICUS EMS	COPERNICUS Emergency Mapping Service
D-RAS	Disaster-Resilience Analytics & Solutions, IDURM, World Bank Group
GRADE	Global RApid post-disaster Damage Estimation
IDURM	Infrastructure Global Department for Disaster Climate Risk Management
NOAA	National Oceanic and Atmospheric Administration
NEMO	National Emergency Management Organisation of Saint Vincent and the Grenadines
NHC	National Hurricane Center
OECS	Organisation of Eastern Caribbean States
OSM	Open Street Map
PDNA	Post-Disaster Needs Assessments
TEV	Total Exposure Value
SVG	Saint Vincent and the Grenadines
SVGMS	Saint Vincent and the Grenadines Meteorological Services
US$	United States Dollar
XC$	East Caribbean Dollar

Contents

Executive Summary

This GRADE report provides a synopsis of the estimated direct economic damage in Saint Vincent and the Grenadines (SVG) due to the passage Hurricane Beryl. The report is based on a rapid and remote post-disaster damage assessment that follows the established GRADE methodology[1].

Hurricane Beryl passed over southern SVG on July 1, 2024. Wind speeds ranged from a Category 4 hurricane in the southern Grenadines, then lessening to the north with Tropical Storm force winds felt on the main island of Saint Vincent. The economic damage estimates are summarized in Table 1, and the key findings summarized below.

1. Updated exposure calculations result in **a total replacement value of all assets of US$ 5.91 billion**, including residential and non-residential buildings and infrastructure.
2. **Total economic damages are estimated at US$ 230.6 million,** or equivalent to approximately 22 percent of SVG's 2023 gross domestic product (GDP), or 4 percent of the total exposed value.
3. **The southern Grenadines were the worst hit**, accounting for a total of US$ 186.8 million or 81 percent of the country's total damage. Union Island was the worst hit island in terms of damage estimates.
4. **Building damage,** including residential and non-residential, accounted for over two-thirds of the direct physical total damage.
5. **Infrastructure,** and to much lesser extent, agriculture damage, are estimated to account for approximately one-third of the total damage to SVG, including impacts on power, telecommunications, water networks, airports, seaports, jetties, and coastal infrastructure.
6. **Agricultural impacts** are relatively minor, with damage to the fishing sector (excluding vessels), crops, livestock, and fruit trees.

Table 1: Summary of GRADE estimations of direct economic damage in SVG from Hurricane Beryl in July 2024 in US$ millions

Islands	Residential	Non-Residential	Infrastructure + Agriculture	Total Value (mn USD)
Union	36.2	28.3	28.9	**93.3**
Palm Island + Petit Saint Vincent	2.3	21.6	8.8	**32.7**
Mayreau	2.9	4.1	3.1	**10.1**
Canouan	15.5	15.6	19.6	**50.7**
Mustique	1.1	.2	1.0	**2.3**
Bequia	8.3	5.4	6.6	**20.3**
Saint Vincent	12.9	4.6	3.7	**21.2**
Total	**79.1**	**79.8**	**71.7**	**230.6**

[1] Global Rapid post-disaster Damage Estimation (GRADE) approach developed at the World Bank and conducted by the Infrastructure Global Department for Disaster Climate Risk Management, Disaster-Resilience Analytics & Solutions (D-RAS) Knowledge Silo Breaker (KSB). The methodology aims to address specific damage information needs in the first few weeks after a major disaster. See: https://www.gfdrr.org/sites/default/files/publication/DRAS_web_04172018.pdf for details of the methodology.

A bespoke exposure model developed for SVG[1,2,3] was updated as part of this GRADE assessment, resulting in a total replacement value of assets (prior to Hurricane Beryl), including residential and non-residential buildings and infrastructure sectors of US$ 5.91 billion. This model was used to calculate the damages caused by Hurricane Beryl.

This GRADE assessment is intended as a rapid remote estimate prepared within a short timeframe to inform early decision-making and is not intended as a substitute for detailed on-the-ground analysis which may be conducted in the weeks and months after an event. The GRADE assessment should be interpreted as a first-order estimation of direct damages, albeit with a significant degree of reliability. However, GRADE's outputs are still estimates; remote-based calculations that are influenced by and updated from available ground-based data. While there is confidence in the overall damage estimates and distribution of damage, the confidence level at the individual asset level is low and therefore results are presented at the island level for each of the Grenadines islands and the main island of Saint Vincent. Furthermore, this GRADE assessment does not include the economic losses, and the recovery and reconstruction needs, that are also crucial for the comprehensive understanding of the impact of the disaster.

1.0 Introduction

The objective of this report is to provide an estimate of the direct economic damage to physical assets caused by Hurricane Beryl in Saint Vincent and the Grenadines (SVG) and to provide information on the spatial distribution of damages to support development of a roadmap for recovery and reconstruction.

1.1 Context

Saint Vincent and the Grenadines is a multi-island country of 142 square miles and approximately 110,000 people[4]. There are 32 islands and cays that make up SVG, of which nine are inhabited: the main island of Saint Vincent and the following Grenadines islands: Young Island, Bequia, and Mustique in the Northern Grenadines, as well as Canouan, Union Island, Mayreau, Petit Saint Vincent, and Palm Island in the Southern Grenadines.

The Southern Grenadines (in the 2012 census) were home to 4,050 people or 3.7 percent of the national total and had experienced the highest rate of population growth in the country of 61.7 percent in the period from 1980 to 2012. In 2012, the Southern Grenadines islands also had the highest labor participation rate in the country, at 47.8 percent of the population, with 28.7 percent of the labor force being employed in the Construction sector, 28.4 percent in the Accommodation and Food Services sector, and 10.4 percent in the Wholesale and Retail Trade/Repair of motor vehicles and motorcycles sector. According to the CDEMA Hurricane Beryl Rapid Needs Assessment report (unpublished as of July 25), the number of houses in these islands was estimated at 1,868 in 2021 by SVG's Statistical Office (967 in Union Island, 125 in Mayreau and 776 in Canouan).

The Northern Grenadines (in the 2012 census) were home to 6,184 people or 5.6 percent of the national total and had experienced population growth of 30.5 percent in the period from 1980 to 2012. In 2012,

[2] https://documents1.worldbank.org/curated/en/099110623153035943/pdf/P1705760e98dae06309c250be5da473f04b.pdf
[3] Gunasekera et al. (2015) Developing an adaptive global exposure model to support the generation of country disaster risk profiles. Earth Science Reviews. 150. 594-608.
[4] https://stats.gov.vc/subjects/population-and-demography/mid-year-household-population-estimates-by-age-and-sex/

the labor participation rate was 39.9 percent of the population, with 17.2 percent of the labor force employed in the Construction sector, 14.7 percent in the Transportation and Storage sector, 14.4 percent in the Accommodation and Food Service sector, and 13.2 percent in the Wholesale and Retail Trade/Repair of motor vehicles and motorcycles sector. According to the CDEMA Hurricane Beryl Rapid Needs Assessment report, the number houses in these islands was estimated at 3,045 in 2021 by SVG's Statistical Office (610 in Mustique and 2,435 in Bequia).

The three southernmost census divisions of Saint Vincent (Kingstown, Kingstown Suburbs, and Calliaqua) combined were home to 50,926 people during the 2012 census or 46.3 percent of the national total and had experienced population growth of 19.6 percent in the period from 1980 to 2012. In 2012 these three census divisions combined had a labor participation rate of 39.5 percent of the population with 21.4 percent of the labor force being employed in the Wholesale and Retail Trade/Repair of motor vehicles and motorcycles sector, 10.5 percent in the Public Administration and Defense, Compulsory Social Security sector, 10 percent in the Construction sector, and 7.2 percent in the Education sector. According to the CDEMA Hurricane Beryl Rapid Needs Assessment report, the number of houses in these three census divisions combined was estimated at 19,731 in 2021 by SVG's Statistical Office (4,874 in Kingstown, 4,996 in Kingstown Suburbs, and 9,861 in Calliaqua). In 2023, SVG's GDP was US$ 1.07 billion, and GDP per capita was US$ 9,691.50[5]. Services (such as tourism), industry, and agriculture are the main sectors of economic activity[6]. Like many small island nations, SVG imports many commodities with import values totaling US$ 372 million[7] in 2021. In this same year, SVG's exports were valued at US$ 35 million and comprised mostly of agricultural exports including arrowroot, exotic fruit including bananas, vegetables, and root crops[8].

SVG is exposed and vulnerable to natural hazards, including hurricanes, flooding, landslides, earthquakes and volcanic eruptions. Vulnerability is comprised of physical vulnerability from less resilient assets such as buildings and infrastructure, while social vulnerability relates to socioeconomic factors that may increase or exacerbate the impacts of disasters, including inequalities and lack of access to resources.

