SAINT LUCIA

Flood Event of December 24–25, 2013

A Report by the Government of Saint Lucia and the World Bank

March 2014

Joint Rapid Damage and Needs Assessment

WORLD BANK GROUP

GFDRR

With financial support from the European Union
In the framework of the ACP-EU Natural Disaster Risk Reduction Program
managed by the GFDRR

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Foreword

On December 24 and 25, 2013, a tropical trough system produced excessively heavy rains in Saint Lucia—at a time normally considered outside of the hurricane season. The extreme rainfall led to rapid and intense flash flooding as well as numerous landslides, and caused severe damage to transport, water supply, and drainage infrastructures as well as significant damage and loss in the agriculture, tourism, and housing sectors.

The southern region of the island—particularly Anse La Raye, Canaries, Soufriere, Micoud, Choiseul, and Vieux Fort—was heavily affected. Immediately after the passing of the trough, emergency response activities were initiated to restore operations and access to services as well as provide critical support to communities that had been most adversely affected. While services and transport mobility have largely been restored, much work remains to be done to rehabilitate and retrofit primary and secondary infrastructures as well as to better integrate risk reduction activities within public and private investment and planning processes.

The government of Saint Lucia recognizes the severity of this event and wishes to express its sincere condolences to the families of those who lost their lives as a result of the storm. In response to the devastation, the government of Saint Lucia has prepared a Joint Rapid Damage and Needs Assessment report in partnership with the World Bank.

This analysis provides an initial foundation for identifying and developing post-disaster recovery and reconstruction activities for Saint Lucia. The report evaluates required efforts—from relief to recovery—and includes short-, medium-, and long-term recommendations for reducing our nation's physical, socioeconomic, and fiscal vulnerabilities to disaster.

To this end, this document represents Saint Lucia's full commitment to build back better toward a more disaster-resilient future.

Honorable Dr. Kenny Anthony
Prime Minister and Minister of Finance

Acknowledgments

This Joint Rapid Damage and Needs Assessment report was prepared at the request of the government of Saint Lucia immediately after the devastating floods and landslides resulting from the December 24–25 trough. It was undertaken jointly by the government of Saint Lucia and the World Bank.

The government wishes to extend its appreciation to the World Bank for its prompt assistance in preparing this report, and acknowledges the numerous ministries and organizations for their support and assistance in granting access to information and their availability for discussions during the assessment. These include:

- LIME (Cable & Wireless)
- Saint Lucia Air and Sea Ports Authority
- The Ministry of Agriculture, Food Production, Fisheries, Co-operatives and Rural Development
- The Ministry of Commerce, Business Development, Investment and Consumer Affairs
- The Ministry of Education, Human Resource Development and Labour
- The Ministry of Finance, Economic Affairs and Social Security
- The Forestry Department and Water Resources Management Agency of the Ministry of Sustainable Development, Energy, Science and Technology
- The Ministry of Health, Wellness, Human Services and Gender Relations
- The Ministry of Infrastructure, Port Services and Transport
- The Ministry of Physical Planning, Housing and Urban Renewal
- The Ministry of Social Transformation, Local Government and Community Empowerment
- The Ministry of Tourism, Heritage and the Creative Industries
- The National Emergency Management Organisation
- Water and Sewerage Company

The World Bank team was led by Tiguist Fisseha (Disaster Risk Management Specialist) and consisted of Kimberly Burrowes (Urban/Disaster Risk Management Analyst), Christophe Chung (Urban/Disaster Risk Management Analyst), Marco Rodriguez Corrales (Senior Disaster Risk Management

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The government of Saint Lucia would also like to acknowledge the financial support provided by the European Union and the Global Facility for Disaster Reduction and Recovery for this post-disaster assessment and report. The photographs used in this publication were either provided by the government of Saint Lucia or taken by the evaluation team.

Abbreviations and Acronyms

CAT DDO	Catastrophic deferred drawdown option
CCRIF	Caribbean Catastrophe Risk Insurance Facility
CDB	Caribbean Development Bank
CDEMA	Caribbean Disaster Emergency Management Agency
DaLA	Damage and Loss Assessment
DANA	Damage and Needs Assessment
DRM	Disaster risk management
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross domestic product
JRDNA	Joint Rapid Damage and Needs Assessment
LUCELEC	Saint Lucia Electricity Services Limited
km^2	Square kilometer
MIPS&T	Ministry of Infrastructure, Port Services and Transport
mm	Millimeter
MoE	Ministry of Education, Human Resources Development and Labour
MoF	Ministry of Finance, Economic Affairs, Planning and Social Security
NEMAC	National Emergency Management Advisory Committee
NEMO	National Emergency Management Organisation
NICE	National Initiative to Create Employment
NRDU	National Reconstruction Development Unit
PCU	Project Coordination Unit
UN-ECLAC	United Nations–Economic Commission for Latin American and the Caribbean
WASCO	Water and Sewerage Company
WRMA	Water Resource Management Agency

Executive Summary

On December 24 and 25, 2013, at a time outside the normal hurricane season, a tropical trough system passed over Saint Lucia and produced extraordinarily heavy rains (greater than 224 mm in a matter of two to three hours), with the highest intensities recorded in the southern portion of the island. Owing to the island's mountainous topography and the already saturated condition of the soil, the rainfall produced intense and rapid flash flooding. As a result, the island suffered severe damages to infrastructure, primarily related to transportation, water, and housing, with the worst damage in the south. Agriculture was also severely affected.

Based upon an initial assessment of impacts to each affected sector, the December 24–25 flood event resulted in total damage and loss of **US$99.88 million** (EC$267.76 million), equivalent to **8.3 percent** of Saint Lucia's gross domestic product. Transport infrastructure sustained the majority of damages (72 percent), followed by infrastructure for agriculture (13 percent), water and sanitation (6 percent), and housing (4 percent). Out of a total population of 180,870,[1] **six persons were confirmed dead, over 550 were displaced, and approximately 19,984 were directly impacted by the event.** A summary of damage and loss by sector is detailed in table 1.

Table 1: Summary of Damage and Loss by Sector

	Damage US$ (millions)	Loss US$ (millions)	Total US$ (millions)	Total Loss and Damage (percent)	Damage EC$ (millions)	Loss EC$ (millions)	Total EC$ (millions)
Sectors							
Productive							
Agriculture	9.21	3.71	12.92	**12.99**	24.76	9.85	34.63
Tourism	0.0	2.11	2.11	**2.12**	0.00	5.66	5.66
Commerce	0.4	NE	0.42	**0.42**	1.13	NE	1.13
Infrastructure							
Water and sanitation	2.30	4.10	6.40	**6.44**	6.07	11.01	17.08
Transportation	68.80	3.10	71.90	**72.31**	184.38	6.96	191.35
Electricity	NE	NE	NE	**NE**	NE	NE	NE
Telecomm	0.12	0.41	0.53	**0.53**	0.32	1.10	1.42
Social							
Housing	2.15	2.05	4.20	**3.81**	5.77	5.51	11.28
Education	0.80	0.19	0.99	**1.00**	2.15	0.51	2.66
Health	0.24	0.13	0.37	**0.37**	0.64	0.35	0.99
TOTAL	**$80.03**	**$19.85**	**$99.88**	**100.00**	**$214.40**	**$53.36**	**$267.76**

Note: NE = not evaluated.

[1] World Bank, World Development Indicators database, 2013.

Chapter 1

Introduction and Event Description

1. Introduction and Event Description

1.1 Country Profile

1. With a gross national income per capita of US$10,300,[2] Saint Lucia is an upper-middle-income small island state, with an estimated population of 174,000 (2010). After growing 4.5 percent annually on average during 2003–2006, economic activity slowed sharply in recent years as Saint Lucia was hit by multiple exogenous shocks: Hurricane Dean in August 2007, an earthquake in November 2007, the global food and energy price hikes in 2007–2008, and severe droughts in 2009 and 2010. Between 2008 and 2009, economic growth fell from 5.8 percent to –1.3 percent, largely resulting from the 2008 global financial crisis. The construction, manufacturing and agriculture sectors were significantly affected, along with the tourism sector, which accounts for 65 percent of GDP and represents the main source of foreign exchange earnings and the second largest employer after the public sector.[3] Saint Lucia's economy continues to contract with an estimated negative growth rate of 2.3 percent in 2013[4] driven by a decline in private investment and construction activity.

2. Despite relatively strong social indicators—the 2013 United Nations Development Programme Human Development Index ranked Saint Lucia as 88th of 187 countries[5]—poverty and inequality remain high in Saint Lucia. According to the latest Country Poverty Assessment (2005–2006), 28.8 percent of the population lives below the locally defined poverty line (an increase from 25.1 percent in 1995), while 6 percent of the population is indigent[6] and 40.3 percent is estimated to consume at a level under the vulnerability line.[7] In addition, approximately 20.5 percent of the population is unemployed (2010), an increase of 11 percent since 2005. In 2006, the Gini coefficient of Saint Lucia was 0.42, with sharp regional differences evident in rates of poverty, ranging from highs of 44.9 percent and 42.4 percent in the Anse La Raye and Soufriere Districts, respectively, to 13.1 percent in the capital city, Castries. Recent disaster trends have also demonstrated that areas with the highest rates of poverty tend to be more harmed than others by disasters such as flooding and landslides.