1.2 Summary of historical disasters

Historically, the most lethal hurricanes to have affected SVG were Hurricane Janet in September 1955 and the Windward Islands Hurricane in September 1898. Hurricane Janet caused the loss of 122 lives in the Grenadines, while the Windward Islands Hurricane – estimated as a Category 2 hurricane when it passed over Kingstown on September 11 – caused up to 300 fatalities, mostly in the northern part of Saint Vincent. Janet was a Category 2 hurricane when it passed south of SVG, in between mainland Grenada and Carriacou on September 23.

Prior to Hurricane Beryl, SVG was spared hurricanes of Category 3 or stronger since at least 1900. Damages and losses from just eight meteorological events between 1980 and 2016, for which cost information was compiled, amount to over US$ 450 million (see Table 2). A more detailed summary of past disasters is provided in Annex 2.

[5] https://data.worldbank.org/country/VC
[6] https://www.gov.vc/index.php/citizens/economy
[7] https://wits.worldbank.org/countrysnapshot/en/VCT
[8] https://wits.worldbank.org/countrysnapshot/en/VCT

Table 2: Summary of recent historical disasters in Saint Vincent and the Grenadines

Year	Event	Costs reported	Sectors impacted
1980	Hurricane Allen	Damage and losses of US$ 16.3 million in 1980 US$ (or US$ 31.7 million in 2024 US$) Equivalent to 20% of 1980 GDP	Damage to banana and coconut crops.
1986	Tropical Storm Danielle and subsequent rain system	Damages of US$ 9.2 million in 1986 US$ (or US$ 26.4 million in 2024 US$) Equivalent to 6% of 1986 GDP	Major power outage and crop damage. 436 residential buildings impacted.
2002	Hurricane Lili (Tropical Storm Lili when it passed SVG)	Damage and losses of US$ 14.8 million in 2002 US$ (or US$ 25.9 million in 2024 US$) Equivalent to 9% of 2002 GDP	Significant damage to several hundred homes and 2 schools. Police station roof lost. 75% of damage and losses in agriculture sector.
2004	Hurricane Ivan	Damages of US$ 40 million in 2004 US$ (or US$ 66.5 million in 2024 US$) Equivalent to 8% of 2004 GDP	Severe damage to 50 houses and 120 more lost their roofs. Union Island hospital lost part of its roof and Palm Island resort lost its jetty.
2010	Hurricane Tomas	Damage and losses of US$ 48 million in 2010 US$ (or US$ 69 million in 2024 US$) Equivalent to 7% of 2010 GDP	20% of damage to agriculture sector. 600 houses lost roofs. Numerous downed power lines, trees, and landslides made some roads impassable.
2011	Sixteen separate flood events during March to April	Damages of US$ 31.1 million in 2011 US$ (or US$ 43.4 million in 2024 US$) Equivalent of 19% of 2011 GDP	Flooding and landslides.
2013	Christmas Trough	Economic losses of US$122 million in 2013 US$ (or US$ 165 million in 2024 US$). Equivalent to 16.2% of 2013 GDP. Direct damages of US$ 86.4 million in 2013 US$ (or US$ 117 million in 2024 US$).	There was significant damage to roads and bridges, 93 landslides, and 530 houses damaged, of which 34 houses were destroyed.
2016	November floods	Damages of US$ 29.7 million in 2016 US$ (or US$ 38.9 million in 2024 US$) Equivalent to 4% of 2016 GDP	Widespread damage to roads, bridges, water infrastructure, and housing

1.3 Event description

On June 25, the National Oceanic and Atmospheric Administration (NOAA)'s National Hurricane Center (NHC) reported a low likelihood of a tropical wave south of Cabo Verde that could develop into a tropical cyclone. By June 26, the NHC anticipated that environmental conditions across the central and western

tropical Atlantic would be “unusually conducive for late June” due to record-warm sea surface temperatures. By this time, thunderstorms had increased and organized, showing curved bands and some rotation. On June 27, the NHC assessed a high likelihood of development. The disturbance further organized, becoming Tropical Depression Two, over the central tropical Atlantic on June 28, about 1,970 km (1,225 mi) east-southeast of Barbados.

The depression moved generally westward and strengthened into Tropical Storm Beryl six hours after forming. Late on June 29, Beryl intensified into a hurricane. On June 29, the Saint Vincent and the Grenadines Meteorological Services (SVGMS) issued a Hurricane Watch for the country.

Beryl became a major hurricane on June 30, further strengthening into a Category 4 hurricane with winds of 130 mph (215 km/h). At 15:10 UTC on July 1, Beryl made landfall in Carriacou, Grenada (see Figure 1), with sustained winds of 150 mph (240 km/h) equivalent to a Category 4 hurricane on the Saffir-Simpson Hurricane Wind scale. Carriacou lies just 19 km south of Union Island. At 03:00 UTC the next day (July 2) after passing SVG, Beryl further intensified into a Category 5 hurricane, peaking a few hours later with winds of 165 mph (270 km/h), while moving west-northwest across the Caribbean Sea at about 20 mph (35 km/h) towards the southern shores of Jamaica.

Hurricane Beryl was the second named storm of the 2024 Atlantic Hurricane season and was the earliest forming Category 5 hurricane on record. It is also the strongest hurricane to have impacted SVG since at least 1900.

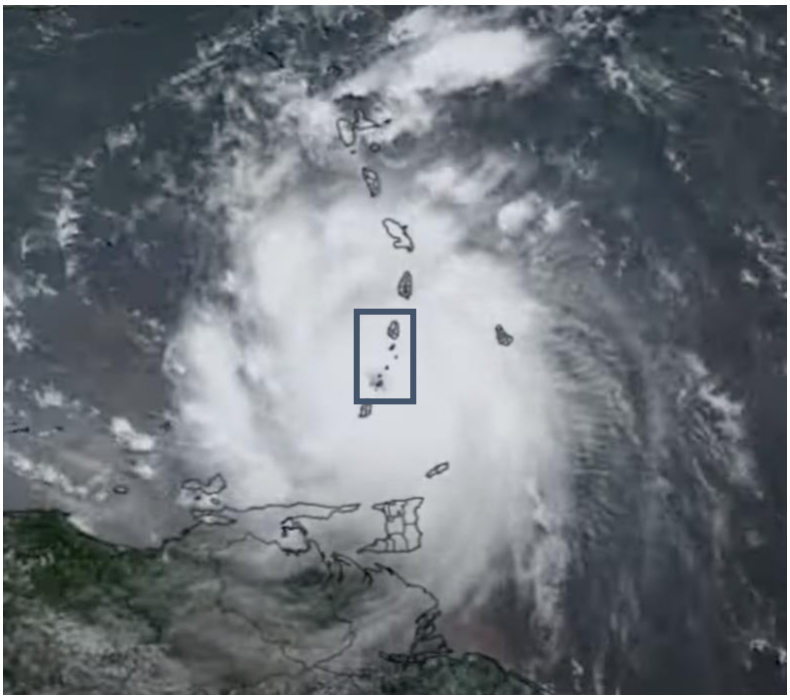

Figure 1: Satellite imagery of Hurricane Beryl over the Lesser Antilles. The box highlights the location of Saint Vincent and the Grenadines. Source: NOAA

Figure 2: Wind History map for Hurricane Beryl to July 5 passing Saint Vincent and the Grenadines[9]

1.4 Reported impacts

Hurricane Beryl exposed 56 percent of the nation's population to winds between Tropical Storm and Category 4 hurricane strength, based on the most recent SVG Population and Housing Census from 2012. The islands of Southern Grenadines (from South to North: Petit Saint Vincent, Palm Island, Union Island, Mayreau, and Canouan) were exposed to winds of a Category 3 to 4 hurricane; the islands of Northern Grenadines (from South to North: Petite Mustique, Mustique and Bequia) to winds of a Category 1 to 2 hurricane, and southern Saint Vincent (census divisions of Kingstown, Kingstown Suburbs, Calliaqua, as well as Young Island) to Tropical Storm force winds.

Detailed structural damage assessments to buildings are ongoing, however rapid surveys were completed by NEMO and CDEMA, and remote sensing damage assessments using satellite imagery have been undertaken by Copernicus across the Grenadines, and the results for residential and non-residential buildings combined are summarized in Table 3[10]. It is seen that damage was assessed as extreme in Union Island, extremely severe in Mayreau, severe in Canouan, minor in Bequia and very low in Mustique. Around 600 buildings were assessed as having been damaged on Saint Vincent, but these have not been disaggregated by damage level, use type, or census division.

[9] https://www.nhc.noaa.gov/storm_graphics/AT02/refresh/AL022024_wind_history+png/145521_wind_history.png
[10] https://rapidmapping.emergency.copernicus.eu/EMSR734/download

Table 3: Summary of Copernicus EMS damage assessments of buildings using satellite imagery as of July 9

DAMAGE LEVEL/ISLAND	Union	Mayreau	Canouan	Mustique	Bequia	TOTAL
Destroyed	882	136	241	0	10	1,269
Damaged	550	42	232	0	98	922
Possibly damaged	30	69	256	8	16	379
Possibly undamaged	35	22	197	850	2,742	3,846
Total Existing	**1,497**	**269**	**926**	**858**	**2,866**	**6,416**
Destroyed	58.9%	50.6%	26.0%	0.0%	0.3%	19.8%
Damaged	36.7%	15.6%	25.1%	0.0%	3.4%	14.4%
Possibly damaged	2.0%	25.7%	27.6%	0.9%	0.6%	5.9%
Possibly undamaged	2.3%	8.2%	21.3%	99.1%	95.7%	59.9%

In addition, CDEMA's Rapid Needs Assessment Team's provisional report (unpublished as of July 25) carried out rapid visual damage assessment across the affected islands and census divisions using a damage scale based on visual evidence of damage to the roof cladding and the roof frames of houses.

The media published varying and ranging reports of damage in the early days after the event. On **Union Island**, the hurricane impact was catastrophic with reports of the majority of buildings sustaining damage ranging from roof cladding loss to complete roof failure (cladding and frame). Some wooden buildings were also completely shattered or collapsed. The airport's control tower was damaged, the terminal building lost its roof, and the hospital, water network, and power plant sustained significant damages[11,12]. There was widespread destruction of infrastructure including roads and electrical systems. Nearly all berthing structures on Union Island were also damaged or destroyed[13].

Mayreau faced a similar fate to Union Island, with reports of the majority of its structures damaged or destroyed, affecting the whole population[14]. Like Union Island, most of its berthing structures were compromised. Communication across the island was severely impacted [15]. Many media reports focused on the collapse of a Catholic church, where more than 40 people had been taking shelter. The church served as a safe shelter during the 2004 Hurricane Ivan, which moderately affected the Southern Grenadines, but could not withstand Hurricane Beryl's Category 4 winds.

The resorts on **Palm Island** and **Petit Saint Vincent** faced severe impacts too. The vast majority of resort structures were damaged, and substantial damages were felt to the resort's infrastructure, including the desalination plant of Palm Island suffering significant damage[16]. Many evacuated prior to the hurricane, but those who remained on Palm Island sheltered in a concrete structure which failed during the hurricane[17].

Canouan experienced substantial impacts from wind, rain and storm surge, with much of the population affected. The airport was reported as closed for commercial activity until further notice[18]. The island also faced communication challenges in the immediate aftermath[19].

[11] https://www.cdema.org/images/2024/07/CDEMA%20SITREP3_Hurricane%20Beryl_July_4_2024.pdf
[12] https://www.usatoday.com/story/news/nation/2024/07/03/hurricane-beryl-destruction-islands/74296817007/
[13] https://rapidmapping.emergency.copernicus.eu/EMSR734/aem
[14] https://www.cdema.org/images/2024/07/CDEMA%20SITREP3_Hurricane%20Beryl_July_4_2024.pdf
[15] https://www.usatoday.com/story/news/nation/2024/07/03/hurricane-beryl-destruction-islands/74296817007/
[16] https://www.usatoday.com/story/news/nation/2024/07/03/hurricane-beryl-destruction-islands/74296817007/
[17] https://www.stvincenttimes.com/palm-island-resort-ravaged-by-hurricane-beryl/
[18] https://onenewsstvincent.com/2024/07/03/argyle-international-airport-reopens-today-july-3/
[19] https://www.cdema.org/images/2024/07/CDEMA%20SITREP3_Hurricane%20Beryl_July_4_2024.pdf

Initial reports from UNOCHA estimated that 20-40% of houses had been damaged on **Bequia**[20]. Although the airport and runway remained operable, they were temporarily closed for a period.

In **Saint Vincent**, media reports suggested that hundreds of houses sustained some damage, with dozens losing roofs[21] and a reported thirty government buildings – mainly schools – suffering mostly minor damage[22]. The Kingstown commercial port was closed due to damage, forcing the cruise ship terminal to manage incoming goods, albeit with weight restrictions. The construction of the new Kingstown cargo port also face setbacks due to damage. The agricultural sector face some impacts as farms with bananas, plantains, fruit trees, and vegetables crops were destroyed. The Botanical Gardens in Kingstown also suffered substantial damage.

Fishing operations were impacted across the islands, with damage to coastal infrastructure and equipment including vessels[23].

2.0 Direct Damage Estimation Methodology

The GRADE methodology adopted here is a fast first-order approximation of the direct economic impact, and so provides a rapid high-level estimate of damages to physical assets used to inform decisions in a timely fashion.

A full catastrophe modelling approach was not adopted in this case. As the scale of the impacted area was relatively small (compared to say country scale) and the country context well known by the GRADE assessment team, better results can be achieved through an engineering approach, which directly considers buildings and other assets.

The GRADE methodology adopted estimates of damages using reported damage data. This methodology is conducted in 3 stages:

1. Data collection, monitoring, and checking;
2. Comparison with damage estimates for historical events;
3. Calibration, modelling, cross-checking, and validation.

The development of an exposure model, which encompasses all sectoral assets in the country, was also completed. This drew on previous work[24], census and living condition surveys, and other Government sources. Where data were out of date, updates and projections were included to achieve a current exposure model: an example of this is the considerable increase to replacements costs that the global pandemic brought, which resulted in the exposure values rising significantly.

The exposure values representing the replacement cost estimates of built assets are presented in Table 4. Total exposure of buildings and infrastructure is estimated to be US$ 5.9 billion (XCD 16 billion). The majority of assets are located on Saint Vincent (66 percent), the Northern Grenadines have 22 percent of the exposure, and 12 percent of the exposed value of assets are located in the Southern Grenadines.

The building typologies were also derived for the residential sector and are shown in Table 5. Notably, over 90 percent of the population reside in buildings that have sheet metal roofs, which can be particularly

[20] https://reliefweb.int/report/grenada/eastern-caribbean-hurricane-beryl-situation-report-no-01-7-july-2024
[21] https://www.stvincenttimes.com/beryl-attacks-svg-devastates-union-mayreau-havoc-on-canouan/
[22] https://www.stvincenttimes.com/beryl-attacks-svg-devastates-union-mayreau-havoc-on-canouan/
[23] https://www.stvincenttimes.com/hurricane-beryl-leaves-svgs-agriculture-fisheries-sector-vulnerable/
[24] https://documents1.worldbank.org/curated/en/099110623153035943/pdf/P1705760e98dae06309c250be5da473f04b.pdf

prone to damage in strong winds, especially if not secured properly. Also notable is that Mustique, Canouan and Bequia, have some very high value properties, which will usually be built to higher building standards.

The total residential and non-residential exposures are shown in Figure 3 and Figure 4 for each census division.

Table 4: 2024 exposure values calculated for Saint Vincent and the Grenadines in US$ millions

Islands	Total Residential	Total Non-Residential	Total Infrastructure	Total Value (mn USD)
Union	81	104	56	**241**
Palm Island + Petit Saint Vincent	5	37	13	**55**
Mayreau	9	12	6	**27**
Canouan	137	189	57	**382**
Mustique	410	102	79	**591**
Bequia	259	303	173	**735**
Saint Vincent	1,242	1,458	1,185	**3,885**
Total	**2,141**	**2,206**	**1,568**	**5,914**

Table 5: Distribution of SVG population living in houses with different roof and wall materials

		Roof type		
		Sheet metal	**Concrete**	**Other material**
Wall type	**Wood**	21%	<1%	<1%
	Concrete/ concrete blocks	69%	4%	2%
	Other material	3%	<1%	<1%

Following the calculations for exposure, the reported damage data is carefully collated and cross-checked across multiple sources. Various metrics that indicate damage or impacts are collected (see Annex 1) and monitored over time until they stabilize. Aerial and satellite imagery products, social media posts, as well as freely available walk-by, drive-through, and drone videos, which provide snapshots of damage for specific areas, were used as checks for various locations throughout Saint Vincent and the Grenadines.

A first estimate of damages was completed using a combination of the exposure, observed damage levels, structural vulnerability data, and unit costs of construction for the residential, non-residential and infrastructure sectors. The value of agriculture outputs combined with the amount of damage observed led to initial damage estimates for the agriculture sector (excluding fishing vessels). To calibrate these estimates, checks were completed against reported data, social media, historical event reports.