3. While Saint Lucia continues to try to improve its citizens' social conditions through investments in infrastructure, economic diversification, and employment generation, its population, economy, and national assets remain highly exposed to natural catastrophic risk. Over the years, disasters stemming from weather-related natural hazards, such as winds, floods, landslides (often related to hurricanes), and droughts have increasingly impacted livelihoods, destroyed infrastructure, and disrupted provision of essential services. As a result, disaster recovery and reconstruction efforts have required the commitment of a growing share of the national budget, thereby imposing large costs on the country's fragile economy and setting back hard-won development gains.[8]

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[2] Estimated 2012 GNI per capita, PPP (current international $). World Development Indicators, The World Bank, 2014

[3] CIA, World Factbook, 2013.

[4] Page 27, Saint Lucia Budget Statement, 2014.

[5] See http://hdr.undp.org/sites/default/files/Country-Profiles/LCA.pdf.

[6] Indigence is defined as "persons whose daily average consumption is too low to guarantee adequate nutrition to maintain good bodily health." Ibid., xvi.

[7] A vulnerability line is defined as 125 percent of the poverty line; it measures the number of persons who are susceptible to becoming poor due to an unanticipated event such as a natural catastrophe or other economic shock. Ibid, 20.

[8] In recent years, a range of adverse natural events has impacted Saint Lucia. Since Hurricane Allen in1980, Saint Lucia has been affected by at least six hurricanes and tropical storms, three of which occurred between 2002 and 2007; by roughly eight major landslides, which have destroyed homes, dislocated communities, and caused significant loss of biodiversity; and by a series of earthquakes in 1990 and in 2007, including a magnitude 7.3 earthquake.

4. Tropical Storm Debbie in 1994 and the tropical wave in 1996, for example, resulted in cumulative damages of US$93.1 million to property and infrastructure across the island. Hurricane Tomas in 2010 affected major sectors of the economy and diminished growth, with the total impact estimated at US$336 million, or roughly 34 percent of Saint Lucia's GDP. In addition to devastating large-scale disasters, small-scale flooding is endemic in low-lying areas and coastal villages already suffering from socioeconomic vulnerabilities. As global climate change continues to increase the frequency and intensity of extreme climate events, the most vulnerable among Saint Lucia's population—particularly the rural poor and agriculturalists—are expected to be especially impacted.

1.2 Vulnerability to Natural Disasters

5. **Overview.** Saint Lucia is vulnerable to numerous natural disasters arising from meteorological events (high wind, excess rainfall, hurricanes, drought) and geophysical events (earthquake, volcano, tsunami). These recurrent events have significantly harmed both the population's socioeconomic well-being and the country's general economic and fiscal stability. Particularly damaging are events associated with excessive or prolonged rainfall, which provokes flooding and landslide activity. The highest elevations are located centrally, in the island's interior, and (due to orographic rainfall effects[9]) these areas typically receive the highest rainfall. As river systems drain radially from the island's center to the coast, transit time for rainfall runoff is relatively short. This effect, coupled with the steeply sloping topography, creates the potential for flash floods.

6. **Physical Vulnerability.** Steep slopes dominate the island's landscape, and tilted volcanic deposits define the geology and soils. A combination of high slope angles and rainfall leads to slope instabilities and a high potential for landslides. The most common type of landslide in Saint Lucia is debris flow, which is defined as the rapid movement of a mass of soil, water, and air. Debris flows pose a significant threat to human lives because they (a) may travel long distances, (b) approach fast, and (c) exhibit a considerable destructive force. The island's mountainous landscape presents significant engineering challenges, particularly for road construction. Many roadways are bordered by high-relief vertical cuts in the landscape, which increase the vulnerability of the transportation network to landslides, debris flows, and cut failures. In addition to the island's steep topography, underdeveloped and dilapidated infrastructure has been a key challenge to reducing vulnerability to disasters. Critical public infrastructure—such as roads, bridges, and water supply systems as well as health and education facilities—remains vulnerable to climate change–related impacts, including flooding and landslides. This vulnerability arises in part from the failure to consider natural hazard and disaster risk in designing and constructing infrastructure, and from deferring maintenance over multiple years.

7. **Economic and Fiscal Vulnerability.** Hydrometeorological disasters have historically imposed significant costs on the Saint Lucia economy, leading to major declines in GDP growth and general productivity. The average annual economic losses associated with extreme hydrometeorological events are equivalent to roughly 2 percent of GDP,[10] while singular high-impact events such as Hurricane Allen (1980) have resulted in damages and losses equivalent to 69 percent of annual GDP.[11] The more recent Hurricane Tomas (2010) resulted in damages and losses estimated at 43.4 percent of GDP.[12] A sample of major hydrometeorological disasters over the past 10 years is summarized in table 2.

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[9] Orographic rainfall occurs when winds push air masses up the side of elevated land formations. The lift of air up and along the side of a mountain, for example, results in cooling, and ultimately condensation and precipitation.

[10] The figure is calculated for the period 1990–2012. See S. Harmeling and D. Eckstein, Global Climate Risk Index 2013 (Bonn: Germanwatch, 2012), http://germanwatch.org/en/download/7170.pdf.

[11] Keren Carla Charles, Fiscal Risks Related to Catastrophes in Latin America and the Caribbean (Washington, DC: World Bank Group, forthcoming).

[12] UN-ECLAC, Saint Lucia, macro Socio-Economic and Environmental Assessment of the Damage and Losses caise by Hurricane Tomas: A Geo-environmental Disaster.

Table 2: Sample of Major Hydrometeorological Disasters in Saint Lucia over the Past 10 Years

Disaster	Year	Economic Impact (US$ millions)
Hurricane Tomas	2010	336.00
Hurricane Dean	2007	18.80
Hurricane Ivan	2004	2.60
Storm Lily	2002	20.00

Source: Caribbean Development Bank.

8. Catastrophes resulting from hydrometeorological events, however, also present significant fiscal shocks to government budgets, and thus reduce access to and quality of public and social services. These shocks are especially pronounced given the already tenuous economic situation of Saint Lucia. Since the poor are the most dependent on government service delivery, especially in the wake of disasters, such events jeopardize efforts to end extreme poverty and to boost shared prosperity while threatening to reverse development gains.

9. Recognizing this impact, the government of Saint Lucia has developed an integrated disaster risk management (DRM) program that aims to safeguard and promote national economic growth in the face of natural disasters, while prioritizing long-term climate and disaster resilience investments as a strategic objective. However, large fiscal deficits and debt accumulations (many of them the result of previous disasters) have required the government to rely on ad hoc budget reallocations and emergency assistance from donors, and to delay the replacement or repair of damaged capital stock.[13] This limited ability to absorb fiscal shocks associated with natural hazard impacts is common throughout the Eastern Caribbean subregion.

1.3 Overview of December 24–25 Flood Event

10. On the evening of December 24, 2013, when a tropical trough system was forecast for the region, extremely intense rainfall developed rapidly and without warning, with peak rainfall occurring between 5:00 p.m. and 9:00 p.m. Flash floods and landslides occurred across the island, directly affecting an estimated 19,984 persons, or 11 percent of the total population.[14] Numerous private homes were lost, and six persons were confirmed dead as a result of the event. Infrastructure, particularly in the water and transport sectors, incurred the large majority of damages, while public health and education facilities were also affected. Following the disaster, there were islandwide interruptions in public services (e.g., water and power), and severely damaged roads hampered transportation for over 80 percent of Saint Lucia's population.

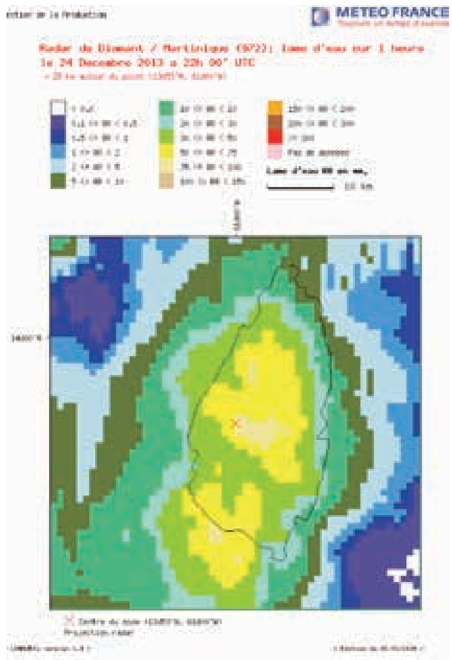
11. The trough system, which had developed from a convective cell just off the southwest coast of Saint Lucia, divided into two centers, one over the central part of the island and one over the southern portion, in the vicinity of Soufriere-Canaries. As presented in figure 1, at 6:00 p.m. the storm centers impacted interior areas—some 75 percent of the island's surface—with heavy rain. Based on Doppler estimates, the core of each cell produced rainfall rates of 75–100 mm/hour, with a larger outer band (shown in yellow in the figure) producing an estimated 50–75 mm/hour. The storm cells moved slowly to the east and the intense rain event continued until approximately 9:00 p.m.

[13] While Saint Lucia is a member of the Caribbean Catastrophe Risk Insurance Facility (CCRIF), which provides parametric insurance coverage for hurricane wind and earthquake, it is not covered for excess rainfall events.

[14] National Emergency Management Organisation Situation Reports 1–10, http://www.cdema.org/index.php?option=com_content&view=category&layout=blog&id=39&Itemid=347.

12. According to the Saint Lucia Water Resource Management Agency (WRMA), the highest levels of rainfall over 24 hours were 323 mm, recorded at the Rousseau and Saltibus rain stations. As illustrated in figure 2, the maximum intensities of rainfall in a three-hour period were experienced in the southern districts of Saint Lucia—a maximum of 224 mm fell in Laborie and Micoud—whereas the northern district of Anse La Raye experienced the lowest rainfall intensities, at 94 mm. Larger volumes of rainfall, than the amounts recorded, are likely to have been received in higher elevations not equipped with gauges.