Risk modelling approaches were used as a final check of damage estimations. A wind-field was developed by collecting and assessing available cyclone track data, along with data on land properties affecting the wind-field such as land use and elevation (see Figure 5). Bespoke vulnerability have been modelled by the

authors for similar building typologies for the Eastern Caribbean, so those functions were used to calibrate the damage estimates.

An overview of the datasets used in this GRADE assessment are shown in Annex 1.

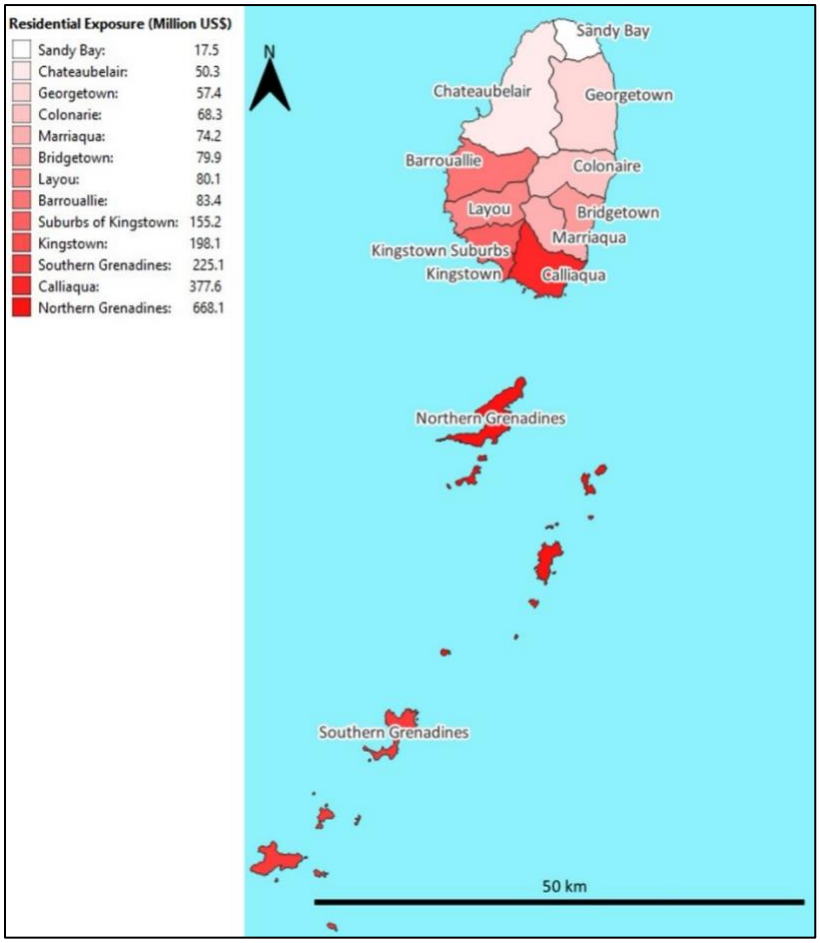

Figure 3: Residential buildings exposure by census divisions of Saint Vincent and the Grenadines

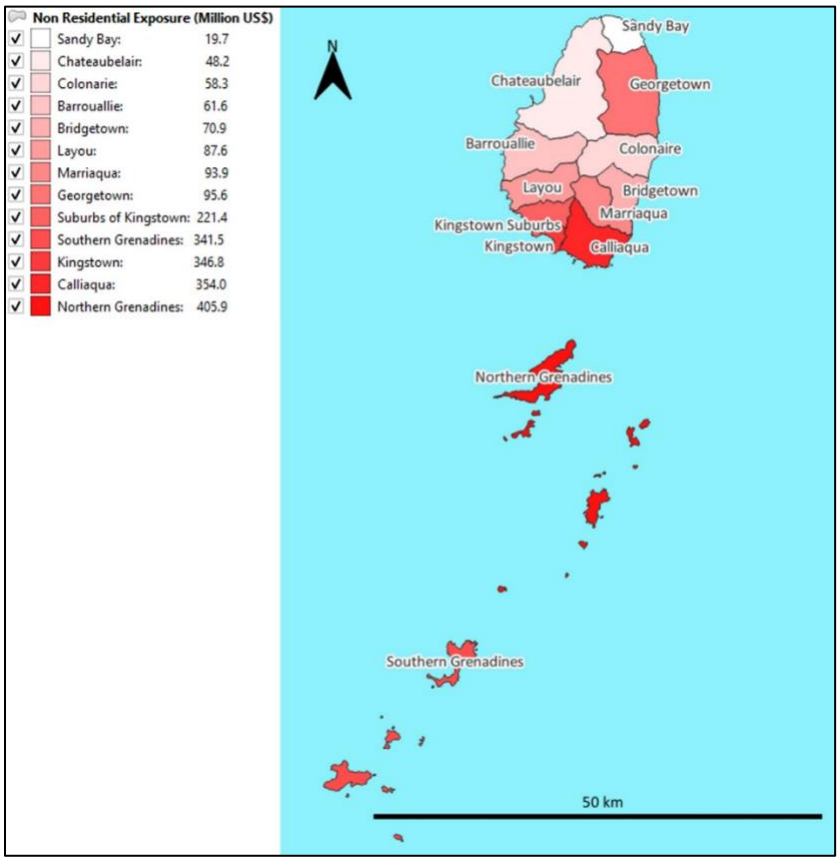

Figure 4: Non-residential buildings exposure by census divisions of Saint Vincent and the Grenadines

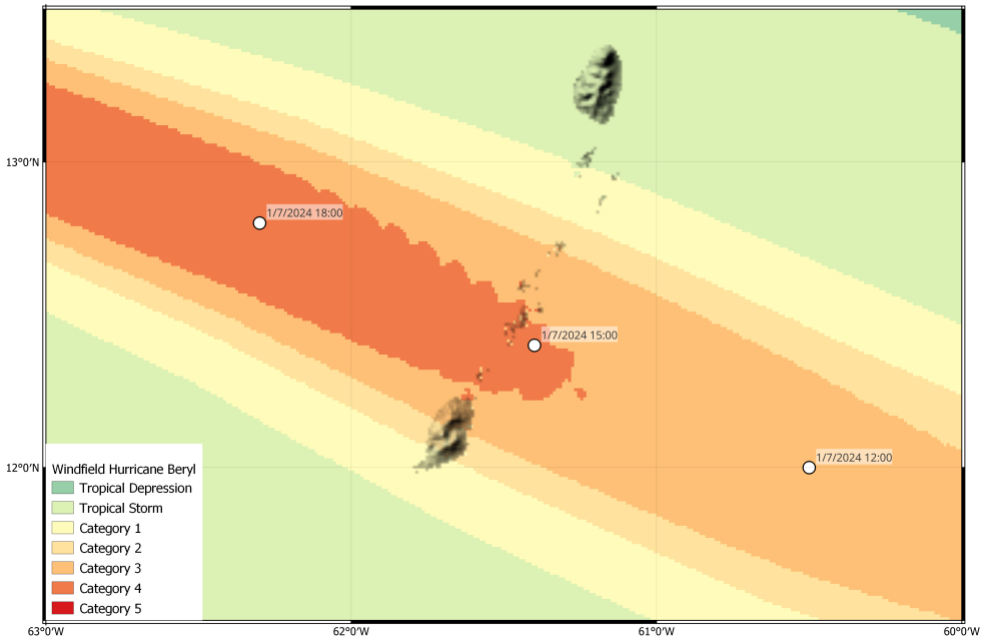

Figure 5: Calculated wind field map for Hurricane Beryl

3.0 Results

Table 6 shows the best estimate of total direct economic damages to physical assets in SVG by sector caused by Hurricane Beryl. Total damages are substantial at an estimated US$ 230.6 million, equivalent approximately to 21.6 percent of the 2023 GDP.

Overall, building damage accounted for more than two-thirds of the total damages. Damage to buildings' contents is also included. Residential damages are estimated to be US$ 79.1 million including structural damage and damage to contents. Non-residential damages, including social infrastructure, public buildings, industrial and commercial assets, are estimated at US$ 79.8 million including damage to resorts, residential buildings used as tourist accommodation and related infrastructure. This also includes resorts such as on Petit Saint Vincent and Palm Islands.

Infrastructure and to a much lesser extent agriculture damages are estimated at US$ 71.7 million. Key sectors included were power networks, telecommunications assets, water networks, transport networks, including airports, roads, and coastal infrastructure. Minor agricultural damage estimates included crop and livestock damages and small-scale infrastructure such as irrigation. Given the relatively minor impact these agricultural damages are integrated under infrastructure damages.

Table 6: Summary of estimated damages by sector in Saint Vincent and the Grenadines

Sector	Definition	Estimated damages US$ million
Residential	Houses and contents	$79.1
Non-Residential	Commercial, industrial, public and mixed-use buildings and contents	$79.8
Infrastructure and Agriculture	Power networks, water networks, telecoms, seaports, jetties, coastal structures, airports, roads, bridges. Crops, livestock, dairy, small-scale infrastructure, fisheries *excluding: boats*	$71.7
Total		$230.6 22% of 2023 GDP[25]

Table 7 and Table 8 present the total damage estimated by sector and by island and separately the portion of these damages that is related to the tourism sector in each island, which includes non-residential buildings and some resort-related infrastructure. Palm Island and Petit Saint Vincent are private island resorts, so economic damages are nearly entirely attributable to the tourism sector. More than one-fifth of the total estimated direct economic damages are related with the tourism sector. Figure 6 and Figure 7 display these data geospatially. However, these results rely on damage estimations for a small number

[25] https://data.worldbank.org/country/st-vincent-and-the-grenadines

of large tourism assets with high asset values, small variations in these values can lead to greater inaccuracies in their specific estimates.

In absolute terms (US$ millions), the island of Mustique suffered little damage, while Union Island and Canouan exhibit the highest damage. Damage on Saint Vincent is estimated to be less than one tenth of the total damages.

Table 7: Total damages by sector and location in US$ millions

Islands	Residential	Non-Residential	Infrastructure + Agriculture	Total Value (mn USD)
Union	36.2	28.3	28.9	**93.3**
Palm Island + Petit Saint Vincent	2.3	21.6	8.8	**32.7**
Mayreau	2.9	4.1	3.1	**10.1**
Canouan	15.5	15.6	19.6	**50.7**
Mustique	1.1	.2	1.0	**2.3**
Bequia	8.3	5.4	6.6	**20.3**
Saint Vincent	12.9	4.6	3.7	**21.2**
Total	**79.1**	**79.8**	**71.7**	**230.6**

Table 8: Total estimated damages for the tourism sector by location in US$ millions

Islands	Tourism (Non-Res + estimated Res, Infra) (mn USD)
Union	7.7
Palm Island + Petit Saint Vincent	30.3
Mayreau	3.2
Canouan	7.3
Mustique	na
Bequia	1.4
Saint Vincent	na
Total	**49.9**

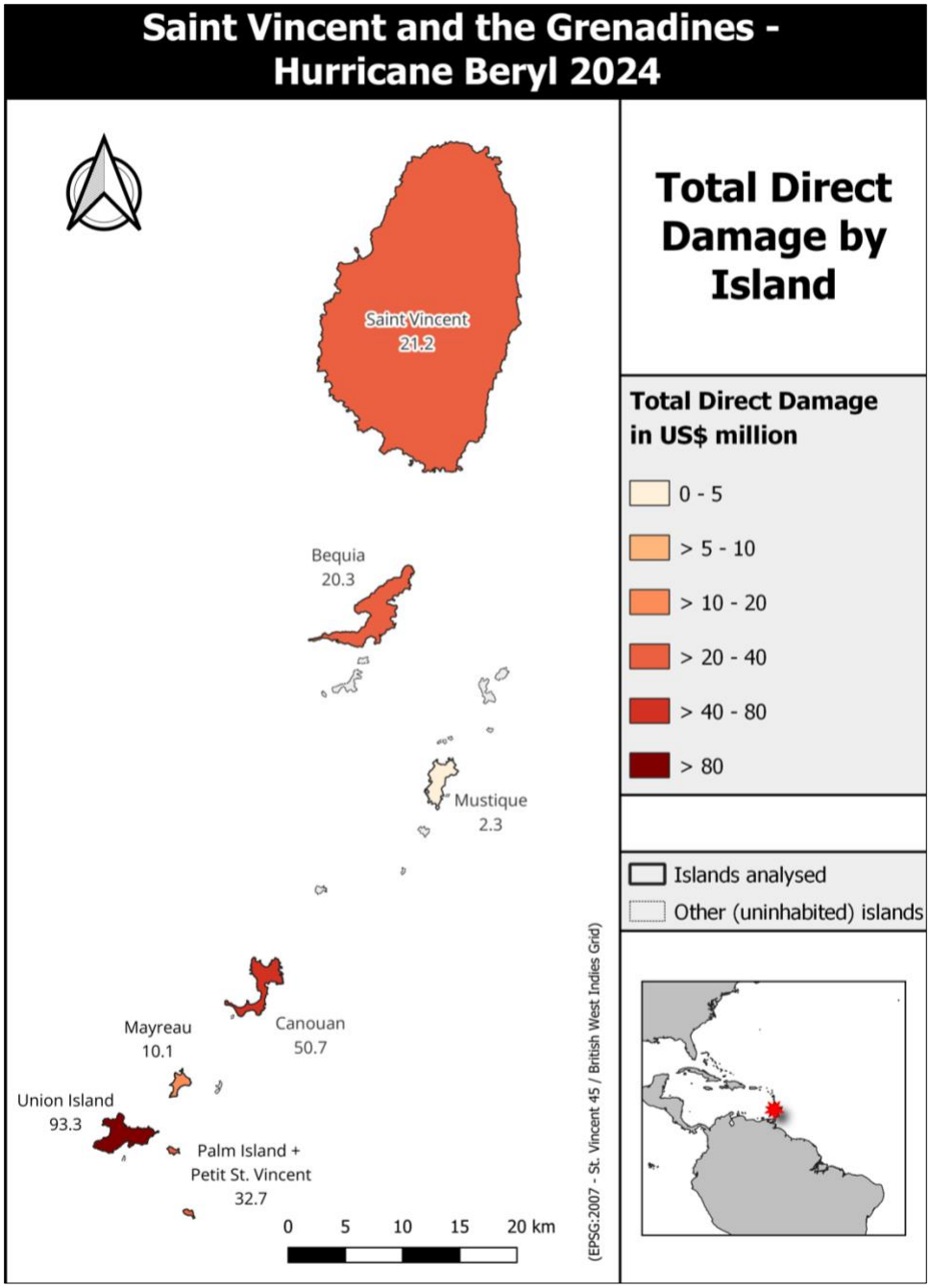

Figure 6: Total damage estimates by island in US$ millions

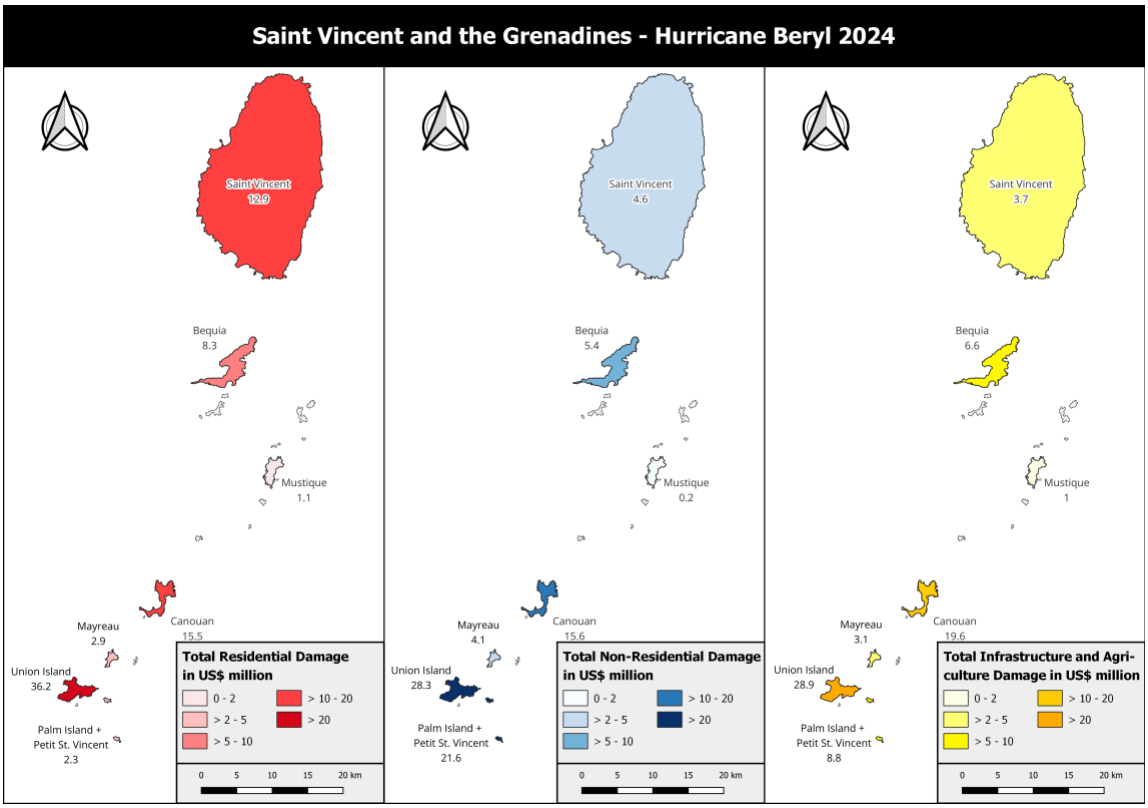

Figure 7: Sectoral damage maps by island in US$ millions

4.0 Interpretation of results

The best overall estimate from the GRADE assessment places the total cost of direct economic damages to physical assets from Hurricane Beryl to residential, non-residential, infrastructure, and agriculture sectors in SVG at US$ 230.6 million or XCD 623 million. This is equivalent to 22 percent of the SVG GDP in 2023. This makes Hurricane Beryl one of the costliest hurricanes to impact SVG on record.