Figure 1: Martinique Doppler, 6:00pm, December 24, 2013



13. The intensity and volume of rainfall over the course of only a few hours make the December 24–25 trough especially significant. Analysis was undertaken to relate the severity of the event with historical expectation and to estimate such an event's return period. Though rainfall curves available for Saint Lucia reflect only a maximum 20-year return period, analysis found this event to be well in excess of the available curve. Based on a review of curves available for Puerto Rico (strictly indicative), interviews with affected persons in the island (including elderly persons who could not remember an event this intense), and evaluation by staff at the Meteorological Office, the three-hour rainfall intensity may be in excess of a 1-in-100 year event.

14. Twelve districts experienced major flash floods and landslides as a result of the event: Sarrot, Gros Islet, Babonneau, Anse La Raye, Castries North, Castries Central, Castries East, Canaries, Dennery, Micoud South, Vieux Fort South, and Soufriere. Castries, the capital and home of much of Saint Lucia's population, experienced substantial flooding, some of which originated in the upper watersheds and increased in intensity as it moved south, and some of which was due to the capacity limitations of the local drainage system (arising in part from trash and sediment accumulation). In Anse La Raye, the entire community was flooded, and residents were forced into shelters. Witnesses reported unusual lightning and thunder activity, confirming the extraordinarily intense convective rainfall during the event. The adverse impact of the disaster was heavily concentrated in areas with the highest poverty rates, as can be seen in comparing areas experiencing the highest levels of rainfall (figure 2) and areas with the largest poverty gap (figure 3).

15. Principal rivers and tributaries in the west and south of the island were quickly overwhelmed during the storm, leading to flash floods in most communities along the Western Highway (e.g., Anse La Raye, Canaries) as well as in Vieux Fort. In addition, flooding along the Vieux Fort River effectively shut down the Hewanorra International Airport for nearly 42 hours (from the evening of December 24 to the afternoon of December 26). Across Saint Lucia, public and private infrastructure and facilities were severely damaged or destroyed; roadways, bridges, energy distribution, and drinking water networks were particularly affected. Sedimentation at John Compton Dam as well as damages to pipe networks left the entire island without piped water—for up to 10 ten days in some communities. In many locations, flooding was exacerbated by poor local drainage infrastructure (e.g., Canaries, Castries, Vieux Fort), with one section of the East Coast Highway collapsing due to insufficient drainage capacity. Accumulated sediment deposits restricted the flow at river mouths, worsening flooding in low-lying communities.

Figure 2: Rainfall Distribution in Three-Hour Period during December 24–25 Trough

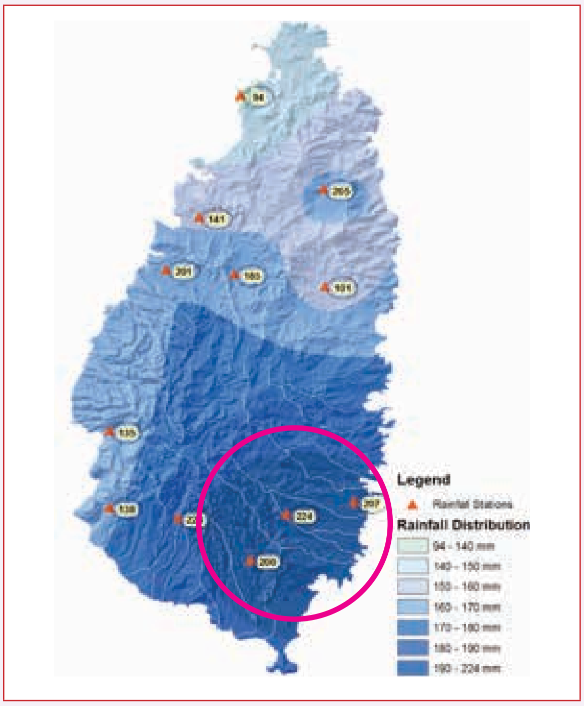
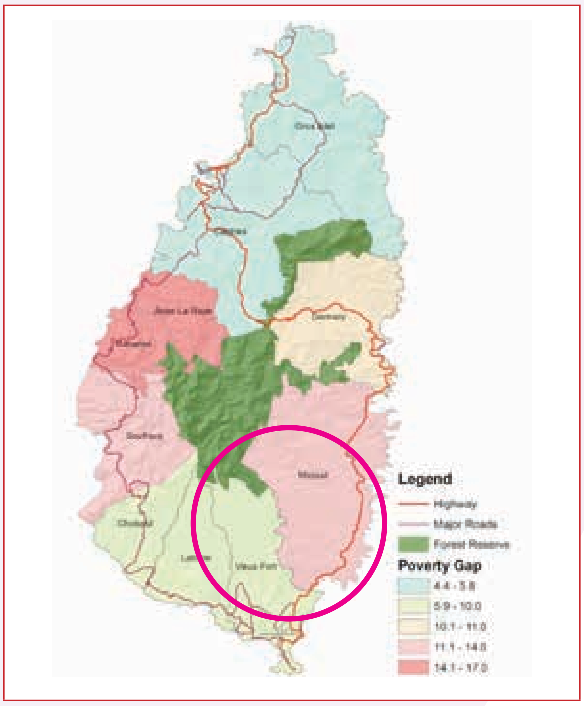


Figure 3: Poverty Gap, 2005–2006



Note: The three hours of peak rainfall vary slightly per district and were calculated using the three hours that reflected the maximum measurements of rain for each district.

16. The impacts of the event were magnified significantly by several factors. Persistent rainfall in the week leading up to December 24 had reduced the soil's capacity to absorb additional rainfall, creating optimal conditions for maximum surface runoff. Significant accumulations of debris, including from several landslides left by Hurricane Tomas, were mobilized during the December 24–25 event. Finally, because the event occurred in the late afternoon/early evening, many individuals were in transit from work and/or returning from holiday shopping. This timing meant that large numbers of people were stranded and unable to return home: over 550 persons were evacuated to emergency shelters and other refuges such as private homes and churches.

17. The disaster was found to have had a psychosocial impact on 450 children from the most affected communities. These children have been enrolled in the Return to Happiness program initiated by the Ministry of Education, Human Resources Development and Labour (MoE). To meet the needs of people displaced by the disaster, the National Emergency Management Organisation (NEMO) activated six of its emergency shelters. Data from the shelters in Anse La Raye, Vieux Fort South, and Castries show that the heavy rains displaced over 550 people. Table 3 summarizes the number of affected people by district.

1.4 The Immediate Response

18. **Advisories and Warnings.** The December 24–25 flood event occurred without significant advance warning. While the progression of the trough was monitored, it is unlikely that the development of the storm cells could have been predicted with sufficient time to issue a meaningful warning. The speed at which the event developed meant that the system's unusual nature became apparent only once the storm had made landfall.

Table 3: Impacted Populations by District

District	Number Affected	Number Most Severely Affected	Children Affected[a]	Displaced in Shelters[b]
Marc/ Bexon	7,119	250	170	N/A
Canaries	2,044	300	50	N/A
Anse La Ray	6,247	200	50	39
Vieux Fort South	4,574	250	150	425
Micoud	—	—	30	—
Castries	—	—	—	100
TOTAL	**19,984**	**1,000**	**450**	**564**

Note: Figures here account for only three of the six shelters activated across the island under NEMO's Emergency Shelter Management Plan.

19. **Activation of the National Disaster Plan.** A formal disaster was not declared. But in keeping with the Saint Lucia National Disaster Plan, NEMO produced a preliminary Damage and Needs Assessment (DANA), which was released immediately following the event, on December 26, 2013. The DANA provided a rapid initial sector- and district-level assessment of the nature and scope of the disaster. This assessment was conducted at the national and district levels by Saint Lucia government agencies in order to create an action plan that would appropriately focus relief and recovery response efforts.

20. In its Initial Situation Overview, NEMO reported that the event became severe around 6:00pm on December 24, and that NEMO began to monitor the situation at that time. At 9:00am the following day, NEMO dispatched a helicopter to rapidly survey the extent of damage. Sectoral agencies conducted their evaluations and quickly moved to restore services.

21. Emergency response activities were initiated immediately thereafter. Local communities quickly organized to assist with rescue, response, and cleanup. Through community responses and Red Cross assistance, evacuations and citizen-organized rescues were carried out and undoubtedly saved lives. The Water & Sewerage Company (WASCO) and the Ministry of Infrastructure, Port Services and Transport (MIPS&T) deployed work teams within hours of the event to reestablish critical services. While service delivery has largely been reinstated across the island, most repairs are temporary, and further effort will be required to ensure that damaged infrastructure is made disaster resilient.

1.4.1 Request for Assistance and International Response

22. Immediately following the event, the Saint Lucia government requested additional external humanitarian assistance from a number of international development partners, including the Caribbean Development Bank (CDB), Department for International Development, Food and Agriculture Organization of the United Nations (FAO), European Union/European Community, Organization of American States, Pan American Health Organization, United Nations Development Programme, United States Agency for International Development, and United Nations World Food Programme. A total of US$1 million from CDB was mobilized to assist with response and recovery (US$250,000 for emergency recovery and US$750,000 for clean-up efforts).

23. On January 7, 2014, the government of Saint Lucia asked the World Bank for technical assistance to assess the extent of the damage and loss and financial support for the reconstruction, rehabilitation, and recovery efforts.