Similar overall damages were seen after Hurricane Allen in 1980, when damages were estimated as 19 percent of SVG's GDP. SVG has not experienced wind speeds over Category 4 hurricane in over 125 years. Hurricane Beryl brought Category 4 hurricane force winds, significant rainfall and storm surges to the Southern Grenadines. Lower wind speeds were recorded in Northern Grenadines and Saint Vincent where storm surge activity was also recorded. Overall, four tiers of damage were observed across the islands:

1. Union Island, Palm Island, and Petit Saint Vincent have had catastrophic damage to buildings, infrastructure and minor agriculture, including contents and other equipment.
2. Mayreau and Canouan have seen substantial damage to buildings and infrastructure, however, the damage was not as catastrophic as further south.
3. Bequia has seen notable damage to buildings and to some infrastructure like power and telecoms but significantly less than further south.
4. Southern Saint Vincent and Mustique had minor damage to buildings (e.g., disconnected roofs).

Infrastructure damages totalled US$ 71.7 million, including major damage to fragile infrastructure networks in the Southern Grenadines, including telecommunications, water, and power. Resilient

reconstruction should be prioritized. Agricultural enterprises suffered damage to crops, livestock, and fruit trees which will directly impact on farmers livelihoods. Concerns about food security in the next three months have been raised given damages to fishing infrastructure (berthing structures) in the Grenadines[26].

The tourism sector in the southern Grenadines has been particularly badly hit, with some large resorts such as Palm Island and Petit Saint Vincent severely damaged, and smaller scale boutique hotels and holiday villas also sustaining damage. In 2023, international tourists' spending in SVG was estimated at over US$ 185 million[27]; tourism provides around 19 percent of formal employment opportunities[28], and employs a significant number of women[29]. In 2019, before the global pandemic, tourism contributed 28.6 percent of SVG's GDP. Many of the country's tourism assets are in the Grenadine islands, so these impacts may be felt severely, even if some assets will be insured.

Table 9 provides the distribution of the vulnerable population obtained from analyis of the SVG 2007-08 Living Conditions Survey. The majority of vulnerable persons live in lower income housing which is often more vulnerable to hurricanes. The widespread use of sheet metal roofing throughout SVG means that the majority of buildings are vulnerable to strong winds, especially when roofs and cladding are not tied down adequately. The damage to structures in the Northern Grenadines and Saint Vincent could be significantly reduced with relatively straight forward structural improvements, for example, installing hurricane straps and using screws instead of nails at the correct spacing to fix down roof sheeting. These measures may have helped in some cases in the Southern Grenadines. However, for major hurricanes more advanced structural improvements may be needed.

Table 9, in the Southern Grenadines, 52 percent of the population is considered vulnerable. Relatively, economic damage of the same level impacts the poor and vulnerable more severely, so recovery and reconstruction support should be tailored to the profile of population impacted.

Table 9: Distribution of population by a household's socio-vulnerability status by region in Saint Vincent and the Grenadines (Source: 2007-2008 SVG Living Conditions Survey)

	Vulnerable	**Not vulnerable**
Kingstown	29%	71%
Suburbs of Kingstown	57%	43%
Calliaqua	42%	58%
Rest of Saint Vincent	57%	43%
Northern Grenadines	24%	76%
Southern Grenadines	52%	48%

Figure 8 indicates the potential indicative savings possible by introducing resilient structural improvements to structures such as those found in SVG. The savings can extend to over US$ 6 for every

[26] UNOCHA (July 19, 2024) Eastern Caribbean: Hurricane Beryl. Situation Report No. 04.
[27] https://www.stvincenttimes.com/st-vincent-tourism-sector-records-growth-as-economy-recovers/
[28] https://www.state.gov/reports/2021-investment-climate-statements/saint-vincent-and-the-grenadines/
[29] https://www.undp.org/sites/g/files/zskgke326/files/2022-09/undp_diagnostic_report_2022_-_stvincentgrenadines-final.pdf

US$ 1 spent. The return on investment for the poorer and more vulnerable groups is greater than for the not vulnerable group in the population. Annex 3 gives an overview of the cost benefit analysis for Saint Vincent and the Grenadines[30].

Saint Vincent and the Grenadines has recently adopted the Organisation of Eastern Caribbean States (OECS) building code, so this, if followed and enforced, could help to ensure that all reconstruction and future new construction is designed and constructed resiliently.

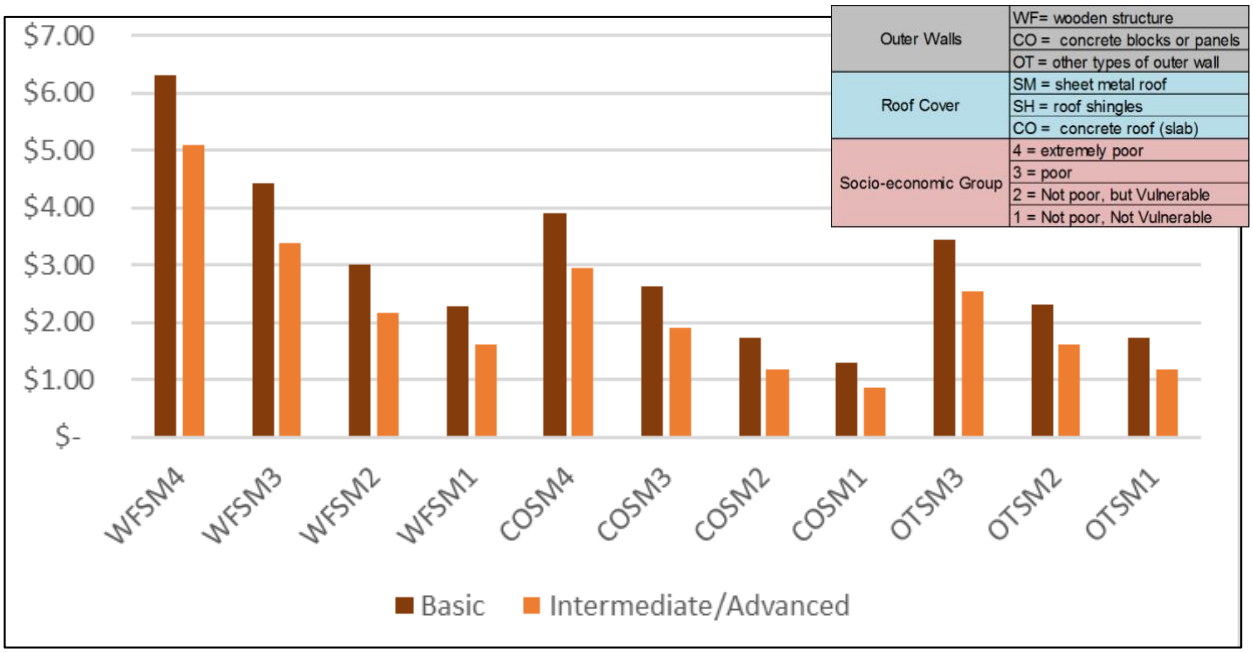

Figure 8: Return on investment per $1 of structural improvements in Saint Vincent and Grenadines as part of a risk profile (basic or intermediate/advanced) made to structures to improve hurricane resilience. The inset legend provides details on the types of outer walls, the types of roof covers, and the categories of socio-economic groups.

Additionally, social inequality often intensifies in the aftermath of a disaster, making it crucial to address the specific needs of vulnerable households and women during recovery efforts. Before Hurricane Beryl, the situation in SVG was already challenging with maternal mortality ratio at 62 per 100,000 live births[31], higher than the average for Upper-Middle-Income Countries (UMC). This high mortality ratio highlights significant gaps in healthcare that can worsen when disaster strains already limited resources. Also, women's labor force participation rate was 54.6 percent, much lower than men's participation rate of 73.1 percent[32]. The informal sector, where women dominate 80 percent of medium, small, and micro enterprises (MSME), suffers greatly during disasters, particularly in wholesale and retail trade and accommodations and food services. With these sectors heavily impacted, women face substantial income losses.

[30] Disaster Risk Assessment and Adaptive Social Protection Analysis for St. Vincent and the Grenadines" (2023) from the WB/GFDRR (Unpublished)

[31] World Bank. (n.d.). *Gender Data Portal: St. Vincent and the Grenadines*. Retrieved July 22, 2024, from https://genderdata.worldbank.org/en/economies/st-vincent-and-the-grenadines

[32] World Bank. (n.d.). *Gender Data Portal: St. Vincent and the Grenadines*. Retrieved July 22, 2024, from https://genderdata.worldbank.org/en/economies/st-vincent-and-the-grenadines

Moreover, disasters often exacerbate gender-based violence (GBV) and mental health challenges, underscoring the intersectional vulnerabilities faced by different segments of the population in the wake of such events. The World Bank notes that post-disaster contexts can present opportunities to enhance gender equality and women's empowerment, emphasizing the need for gender-responsive recovery and reconstruction efforts.[33] Additionally, leased land is predominantly held by men in SVG. Following the 2013 floods, about 500 people remained homeless, mainly women and children, likely owing to poor housing, especially among Female-Headed Households (FHHs)[34].

GRADE assessments for smaller nations can significantly benefit from reporting of damages. Usually the D-RAS team draws on risk modelling approaches when performing GRADE assessments, however in this case, where total numbers of buildings are relatively small, the damages reports, satellite assessment, and visual inspections will likely offer more accuracy.

4.0 Conclusions

This GRADE report provided a synopsis of the direct economic impacts to physical assets of Hurricane Beryl in SVG during July 2024. Damage was concentrated in the Southern Grenadines, where wind speeds were higher, however, notable levels of damage also extended north to the main island of Saint Vincent. Total damages are estimated to be US$ 230.6 million or approximately 22 percent of SVG's 2023 GDP, to residential buildings and their contents, non-residential buildings and their contents, infrastructure, and agriculture.

Union Island was the worst hit, suffering an estimated US$ 93.9 million in damages (41 percent of the total damages). Canouan sustained an estimated US$ 50.7 million in damages (22 percent of the total damages). Palm Island and Petit Saint Vincent are small islands that host luxury resorts, and damages are estimated to be substantial. Mayreau, also in the Southern Grenadines, is estimated to have sustained US$ 10.1 million in damages. Mustique suffered only minor superficial damage, totaling an estimated US$ 2.3 million, while nearby Bequia sustained an estimated US$ 20.3 million in damages. The southern parts of the main island of Saint Vincent were subjected to tropical storm force winds and sustained an estimated US$ 21.2 million in damages.

The Southern Grenadines are home to a population of which 52 percent are considered vulnerable; however, these are 2007/8 figures from the Government of SVG. Relief and reconstruction efforts will need to be tailored to support this group of Vincentians to recover.

In total, damage to buildings accounts for over two-thirds of the total damage. The residential sector is estimated to have sustained US$ 79.1 million in damage, while non-residential buildings sustained US$ 79.8 million in damages. Infrastructure and agriculture combined account for an estimated US$ 71.7 million in damages, within which damages to agriculture are relatively small.

Damages to the tourism sector (included in related non-residential buildings and related infrastructure) are particularly important given the significant role it plays in the SVG economy and the concentration of tourism assets in the Southern Grenadines. The sector is estimated to have sustained approximately US$

[33] Erman, A. et al. 2021. Gender Dimensions of Disaster Risk and Resilience: Existing Evidence. World Bank, Washington, DC. https://openknowledge.worldbank.org/handle/10986/35202

[34]https://documents1.worldbank.org/curated/en/099625411282224057/pdf/P1712560d4efcc0950b9030c6feb9f513e8.pdf

50 million in damages, with a large proportion of that due to the impacts on Palm Island and Petit Saint Vincent. These values may change as damage to these two resort islands becomes better understood through detailed assessments.

Notably, over 90 percent of the SVG population live in structures that have sheet metal roofing, which is particularly vulnerable to strong winds. Minor structural improvements would increase resilience against future storm events and should be closely considered for the recovery and reconstruction efforts, given the context of climate change.

This GRADE assessment is based on damage reporting from a range of agencies, local media reports, as well as modelling of the present-day buildings and infrastructure in SVG. Analysis and results were checked and verified using a wide range of data sources, including satellite imagery, academic studies, government data, CDEMA and NEMO reporting, and social media reports.

Annex 1: Data sources

Datasets used include:

- CDEMA and OCHA Situation Reports
- SVG NEMO Reports including the NEMO/CDEMA Rapid Needs Assessment (RNA) Report – HU Beryl for SVG (2024)
- Population from Census data and projections
- Local media publications, including the Saint Vincent Times, iWitness News, One News SVG, Searchlight.vc and The Vincentian Newspaper
- ReliefWeb and Humanitarian Info updates
- UNOSAT, Copernicus, Sentinel and other remote sensing imagery
- GlobalML and Google Building footprints
- Local and international news reports
- Social Media reports from X, Facebook and other sources and corroboration of photo data
- Unit Costs of Construction (UCC) from Building Permit statistics (2004, 2012, and 2019).
- Building and population data and projections
- 2012 SVG Population and Housing Census
- 2007-2008 SVG Living Conditions Survey
- Physical Planning Unit data (building attributes, enumeration districts, hotels and other public buildings)
- World Bank's Country Disaster Risk Profile (CDRP) for SVG
- Past PDNAs and disaster reporting in SVG and the Windward Islands
- NOAA National Hurricane Center datasets
- CHARIM Project datasets including Land Cover 2014
- Settlement Information Agriculture data from 2015-2022 from Ministry of Agriculture, Forestry, Fisheries with FAO data
- Infrastructure data from OSM, CHARIM, and other global products
- Building typologies from census data, footprints from OSM
- UWI Seismic Research Center Reports
- World Bank economic data
- Capital stock estimates using budget and capital investment data
- Wind station data

Annex 2: Historical hurricane event descriptions

Notable hurricanes in SVG also occurred in August 1831 and September 1898. The September 11, 1898, hurricane caused the loss of up to 300 lives and damage to properties and agricultural production, including the destruction of 6,000 houses, leaving half of the population homeless while limited subsistence crops and external communications were lost[35]. Contemporaneous reports suggest windspeeds of 110 mph, which would make the 1898 hurricane equivalent to a Category 2 to 3 event. Hurricane Janet from September 1955 was considered the first Category 2 hurricane to directly affect SVG since 1898.

Hurricanes Allen in 1980 and Emily in 1987 caused damage to banana and coconut crops. Damages and losses caused by Allen, that affected Saint Vincent as a Category 2 hurricane, were estimated at 20 percent of 1980's GDP, about US$16.3 million. Hurricane Emily in 1987, which was of tropical storm strength when it passed over Saint Vincent, impacted banana plantations, resulting in 70 percent of crop loss.

On September 8, 1986, Tropical Storm Danielle produced a heavy rain band with hurricane-force gusts that moved across Saint Vincent, causing a major power outage and crop damage. Another rain system affected the country a few weeks later, and the combined monetary damage totaled US$9.2 million (in 1986 values). About 142 people had to seek shelter after their homes were destroyed, and 436 homes and residential buildings were impacted.

The hurricane seasons in the 1990s were very active, and impacts were felt in SVG in 1994, 1995, 1998, and 1999. Hurricane Lenny in 1999 caused extensive damage to the west coast of the island, washing away four buildings, and damaging five others. About 50 people were moved to shelters.

In 2002, Hurricane Lili (a tropical storm when it passed near SVG) caused significant damage to several hundred homes and two schools. The roof of the Rose Hall Police Station was blown off. In all, estimated losses totaled US$14.8 million or XC$40 million[36] (of which XC$30 million was in the agricultural sector) or nearly 9 percent of that year's GDP.

In August 2004, a tropical depression dumped 235 mm of rain on Saint Vincent, flooding the E. T. Joshua Airport terminal and causing the runway at Arnos Vale to close temporarily. Later that August, Tropical Storm Earl was responsible for at least two houses losing their roofs, extensive power outages, and moderate banana crop damage.