Chapter 2

The Joint Rapid Damage and Needs Assessment Approach

2. The Joint Rapid Damage and Needs Assessment Approach

2.1 Assessment Process

24. In response to the request of the Saint Lucia government, the World Bank deployed a technical team to conduct the Joint Rapid Damage and Needs Assessment (JRDNA). Arriving in Saint Lucia on January 20, 2014, the team worked with national authorities to take stock of and tabulate damage and loss, visit affected areas, gather information, and analyze the results.

25. On January 27, 2014, the mission team presented preliminary findings to the government, including the Ministry of Finance, Economic Affairs and Social Security (MoF) and the NEMO. The main purpose of this initial presentation was to brief the government on the assessment to date, outline information gaps, and discuss recommended steps for recovery and rehabilitation. A second, more in-depth presentation was then given virtually, via video conference, to the technical experts within various ministries. At a final, high-level presentation given in-country on February 11, findings were offered for endorsement by the Saint Lucia government. Table 4 summarizes the assessment schedule.

26. The information in this JRDNA report reflects the results of the assessment and information available as of January 31, 2014.

27. **DaLA Training.** The MoF chaired a half-day Damage and Loss Assessment (DaLA) technical workshop on Wednesday, January 22, 2014. The 33 experts who attended represented ministries and organizations from impacted sectors, including the MoF; the MIPS&T; NEMO; the Ministry of Health Wellness, Human Services and Gender Relations; the Ministry of Social Transformation; the Ministry

Table 4: Assessment Schedule

Time Period (2014)	Activity
January 7	Government request for technical assistance following the December 24–25 flood event
January 20–31	JRDNA data collection in coordination with the government and the World Bank technical team
January 22	DaLA methodology technical workshop (presentation to the technical experts at the line agencies and sharing of the NEMO DANA findings)
January 27	Preliminary presentation of findings to MoF and NEMO
January 30–February 5	Preparation of the draft assessment report
February 5	Presentation of findings to technical experts in the ministries involved in the data collection process
February 11	High-level presentation to the government for endorsement
February 15–28	Filling in of gaps and updating of the report
March 6–18	Government review and feedback on the report
March 20	Finalization of the report

Note: DaLA = Damage and Loss Assessment.

of Education; WASCO; the Ministry of Sustainable Development, Energy, Science and Technology (including the Sustainable Development and Environment Division, Forestry Department, and WRMA); the Ministry of Physical Development, Housing and Urban Renewal; Saint Lucia Air and Sea Ports Authority; and the Ministry of Agriculture.

28. The workshop outlined the methodology for collecting data as part of the assessment of damage and loss. The training focused on assessments in four main sectors: productive, infrastructure, social, and cross-cutting.

2.2 Assessment Scope

29. The assessment covers the damage and loss caused by heavy rainfall on December 24–25 and the associated floods and landslides. The main assessments of the damage and loss were conducted islandwide and took into account data from all districts. The following subsectors were included in the assessments: agriculture, tourism, commerce (productive sector); transportation, water and sanitation, electricity, telecommunications (infrastructure sector); and housing, education, and health (social sector).[15]

The Damage and Loss Assessment Methodology

The DaLA methodology uses the country's system of national accounts and involves all macroeconomic sectors, including productive (agriculture, tourism, commerce, and industries), infrastructure (transportation, electricity, water supply, telecommunications, and sanitation), and social (housing, education, and health), as well as cross-cutting issues (e.g., the environment and gender). Under the methodology's conceptual framework, the following *disaster effects* are measured during the assessment:

> ***Damage*** *is defined as the monetary value of physical, durable assets that may be fully or partially destroyed due to the action of the natural hazard that caused the disaster. They are expressed in terms of the replacement value of the assets assuming the same characteristics that they had prior to the disaster.*
>
> ***Losses*** *are changes in the normal flows of the economy that may arise in all sectors of economic and social activity due to the external shock brought about by the disaster, and that may continue until full economic recovery and reconstruction have been achieved. They are expressed in current values.*

2.3 Assessment Methodology

30. This rapid assessment is broadly based on the DaLA methodology developed by the United Nations Economic Commission for Latin America and the Caribbean (UN-ECLAC) in the early 1970s and further updated and expanded by the World Bank's Global Facility for Disaster Risk Reduction.[16]

15 Note that time constraints made including cross-cutting sectors (environment and gender) impossible.

16 See Global Facility for Disaster Risk Reduction, *Guidance Notes for Damage, Loss and Needs Assessment*, vol. 1, *How to Conduct a Damage, Loss and Needs Assessment*; vol. 2, *How to Estimate Sectoral Damage and Loss*; vol. 3, *How to Estimate Post-disaster Needs for Economic Recovery and Reconstruction* (Washington, DC: World Bank, 2010); and vol. 4, *How to Estimate Disaster Impact at Macro-economic and at Personal Levels* (Washington, DC: World Bank, forthcoming).

31. The team applied the DaLA assessment approach to the extent possible, though some deviations were necessary owing to the timing of the assessment. The main focus of the assessment was to estimate the damages to physical assets and the corresponding needs. Based on the available information, this report provides an approximation of damages to assets and loss to the economic flows, and provides some inputs to assist in summarizing total macroeconomic impacts.

32. Wherever possible, the reconstruction needs are computed and expressed as the financing requirement for restoring damages with a "build back smarter" factor for quality improvements, resilience, and risk reduction.

2.4 Limitations and Caveats

33. The findings presented in the JRDNA are intended to quantify the impacts of the December 24–25 flood event, identify Saint Lucia's long-term recovery and reconstruction needs, and provide recommendations to increase the country's disaster resilience. The data in this report are derived from figures provided by the government and incorporated into the analysis by the sector teams following discussions with government officials and on the basis of strategic interviews, expert opinions, feasibility considerations, and other implementation considerations.

34. Since some of the assessments and specific sectoral analyses are ongoing, the figures presented in this report should be considered as the best estimate possible given available data and time constraints. Furthermore, given the short time available for this rapid assessment, and the focus of local authorities on rapid emergency response, this report does not account for the disaster's impact on cross-cutting areas such as the environment and gender. Nor does it fully account for the possible macroeconomic performance modifications, including possible slowdown of gross domestic production, deterioration of the balance of payments and of fiscal sector position, and increase in inflation arising from the losses in production—though it does approximate loss to the economic flows (albeit partially) based on available information.

35. Finally, because of time constraints, the assessment does not include the possible decline in personal or household living conditions, livelihoods, and income; possible increase in costs of living; or poverty aggravation arising from the resulting losses caused by the disaster.

36. The damage and loss figures presented in this report should therefore not be considered definitive; instead, they offer a preliminary and conservative understanding of the disaster's impact in order to guide the recovery and reconstruction efforts.

Chapter 3

Damage and Loss by Sector

3. Damage and Loss by Sector

37. **Summary.** According to a summary of the data reported from each affected sector, the December 24–25 flood event resulted in an estimated total damage and loss of **US$99.88 million** (EC$267.76 million), equivalent to **8.3 percent** of the country's GDP. Most of the flood damage was sustained in the transport sector (72.3 percent), followed by sectors. Table 5 summarizes the damage and loss by sector.

Table 5: Summary of Damage and Loss by Sector

	Damage US$ (millions)	Loss US$ (millions)	Total US$ (millions)	Total Loss and Damage (percent)	Damage EC$ (millions)	Loss EC$ (millions)	Total EC$ (millions)
Sector							
Productive							
Agriculture	9.21	3.71	12.92	**12.99**	24.76	9.85	34.63
Tourism	0.00	2.11	2.11	**2.12**	0.00	5.66	5.66
Commerce	0.40	NE	0.42	**0.42**	1.13	NE	1.13
Infrastructure							
Water and Sanitation	2.30	4.10	6.40	**6.44**	6.07	11.01	17.08
Transportation	68.80	3.10	71.90	**72.31**	184.38	6.96	191.35
Electricity	NE	NE	NE	**NE**	NE	NE	NE
Telecomm.	0.12	0.41	0.53	**0.53**	0.32	1.10	1.42
Social							
Housing	2.15	2.05	4.20	**3.81**	5.77	5.51	11.28
Education	0.80	0.19	0.99	**1.00**	2.15	0.51	2.66
Health	0.24	0.13	0.37	**0.37**	0.64	0.35	0.99
TOTAL	**$80.03**	**$19.85**	**$99.88**	**100.00**	**$214.40**	**$53.36**	**$267.76**

Note: All ministries and agencies are still in the process of analyzing and quantifying their losses; as a result total losses are expected to increase in each sector. NE = not evaluated.

38. The following section is organized by subsector under the categories of infrastructure sectors, productive sectors, and social sectors.

3.1 Infrastructure Sectors

3.1.1 Transport

39. **Background.** Saint Lucia's transportation network largely comprises a north-south highway that runs along the island's coast and connects all major urban communities, the two main airports (Hewanorra International Airport and the George F. L. Charles Airport), and the country's two main

ports (Port Castries and Port Vieux Fort). The highway represents a major artery for the flow of goods and services. This system is connected to the interior, rural communities through a network of secondary, tertiary, and smaller farm-to-market feeder roads.

40. **Impact of Disaster.** The impacts identified in the transport sector largely relate to damage and loss incurred to the main roads and bridges as well as impacts resulting from compromised riverbanks. The storm severely damaged the main highway, which connects communities in Saint Lucia's south and west to one another and to the north. Approximately 12 sections of road will require extensive reconstruction. Within a few days of the flood event, the Saint Lucia government had restored primary network access by removing debris and constructing temporary emergency bypasses and bridge infrastructure in heavily damaged areas.

41. Other damage in the transport sector involved the country's principal airport, Hewanorra International Airport. Temporary flooding of the terminal building and runway forced the closure of the airport facility for nearly 48 hours. The airport was reopened on December 26, 2013, once cleanup was completed, though additional rehabilitation works as well as possible rerouting of the Vieux Fort River may be required. The country's principal seaport facilities suffered minimal damages.

42. Estimated damage to bridges and roadways is **US$68.8 million** (EC$184 million). This figure, however, does not include the rerouting of the Vieux Fort River, which caused the flooding at the airport, nor any estimates for the potential land acquisition required in the implementation of necessary rehabilitation works. Damage and loss in the transport sector are summarized in table 6.

Table 6: Transport – Calculation of Damage and Loss

Description	Damage US$ (millions)	Loss US$ (millions)	Damage EC$ (millions)	Loss EC$ (millions)
Bridge reconstruction	21.41		57.38	
Bridge repair and drainage works	6.01		16.11	
River clearing, bank protection, and training works	16.10		43.15	
Slope stabilization	25.19		67.50	
Road works	0.09		0.25	
Land slip cleanup		1.17		
Flood debris removal		0.13		3.13
Temporary bypasses and bridge repairs		0.16		0.36
Bailey bridges (2)		0.50		0.44
Geotechnical studies		0.76		2.02
Hydrology and hydraulics studies		0.38		1.01
TOTAL	**$68.80**	**$3.10**	**$184.38**	**$6.96**

43. **Assumptions.** The damage represented in table 6 includes main roads (primary and secondary) and bridges. In order to calculate damage, all estimates used market unit rates. This calculation also includes a contingency of 15 percent for construction costs but does not include a contingency for damage discovered during construction (typically an additional 5 percent).

44. Loss calculated for the transport sector includes costs of debris removal and the cost of two temporary (Bailey) bridges. The damage calculation includes a combined design (8 percent) and supervision (4 percent) cost for all rehabilitation/reconstruction works, as well as a 15 percent construction contingency. In addition, in order to support the rehabilitation and redesign of damaged or destroyed civil works, the loss calculation considers the requirement for pre-engineering studies—more specifically, hydrology and hydraulic studies and geotechnical investigations. Total transportation losses are estimated at roughly **US$3.1 million** (EC$6.96 million).

45. The losses do not consider the value of the increase in transit time, the impact on the cost of transport of agricultural goods to market, the increase in the time and cost of tourism transport, or transportation impacts to commerce and industry. Nor do these estimates account for the costs associated with rehabilitation of tertiary and some secondary road systems. Estimated loss does not include loss incurred due to limitations in transportation access, and costs of cleanup for the sector are also likely underestimated.

46. **Financial.** Combined damage and loss for the sector total **US$71.9 million** (EC$192.69 million). As required engineering studies are completed, particularly hydrology and hydraulics studies, construction costs will likely rise above current estimates as designs seek to increase structural resilience to recurrent events. Construction costs are expected to increase by 10 percent to 15 percent as additional losses are realized over time.

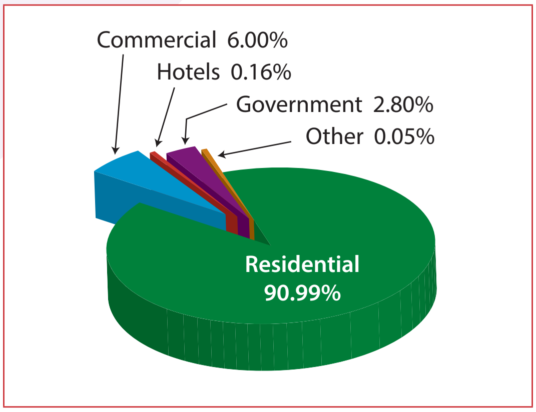
3.1.2 Water and Sanitation

47. **Background.** Saint Lucia's water supply system is composed of numerous small stream abstraction and treatment sites as well as a large reservoir located upstream of the John Compton Dam. Water from this dam is transmitted to the Theobalds Water Treatment Plant, which produces an average of 7.5 million imperial gallons per day, or 65 percent of the island's total water production. This system largely serves the northern portion of the island, including the country's capital and principal tourism areas.

48. The national Water and Sewerage Company (WASCO) provides potable water services throughout the island. The company serves a population of 163,267, and an average of 5,053,458 imperial gallons of water are purchased from it daily. This figure, however, does not include nonrevenue water, which accounts for an additional 6,484,117 imperial gallons. The total average production for all WASCO systems is estimated at 11.54 million imperial gallons per day.

49. Residential users represent approximately 90 percent of all WASCO accounts (figure 4).

Figure 4: WASCO Accounts, by Type



Source: Wasco fact sheet, August 2013.

50. **Impact of the Disaster.** Damages to the water sector were primarily incurred by water intakes and transmission lines. The majority of WASCO's intakes are located in inland areas where water is abstracted from streams, treated, and transmitted downstream to storage and distribution facilities. The rapid flooding of December 24–25 produced high-velocity flows that deposited debris and sediment in the intake basins, in many cases completely covering the intake system, and that battered the pump stations and weirs with large rocks.

51. In addition, many of the access roads leading to the water intakes were heavily damaged—sections of road washed out in many locations—or else so covered in flood debris and rubble that they were impassable.[17]

52. **Water Service Interruptions.** A total of 19 water supply systems were affected throughout the island. Of a total of 61,341 service accounts, 52,772 experienced supply interruptions. Among WASCO's customer base, 86 percent experienced service interruptions when the Theobalds treatment facility (which supplies the majority of the north of the island, including Castries) became compromised and when transmission pipes for both treated service water and raw water supply were damaged. In addition, numerous abstraction systems were compromised by flood damage and heavy siltation. In some cases power interruptions contributed to service losses. A summary of the systems affected is presented in table 7.

Table 7: Affected WASCO water Supply Systems

Location	Daily Production (100,000 imperial gallons)	Number of Accounts
Babonneau	13.35	2,818
Millet	100.00	35,602
Venus Estate, Anse La Raye	4.00	502
Anse la Verdue	0.40	22
Canaries	1.00	381
North Dennery	1.30	334
Errard River, Dennery	6.00	914
Deniere Riviere	1.00	1,127
Lumbard	1.30	1,014
Mahaut	1.20	810
Desruisseaux	1.90	143
Toucousson	0.60	1,878
Saltibus	0.50	110
Delcer	2.80	57
Ruby/Diamond	3.30	1,371
Fond St Jacques	2.30	827
Bouton	0.09	27
Woodlands/Beausejour	17.00	4,756
Belle Vue	1.40	79
TOTAL	**159.44**	**52,772**

Source: WASCO, "Assessment of Damages Post 24th December Weather Trough," January 2014.

[17] In most cases, maintenance of these roads is managed by WASCO, and a significant portion of the response costs incurred by WASCO related to access road repair.

53. To provide temporary relief from system outages, water was trucked to select locations. NEMO's portable emergency water treatment units were also deployed to provide water supply.

54. The majority of systems were restored within the first seven days of the disaster. Smaller systems were generally the first to be put back into service. The larger systems, including Canaries and Anse La Raye, were also restored within a week; the Theobalds Water Treatment Plant came back into service (at approximately 80 percent of total capacity) within five days and was at full capacity within nine days. As of January 9, 2014, the only systems still out of service were the Beausejour and Micoud Village systems.[18]

55. The rehabilitation works undertaken in the immediate aftermath of the storm were only interim measures, intended to quickly provide potable water to the affected population. Thus while service has been reinstated, much of the affected infrastructure remains in vulnerable condition.

56. **Sanitation.** The main public wastewater treatment systems were largely unaffected.[19] Nevertheless, select systems located in flood-impacted zones are likely to have been compromised. Solid waste management was unaffected.

57. **Reconstruction.** Rehabilitation works will require not only repair of damaged systems, but also investments to realign and strengthen exposed infrastructure in order to accommodate changes in the landscape and raw water quality resulting from the flood event. With respect to the John Compton Dam, siltation has become a significant problem. The gradual accumulation of sediments over the life of the dam has reduced the system's capacity to provide raw water. The passage of Hurricane Tomas in 2010 left the low-water intake structures blocked by sediment. With only high-water intakes available, the dam's storage capacity at the time of the disaster was estimated at a 25–30-day supply of water. According to rough estimates, the flooding event added another two feet of sediments,[20] which increases the already existing dredging requirement by an estimated 60,000 cubic yards. Owing to the complexity of the sediment removal problem, a unit cost of US$30/cubic yard is estimated, resulting in approximately US$1.8 million (EC$4.77 million) of additional costs, estimated prior to the December 2013 flooding, for sediment removal.

58. **Financial.** Damage to the water and sanitation sector was estimated at approximately **US$2.3 million** (EC$6.0 million), while total loss was estimated at approximately **US$4.1 million** (EC$6.2 million). The estimate for loss was based on the need to truck water to affected communities and on lack of access to water services identified during consultations with government agencies and communities. The combined damage and loss to the sector is approximately **US$6.4 million** (EC$17.1 million). This does not include the rehabilitation costs associated with refitting the system to replace infrastructure made vulnerable by the flood event, nor does it include lost revenue owing to system outages. Including estimated impacts associated with additional sediment removal in the primary reservoir, total water sector damage and loss are estimated at **US$6.1 million** (EC$17.08 million). The summary for damage and loss in the water sector is presented in table 8.

3.1.3 Telecommunications

59. **Background.** The main telecommunication providers in Saint Lucia are Digicel and LIME (formerly Cable & Wireless); both offer mobile telephone and Internet services, while only LIME provides landline services. Together, the two companies had approximately 250 main telephone lines and over 210,000 mobile cellular subscribers in 2008.[21]

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18 WASCO, "Assessment of Damages Post 24th December Weather Trough," January 2014.
19 The majority of wastewater is managed using private septic systems or soak-aways.
20 This is a conservative estimate based on observations of WASCO engineers before and after the storm.
21 World Bank, World Development Indicators database.