In September 2004, Hurricane Ivan caused severe wind-driven damage to 50 houses, while another 120 houses lost their roofs. Additionally, the Union Island hospital lost part of its roof, and a resort on Palm Island lost its jetty. Wave heights from the hurricane reached 20 feet (6.1 m) along parts of the SVG coastline washing away two houses and causing heavy damage in the northern part of Union Island, while the ensuing storm surge destroyed 19 homes and damaged 40 more. Damage in SVG totaled US$40 million (7.7 percent of its 2004 GDP). In Mayreau, a tremendous amount of coral rubble was deposited all over, with "islands" forming on the reefs at Grand Tarchie, as well as at Clifton and Ashton in Union Island. A few yachts reportedly went aground at Union Island, and a commercial vessel, which attempted to shelter at Spring Bay, Bequia, was blown ashore[37].

[35] Cap TA et al. (1899) The West Indian Hurricane, September 1898 (Plate II). Quarterly Journal of the Royal Meteorological Society 25(109), pp. 23-32. https://doi.org/10.1002/qj.49702510904

[36] 1 US$ = 2.7 East Caribbean Dollars (XC$)

[37] https://www.caribbeancompass.com/hurricanegren.htm

In October 2010, Hurricane Tomas caused damage and losses equivalent to 7 percent of 2010 GDP of SVG. This was a rapidly intensifying tropical storm then turned into a hurricane as it approached SVG and caught many Vincentians off guard. It was reported that the agriculture sector sustained over US$25 million (XC$67 million) in damages, while total damages reached US$48 million (XC$ 130 million). Over 1,200 people were forced to seek refuge in hurricane shelters, and about 600 houses had lost their roofs. Numerous downed power lines, trees, and landslides made some roads impassable, though they were re-opened within two to three days. Within six months of Tomas's arrival, heavy rains caused further flooding and landslides (especially in the March-April 2011 period when more than sixteen separate flood events and floods combined with landslides events were recorded). Damage from these was estimated at US$31.1 million (XC$84 million).

The most destructive event of recent decades in SVG was the 2013 Christmas Trough. According to SVG's National Emergency Management Organization (NEMO), the consequent floods caused economic losses of US$122 million (XC$330 million), equivalent to 16.2 percent of its 2013 GDP, while the direct damages were estimated at US$86.4 million (XC$232 million). There was significant damage to roads and bridges, 93 landslides, and 530 houses damaged, of which 34 houses were destroyed.

In September 2016, Tropical Storm Matthew (later becoming Hurricane Matthew) brought heavy rains causing floods and landslides across the island. In November 2016, two tropical trough systems produced heavy rains, which resulted in intense flooding across the island chain. Torrential rains, ensuing flash flooding, and landslides resulted in widespread damage to roads, bridges, water infrastructure, and housing. The cost of damages from the November 2016 floods was estimated at US$29.7 million or 3.85 percent of the 2016 GDP.

In August 2017, Hurricane Harvey made landfall on Saint Vincent as a tropical storm, causing nine flooded homes, four wind damaged homes, and a tree to fall on a school. Blocked drains in Port Elizabeth (Bequia Island) resulted in more than 15 flooded businesses. A total of 15 people were housed in shelters after the storm.

In September 2018, Tropical Storm Kirk's rough seas caused coastal flooding that forced three families to evacuate their homes in New Sandy Bay village and seek shelter in a public school. Kirk was also responsible for the presumed deaths of two fishermen after they ventured out during the storm. In addition, heavy rainfall and resultant river flooding affected northeastern Saint Vincent, with precipitation totals exceeding 100 mm.

Annex 3: Overview of cost benefit analysis of structural improvements for SVG

The report "Disaster Risk Assessment and Adaptive Social Protection Analysis for St. Vincent and the Grenadines" (2023) from the WB/GFDRR (Unpublished) includes a cost benefit analysis of existing socioeconomic and tropical cyclone hazard data in order to estimate risk and account for climate impacts; and then to quantify the correlation between hazard and social protection, and to estimate future potential losses and therefore budget requirements for social protection policy. Two options were explored as part of the cost-benefit analysis to gauge the benefits versus the costs of a large-scale retrofitting of sheet metal roofs required for protection from hurricane winds in SVG's residential typologies.

The traditional methodologies of cost-benefit analyses use a relative cost of retrofit compared to the value of the house before retrofit (according to the Federal Emergency Management Agency of the United States (FEMA)). When an extensive retrofit program is considered, such methodologies are often used because of the unknown nature of the cost of retrofit relative to the value of house. Depending on a household's social class, the value of a house can differ greatly. In this way, the cost-benefit analyses often produce results where the more vulnerable building stock has larger benefits.

Table 10 summarizes the various characteristics and construction attributes that are affected by wind damage and other vulnerabilities. Each of these were explored. Users should refer to the FEMA Retrofit Guide[38] for more details. Table 11 summarizes the costs relative to the building value of the various retrofit options for wood frame houses with a hipped or gable roof.

Table 10: The list of building characteristics to be examined for Retrofit Option 2 from FEMA P-804, 2010.

Characteristic	Value	Comments
Building Type	Wood or Masonry	Indicates if the single-family residence is constructed out of wood or masonry.
Number of Stories	One Story, or Two or More Stories	Indicates if the single-family residence has one or more stories.
Roof Shape	Hip or Gable	Indicates if the single-family residence has a hip or gable roof.
Secondary Water Resistance	Yes or No	Identifies whether there is a secondary water resistance barrier to prevent water penetration through the roof decking after the loss of the roof covering.
Roof deck Attachment	6d Nails at 6/12, 8d Nails at 6/12, 6d/8d Mix at 6/6, or 8d Nails at 6/6	Refers to the nail diameter (e.g., 6d refer to 0.06 inch) and spacing of the nails (6/12 is 12 inches on-center, 6/6 is 6 inches on center) that attach the roof decking.

[38] https://www.fema.gov/sites/default/files/documents/fema_p-804-wind-retrofit-guide-042023.pdf

Roof-Wall Connection	Toe-Nail or Strap	Indicates if the load path of the single-family residence can transfer loads from the roof to the foundation. In general, a strap provides a better connection from the roof framing to the walls than solely nails. The roof-wall connection has been a weak, damage-prone point in past hurricanes.
Shutters	Yes or No	This characteristic indicates if the single-family residence has shutters, thereby reducing windborne debris damage to the building and its contents.
Garage	None, Weak Door, Standard Door, or South Florida Building Code (SFBC) 94 (if shuttered)	Indicates whether the residence has a garage, and, if present, the strength of the garage door. Reinforced garage doors are considered standard and unreinforced doors are considered weak.
Masonry Reinforcing	Yes or No	This characteristic indicates if a masonry single-family residence has reinforced or unreinforced masonry walls.

*Table 11: Estimated retrofit costs as a % of building value with various options for hip and gable type roofs (an of **average one- and two- story, wood framed houses**), according to FEMA.*

Retrofit Cost as % of Building Value	**Hip**	**Gable**
Basic without replacing roof cover	1.8%	2.4%
Basic with replacing roof cover	4.0%	5.2%
Basic with opening protection, not replacing roof cover	4.0%	4.7%
Basic with opening protection with replacing roof cover	6.3%	7.5%
Intermediate without replacing roof cover	5.0%	5.8%
Intermediate with replacing roof cover	7.8%	8.6%
Advanced without replacing roof cover	11.3%	12.1%
Advanced with replacing roof cover	14.1%	14.9%

It is important to consider that the retrofit costs differ significantly due to differences in construction type and existing home values. For example, concrete block wall-sheet metal roof houses would likely require the highest costs associated with a change to the various components. A professional assessment would be required to back up this option. It would be uneconomical for this typology when applying an intermediate/advanced option. While this type of building would maintain 10% of its value over a 30-year lifecycle, the homeowner would still likely face repair costs from hurricane damage.

About GRADE

GRADE reports provide an estimate of the costs associated with the economic damage to physical assets of housing, public buildings, non-residential buildings, agriculture, and critical infrastructure using a methodology that considers the disaster's three components: hazard, exposure, and vulnerability. To conduct GRADE reports, the World Bank's D-RAS team compiles physical damage information by employing hazard and engineering modelling, checks the information carefully against observations and historical precedent, and presents the data, figures, and estimated costs in the first weeks after a major disaster such as cyclones, earthquakes, floods, hurricanes, typhoons, and conflicts. GRADE reports continue to provide a useful initial estimate of the damages and economic impact and help contribute and complement additional damage and loss assessments conducted, which all are key to plan and design disaster recovery and reconstruction. To date, the D-RAS team has conducted more than 60 GRADE assessments. So far, on average, GRADE's estimated overall damages are above 80 percent accurate relative to the detailed, on the ground assessments that follow in the weeks and months after a disaster.