Table 8: Water – Calculation of Damage and Loss

Description	Damage US$ (millions)	Loss US$ (millions)	Damage EC$ (millions)	Loss EC$ (millions)
Works	0.9		2.4	
Materials	1.3		3.7	
Losses from lack of access and trucking costs		2.3		6.2
Increased dredging requirement for John Compton Dam		1.7		4.8
TOTAL	**$2.3**	**$4.1**	**$6.1**	**$11.0**

60. **Impact of Disaster.** The flooding damaged the fiber-optic system, causing service interruptions and affecting phone coverage. Redundancies built into the system minimized impacts, and after only a few days service was restored, though the system continues to operate on emergency patches. The fiber-optic system rings the island and follows the primary access road. Damage to fiber-optic cable corresponded with road and bridge damage resulting from land slips. Numerous cuts in the cable system were noted, even though most of the system is underground. According to LIME, financial impacts included lost revenues at a time of year (Christmas and New Year's) when demand for services is at a peak.

61. **Financial.** Total damage in the telecommunications sector is estimated to be **US$120,000** (EC$322,584) and the loss is approximately **US$405,000** (EC$1,088,721). The combined damage and loss to the sector are estimated at approximately **US$525,000** (EC$1.3 million), as summarized in table 9.

Table 9: Telecommunications – Calculation of Damage and Loss

	Damage US$	Loss US$	Damage EC$	Loss EC$
Financial loss (mobile, landline, Internet, cable TV)	NE	275,000	NE	739,255
Emergency repair to damaged systems	NE	130,000	NE	349,466
Repair to damage cell site and cables	120,000	NE	322,584	NE
TOTAL	**$120,000**	**$405,000**	**$322,584**	**$1,088,721**

Note: NE = not evaluated.

3.1.4 Electricity

62. **Background.** Saint Lucia Electricity Services Limited (LUCELEC), established in November 1964, is the sole commercial generator, transmitter, distributor, and seller of electrical energy in Saint Lucia. It serves a customer base of nearly 60,000,[22] consisting of residential, commercial, and industrial users. LUCELEC operates three power stations, with a standby facility at Soufriere on the western coast of the island and three substations integrated to one power system. The company uses diesel fuel as its exclusive energy source.

[22] http://www.lucelec.com/content/electricity-bills-explained.

63. **Impact of Disaster.** Following the heavy rains, emergency response systems were brought online. Outages were experienced from River Doree to Soufriere, and from Micoud Village to Praslins. Largely as a result of localized electrical ground faults in the system, several smaller areas also experienced outages, including Bisee, parts of Babonnueau, Coubrail, parts of Marisule, and other pockets around the island. Most of the damage was associated with broken or leaning poles and blown fuses. Overall, the power supply sector did not experience major damage or loss.

3.2 Productive Sectors

3.2.1 Agriculture

64. **Background.** While contributing only 3.9 percent of GDP,[23] agriculture is nevertheless a critical sector, employing approximately 11 percent of the total working population.[24] Saint Lucia is a net food-importing country, and the trade deficit in its food imports has grown over the last 10 years. Banana production remains central to the sector, despite its contraction over recent years; it occupies 48 percent of the cultivated land and accounts for 41.4 percent of gross agricultural output. Other important crops include coconut, cocoa, vegetables and herbs, other fruit and tree crops, and cut flowers. Fishing is the third-largest agricultural sector, despite contributing only US$6.74 million (EC$18.06 million) to the country's GDP, and it provides livelihoods for many small farmers. The livestock sector is small (though it continues to experience some growth) and dominated by the poultry and pork subsectors.

65. **Impact of the Disaster.** The agriculture sector was impacted by the flooding and landslides as follows: Physical damages included loss of crops and livestock and damage and loss to the fisheries sector, which is largely artisanal. Affected infrastructure included irrigation and drainage systems and farm infrastructure, while damages to rural roads, bridges, and riverbanks resulted in a loss of market access.

66. The amount of land impacted was estimated at 1,376 acres (5.6 km^2, around 5 percent of the country's total agricultural land area), and 286 farmers were directly affected, with production, stock, and equipment suffering significant physical damage. Because the most vulnerable populations in Saint Lucia engage in agricultural employment, these impacts are experienced as especially severe.

67. In response to a request from the government of Saint Lucia, the FAO assisted the Ministry of Agriculture, in preparing a detailed loss and damage assessment.[25] Agriculture sector impacts are summarized below based on that report:

- **Crop subsector.** This subsector was severely impacted, especially the banana, plantain, vegetable, and root crop industries.
- **Livestock subsector.** Although this subsector is not large, some farmers lost all their livestock and also sustained significant damage to production facilities and infrastructure.
- **Fisheries subsector.** This subsector experienced select damage (e.g., to fishing gear and engines), with minor damage reported to fish landing sites. Some 80 percent of all aquaculture ponds suffered varying degrees of damage, mainly due to siltation and loss of tilapia and shrimp. Siltation problems were evident on sea moss farms. The marine environment (coral reefs, etc.) will continue to be affected by high turbidity for many months to come due to high levels of siltation in the river channels.

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23 World Bank, 2012 estimate.

24 Percentage cited and statistics on agriculture that follow in this paragraph are from Central Statistics Office of Saint Lucia, Annual Statistical Digest, 2011.

25 Ministry of Agriculture (with assistance of FAO), "Revised Agricultural Sector Assessment of the Damage and Loss Caused by Low-level Trough Weather System," January 31, 2014.

- **Irrigation.** There was extensive damage to irrigation infrastructure, including pumps, due to siltation and overland flooding.
- **Drainage.** Heavy siltation of the lower valley areas affected drainage systems, including farm drainage systems.
- **Farm and feeder roads.** These roads experienced extensive damage and siltation and now have restricted access.
- **Riverbanks.** Extensive riverbank erosion was evident in some areas.
- **Forestry subsector.** Varying degrees of damage were reported to forest areas, forest infrastructure, ecotourism facilities, riverbanks, and water intakes.
- **Valley lands.** Heavy deposition of sand on land adjacent to main river channels resulted in changes in the soil type. A large volume of debris and stones was also deposited on adjacent lands.

68. **Forestry.** More specifically, damage in this subsector is reported as resulting from flood and landslide and includes damages to forest infrastructure, tourism sites (trails, visitor centers, etc.), and associated damages affecting watershed resources. While forests are largely managed by the Forestry Department, the WRMA is also involved in the forestry subsector through its work in maintaining a system of rain and stream flow gauges. Leaving aside the need to improve the capacity of this network by adding instrumentation in strategic locations, direct damages from the loss of field stations is estimated at **US$200,000** (EC$530,000).

69. **Financial.** Total damages in the agricultural sector (including forestry subsector) are estimated to be **US$9.21 million** (EC$24.76 million). Total loss is estimated to be **US$3.71 million** (EC$9.85 million). The estimated total in damage and loss is **US$12.9 million** (EC$34.63 million). This amount represents approximately 27 percent of the total GDP contribution from the agriculture sector and poses a significant exogenous shock, directly affecting as it does 11 percent of the population (that is, those directly employed in the agriculture sector). A summary of associated damage and loss is included in table 10.

3.2.2 Tourism

70. **Background.** Tourism is Saint Lucia's largest sector as a share GDP, contributing more than 60 percent. Tourism facilities are distributed around the country, with the majority of operations located on the northern leeward (western) side. Amenities in this region include large beaches, numerous hotel and restaurant facilities, and a major yacht basin serving the sailing community. The Saint Lucia Tourist Board reported an estimated 315,000 international arrivals in 2013 alone—the highest number of recorded tourist arrivals in the past three years. The island's north is typically dry, with few major rivers and streams; with respect to hazards, the north is more susceptible to storm surge and wind than inland flooding. Hence this area reported no significant damages arising from the December 24–25 event. Overall, no damages affecting tourism were reported, apart from tourist sites included under the forestry subsector.

71. The tourism sector provides direct employment to 15–20 percent of the population, and is projected to employ up to 25 percent of the population by 2023. Currently more than 35 percent of the population is indirectly employed by the sector.[26] The main activities that contribute to employment within the tourism sector in Saint Lucia include diving, beach activities, hiking, and bird watching.

[26] World Travel & Tourism Council, Travel & Tourism Economic Impact 2013: St. Lucia (London: World Travel & Tourism Council, 2013).

Table 10: Agriculture – Calculation of Damage and Loss

Items	US$	EC$
Total Effect	**$12,721,641**	**$ 33,712,348**
Total Damage	**$9,006,474**	**$23,867,157**
Immediate Emergency Response (0–3 months)	**$5,006,168**	**$13,266,345**
Banana/plantains	1,453,886	3,852,800
Other crops	1,114,411	2,953,190
Livestock	195,509	518100
Fisheries	203,869	540,255
Farm infrastructure (tools and equipment, off-farm irrigation)	461,509	1,223,000
Farm infrastructure (drainage, main drains)	1,611,924	4,271,600
Farm roads	34,943	92,600
Immediate emergency requirements	5,006,167	13,266,345
Immediate Emergency Rehabilitation Response (0–3 months)	**$4,000,306**	**$10,600,812**
Farm infrastructure (on-farm irrigation, drainage, office)	3,401,287	9,013,412
Farm roads	599,018	1,587,400
Land loss		
Livelihoods Response (3–6 months)		
TOTAL LOSS	**$3,715,166**	**$9,845,191**
Banana/plantains	654,249	1,733,760
Other crops	222,881	590,635
Livestock	46,194	122,415
Fisheries	57,456	152,260
Farm infrastructure	2,407,177	6,379,020
Farm roads	226,453	600,101
Land loss	100,754	267,000

Source: Adapted from Ministry of Agriculture (with assistance of FAO), "Revised Agricultural Sector Assessment of the Damage and Loss Caused by Low-level Trough Weather System," January 31, 2014.
Note: The calculations in the table do not include damage and loss to the forestry subsector.

72. **Impact of the Disaster.** Most tourism facilities are located in the north, and so were not directly affected by the flooding, which occurred largely in the south.

73. The major impact of the storm to the tourism sector largely stems from the limitations in access due to damaged interior roads; blocked primary roads likely had an impact on jobs in this sector in the form of diminished opportunities. Limited access to the interior could affect businesses providing tours (land based as well as cruises) and could also affect businesses that benefit from visitor contacts, such as the hotel industry, where employees had difficulties getting to work.

74. In addition, tourist activities such as diving, snorkeling, etc., that depend on marine ecosystems would have been affected by siltation from the storm.

75. Data on economic impacts to taxi services and small tour operators were not available, but they are likely to have been significant. Certainly these subsectors were heavily impacted by the increased travel time arising from inaccessible roads and tour cancellations.

76. **Financial.** Impact to tourism, as a percentage of sectoral GDP contribution, was relatively small. While minimal to no damages were reported, it is likely that smaller, local enterprises suffered damage, particularly in the Vieux Fort, Canaries, and Anse La Ray areas. Losses for the sector—stemming largely from impact costs associated with water and electricity, as well as lost revenues—are estimated at **US$2.1 million** (EC$5.7 million); table 11 provides further detail. Neither the damages nor losses reported here capture the disaster's impact on small operators.

Table 11: Tourism – Calculation of Damage and Loss

	Damage US$ (millions)	Loss US$ (millions)	Damage EC$ (millions)	Loss EC$ (millions)
Higher operational costs (water, electricity)	—	1.50	—	4.00
Impact on revenues	—	0.41	—	1.10
Revenue lost from cruise ship passengers	—	0.21	—	0.58
TOTAL		**$2.12**		**$5.68**

3.2.3 Industry and Commerce

77. **Background.** Saint Lucia's balance of import and export value shows a deficit. The value of total imports in 2012 was an estimated US$1.9 million, while the value of total exports was an estimated US$0.09 million, leaving a negative balance of US$1.8 million.[27] In 2012, Saint Lucia's manufacturing sector contributed a little over 4 percent to the national economy.

78. **Impact of the Disaster.** Most affected businesses can be categorized as medium to large industry and small or micro enterprises. The flood event's impacts to this sector are geographically focused in the areas of Cul de Sac and Bexon. Businesses lost inventory, physical infrastructure, and business opportunity; potential clients were affected as well. According to the assessment by the Ministry of Commerce, Business Development, Investment and Consumer Affairs, 14 companies reported total damages of **US$420,000** (EC$1.1 million). Of the businesses damaged, some 42 percent had no insurance coverage.

79. Approximately 113 small and micro enterprises were affected, principally by interruptions in the water supply and limitations in transportation. Impacts to these enterprises largely relate to opportunity costs that have not been quantified.

[27] International Trade Center, International Trade Statistics, Saint Lucia, 2012.

3.3 Social Sector

3.3.1 Education

80. **Background.** In Saint Lucia, education is compulsory between the ages of 5 and 15 years. The country maintains 38 early childhood education centers and 96 preschool centers serving children under the age of 5. Saint Lucia also holds 8 private primary and secondary schools and 5 centers that focus on special education.[28] Public primary and secondary schools are well attended, with gross enrollment rates of 96 percent and 93 percent, respectively.

81. **Impact of the Disaster.** Six facilities in the regions of Canaries, Anse La Raye, Vieux Fort, and Bexon were flooded, and one infant school in Canaries required reconstruction. Some schools suspended classes for two extra weeks after the holiday season to accommodate clean-up and recovery efforts.

Image 1: Damage to the Classrooms at Canaries Infant School

Image 2: Damage to Materials in Bexon Primary School

82. **Financial.** The damage to the education infrastructure is reported at **US$804,163** (EC$2.16 million), and losses are reported as **US$188,433** (EC$505,000). Losses are attributed to the cost of repairing schools, as well as the cost of demolition and rubble removal and clearing of silt. Not included are the costs associated with the relocation of infrastructure. The combined damage and loss to the sector amount to approximately **US$992,596** (EC$2,660,156); see table 12 for details.

83. Given the nature of flash flooding, recovery planning will need to evaluate the current location of schools that were affected by the event, which fortunately occurred at a time when classes were not being held. As relocation costs are identified, total rehabilitation costs will increase significantly for this sector.

3.3.2 Health

84. **Background.** The Saint Lucia health sector comprises a mix of public and private service providers. It is estimated that the public sector provides only half of the primary care but 90 percent of secondary care in the country.[29] The public health sector is organized into eight health regions that deliver services through a combination of health centers, district hospitals, a polyclinic, pharmacies, and

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[28] Data Management, Corporate Planning Unit of the Ministry of Education, Human Resource Development and Labour, Education Statistical Digest, 2013.

[29] Barrett, Rafael D. 2011. A Policy Review and Analysis of the Saint Lucia Universal Health Care Initiative. Castries: Saint Lucia Ministry of Health and PAHO.

Table 12: Education – Calculation of Damage and Loss

Description	Damage US$	Loss US$	Damage EC$	Loss EC$
Facilities damaged or destroyed	655,485	—	1,756,701	—
Equipment and furniture lost	75,692	—	202,855	—
Cost of repair to schools (used as a shelter)	—	111,940	—	300,000
Student losses (books, uniforms, etc.)	72,985		195,600	—
Cost of demolition and rubble removal	—	7,463	—	20,000
Clearing of silt	—	69,030	—	185,000
TOTAL	**$804,163**	**$188,433**	**$2,155,156**	**$505,000**

Source: MoE, "Damage Assessment of Affected Schools Due to Flooding on Dec. 24, 2013," January 27, 2014.

two general hospitals. A network of 32 public health centers (primary care) distributed across the island, two polyclinics (one in Gros Islet, which provides primary care support and community secondary care services with extended hours), four parastatal facilities, and an outpatient department in each of the three main hospitals (secondary and limited tertiary care services) deliver health care in Saint Lucia.

85. The private sector owns and manages the majority of facilities (116 of a total 195), most of which are private physician and dentist operations. Table 13 presents the number of facilities by category and ownership based on the records for public and private sector facilities.

86. **Impact of Disaster.** The trough event resulted in six confirmed fatalities (five in the south and one in the north). As a consequence of the flooding, five health centers were damaged or significantly affected, and the delivery of services was temporarily impacted by interruptions in electric power, water supply, and concerns for the security of personnel. The medical centers affected were Victoria Hospital, Saint Lucia National Mental Wellness Center, Community Nursing, Gros Islet Polyclinc, and St. Jude Hospital.

Table 13: Type of Health Facility by Ownership

Facility	Public	Parastatal	Private	Subtotal
Health center	32	0	0	32
Consultation room (MDs only)	0	0	77	77
Polyclinic	2	1	5	8
District hospital	2	0	0	2
General hospital	1	1	1	3
Laboratory	2	1	5	8
Pharmacy	36	1	25	62
TOTAL	**75**	**4**	**113**	**192**

Source: Ministry of Health, Wellness, Human Services and Gender Relations data.

87. Following the flood event, the delivery of health services was quickly restored, and a surveillance campaign to monitor potential disease outbreaks was implemented, particularly with respect to dengue and leptospirosis. A campaign to advise the population on treating household water was also launched immediately after the disaster.

88. **Financial.** The total damage to the health sector is estimated at **US$238,458** (EC$639.067). This estimate includes costs associated with damage to infrastructure and the destruction of furniture, equipment, and medical supplies. Loss is estimated at **US$134,204** (EC$359,667) and includes retrofitting of facilities, relocation of services, cleanup, disease control, and activities required to reestablish sanitary conditions.

89. The estimate also includes costs associated with the increase in patient load arising from treatment of persons injured by the event. In total, it is estimated that the health sector suffered a combined loss and damage impact of **US$372,662** (EC$998,734). As with the other sectors, damages suffered in the health sector may require the relocation of facilities to avoid exposure to future flood events. For example, the Anse La Raye health center is located in a floodplain and periodically suffers flood damages; thus relocating this facility is a reasonable response, though it is not captured in this assessment. Identified damage and loss in the health sector are presented in table 14.

Table 14: Health – Calculation of Damage and Loss

Description	Damage US$	Loss US$	Damage EC$	Loss EC$
Facilities destroyed	49,085	—	131,548	—
Facilities damaged	29,451	—	78,929	—
Equipment and furniture lost	63,387	—	169,877	—
Medicines and supplies destroyed	96,535	—	258,714	—
Increased cost of treatment	—	20,000	—	53,600
Increased cost of referrals	—	—	—	—
Lost revenue from decreased patient capacity	—	—	—	—
Sanitary conditions	—	16,740	—	44,863
Disease control	—	11,160	—	29,909
Relocation of services	—	35,712	—	95,708
Cost of demolition and rubble removal	—	9,300	—	24,924
Retrofitting of infrastructure	—	41,292	—	110,663
TOTAL	**$238,458**	**$134,204**	**$639,067**	**$359,667**

3.3.3 Housing

90. **Background.** According to Saint Lucia's 2010 Population and Housing Census Report,[30] the country has 54,005 homes. Castries accounts for the highest concentration of housing stock, with approximately 40 percent of all dwellings. The Gros Islet district in the north of the island has the second

[30] Saint Lucia, Population and Housing Census, Statistical Department, 2010.

highest concentration, with roughly 14 percent. Micoud, Vieux Fort, and Dennery (in the southern and eastern parts of the island) rank third, fourth, and fifth, respectively, and combined they represent a total of 28 percent of the housing stock.[31]

91. Dwelling units are built mainly of wood, concrete, a combination of wood and concrete, or plywood. The majority of households (43.4 percent) occupy dwelling units with outer walls of concrete; 20.2 percent occupy dwelling units with wooden outer walls; 18.3 percent occupy dwelling units with outer walls of wood and concrete; and 15.5 percent occupy dwelling units with outer walls of plywood (see table 15).[32]

Table 15: Occupancy of Housing Types, by Household Income Quintile

	Household Quintiles					
Material of Outer Walls	**Poorest**	**II**	**III**	**IV**	**V**	**TOTAL**
	(%)	**(%)**	**(%)**	**(%)**	**(%)**	**(%)**
Wood/timber	32.0	23.7	19.1	16.1	10.1	20.2
Concrete/concrete Blocks	20.9	30.6	41.6	55.3	68.5	43.4
Wood and concrete	14.0	23.8	18.6	17.6	17.7	18.3
Stone	0.0	0.0	0.0	0.0	0.4	0.1
Brick/blocks	2.1	2.4	2.4	2.0	1.2	2.0
Plywood	30.7	19.1	17.9	8.5	1.6	15.5
Makeshift	0.4	0.4	0.4	0.0	0.0	0.2
Other/don't know	0.0	0.0	0.0	0.4	0.0	0.1
Not stated		35,712		95,708		
TOTAL (number)	**9,367**	**9,267**	**9,272**	**9,261**	**9,417**	

Source: Kari Consultants, Ltd., Trade Adjustment and Poverty in Saint Lucia 2005/06, vol. 1, Main Report, Caribbean Development Bank, 2007http://www.caribank.org/uploads/publications-reports/economics-statistics/country-poverty-assessment-reports/SLUCPAMainReport.pdf.

92. **Impact of Disaster.** A total of 743 houses were impacted by the event; of these, 7 houses were completely destroyed, 33 sustained partial damages to the structure, and the remaining units suffered damages to furniture and household contents. There were 92 persons directly affected, including 11 left homeless. In response, the government of Saint Lucia organized temporary shelters from government resources and with the support of donations. Table 16 summarizes damaged housing stock by location.

93. The most significant damage to housing stock occurred in the southwestern portions of the island. The areas most affected include Marc-Bexon, Bexon Highway, and Canaries. Approximately 69 percent of the houses affected were built of wood.

94. Approximately 82 percent of the damages evaluated resulted from flooding, with the remainder attributed to landslides. According to the government assessment, damages (including replacement costs) were estimated based on the cost of construction, labor, and materials and amounted to

[31] Engineering, Construction and Management Consulting, Ltd., "National Report on Housing and Resettlement in Saint Lucia," April 2007, http://nhcsaintlucia.com/Articles/NationalReportOnHousingInStLucia.pdf.
[32] Kari Consultants, Ltd., Trade Adjustment and Poverty in Saint Lucia 2005/06, vol. 1, Main Report, Caribbean Development Bank, 2007, http://www.caribank.org/uploads/publications-reports/economics-statistics/country-poverty-assessment-reports/SLUCPAMainReport.pdf.

Table 16: Housing Damage per District

Location/District	Houses Damaged	Houses Destroyed	Total Damaged or Destroyed	Percentage of Total
Vieux-Fort North	2	3	5	12.5
Anse La Raye	4	1	5	12.5
Canaries	3	3	6	15.0
Laborie	3	0	3	7.5
Marc-Bexon	13	0	13	32.5
Bexon Highway	8	0	8	20.0
TOTAL	**33**	**7**	**40**	**100%**

approximately **US$490,485** (EC$1,314,500). These estimates are based on *like* and *in-kind* replacement, meaning that this figure reflects the costs of existing structures as surveyed, many of which are classified as substandard housing. With regards to household goods, which include appliances, furniture, and related items destroyed by floods, an estimate of **US$2,238** (EC$6,000) per household was used to calculate damages for 743 households, for a total of **US$1,663,432.84** (EC$4,458,000). Table 17 summarizes the damage and loss to the housing sector.

95. Because the majority of damaged houses were located along riverbanks and in adjacent vulnerable areas, relocating select households to lower-risk settings is being considered. It is therefore reasonable to consider the cost of replacement of affected properties and their relocation to low-risk settings.

96. Many of the affected households are classified as low income or impoverished, meaning that the scope of relocation costs is likely underestimated, and any relocation program will likely grow from the 23 households now identified in high-risk areas.

Table 17: Housing – Calculation of Damage and Loss

Description	Damage US$	Loss US$	Damage EC$	Loss EC$
Housing destroyed (7 units)	348,880.60	—	935,000.00	—
Housing damaged (33 units)	141,604.48	—	379,500.00	—
Loss of household goods (743 units)	1,663,432.84	—	4,458,000.00	—
Cost of demolition	—	82,089.55	—	220,000.00
Lost rental income	—	4,119.40	—	11,040.00
Cleanup and debris removal	—	104,477.61	—	280,000.00
Relocation project (23 households)	—	1,858,944.00	—	4,928,370.00
TOTAL	**$2,153,918**	**$2,049,631**	**$5,772,500**	**$5,439,410**

Source: Engineering, Construction and Management Consulting, Ltd., "National Report on Housing and Resettlement in St. Lucia," 2007, http://nhcsaintlucia.com/Articles/NationalReportOnHousingInStLucia.pdf.

Image 3: Damages to the Housing Stock in the Western and Southern Regions

97. If a relocation program is implemented with government assistance, it should make use of a standard housing design that incorporates disaster-resilient features (e.g., hurricane-resistant roofing, seismic resistance, adequate height from the ground, etc.) and a minimum architectural layout based on family size to produce a livable home.[33] Such a house, excluding land (and adjusting for inflation from 2007), is estimated to cost approximately **US$47,600** (EC$127,000) per unit, for a total of **US$1,095,075** (EC$2,934,800). Land would represent an additional cost of approximately **US$19,400** (EC$52,000) per unit, with a total cost of **US$446,200** (EC$1,197,438). This estimate includes access and utilities improvements. Land estimates were adjusted from the 2007 study for inflation only, and since real estate is heavily dependent on supply and demand, the land cost is probably significantly underestimated. As a total cost, relocation is included as a loss in table 17. Table 18 details how costs were calculated.

Table 18: Summary Relocation Cost Estimates, 23 Households

Description	Cost US$	Cost EC$
Study and other agreements	20,000	53,600
Engineering designs	20,000	53,600
Site work, surveys, and geotechnical (23 units)	69,000	184,920
Supervision (23 units)	43,803	117,392
Infrastructure (with service and utilities access)	1,095,075	2,934,800
Cost of land ((EC$14,000 per 1,000 square feet)	446,805	1,197,438
Contingencies (15%)	164,261	440,220
Total estimated cost of relocation	**$1,858,944**	**$4,928,370**

98. **Financial.** Overall, damage and loss to the housing sector total to an estimated **US$4.2 million** (EC$11.2 million) including costs for relocation. These estimates focused on larger communities, such as Anse La Raye and Canaries, and it is likely that additional homes in interior locations were damaged but not accounted for in the assessment. Loss of land is not included, and damages to home septic systems have not been evaluated.

[33] For a three-person family, for instance, such a structure might include two bedrooms, kitchen, eating area, bathroom, and sitting area with plumbing and electrical. Based on previous studies, a basic low-income family house would be approximately 595 square feet sited on approximately 3,700 square feet of land.

Chapter 4

The Macroeconomic Impact

4. The Macroeconomic Impact

99. The macroeconomic impact of the floods and landslides of December 24–25 will not be immediately reflected in Saint Lucia's economic trajectory. Nor will the impacts necessarily be apparent in the country's GDP. They will likely predominantly be felt by persons living near or below the poverty level—the population with the least capacity to recover. Hence, although in years to come GDP may not reflect the effects of the storm, Saint Lucia's poverty levels, especially in the affected areas, are likely to increase.

100. In the agriculture sector, there may be an increase in the costs of agricultural products in the next six months, as well as an increase in the inflation rate. This would lead to more importation of agricultural products, which in turn would affect the country's balance of payments. It is possible that there will be a decrease in the total value of the agriculture sector's contribution to overall GDP in 2014. The damage and loss quantified after the trough represents around 25 percent of the agriculture value, and this damage alone could result in up to a 10 percent decrease in the sector's contribution (4 percent of total GDP), consequently leading to a decrease in Saint Lucia's GDP by 0.40 percent by the end of 2014. This effect is expected to be negligible in the national context. In the context of individual livelihoods, however, the impacts of this decline could be significant, given that agriculture represents 11 percent of national employment.

101. The impact to macroeconomic projections for other sectors is expected to reflect localized impacts from the disaster. The redistribution resources for rehabilitation of the basic infrastructure and personal losses will affect localized economies as the population recovers from the event. Housing sector damage and loss will include the need for imported construction materials, ultimately affecting the balance of payments. Since many of the persons directly affected live at or near the poverty level, it is likely government resources will be engaged to provide assistance, in turn reducing available resources to other recovering sectors. Local commerce will probably require time for recovery. Shops and businesses are likely to see a downturn in business activity over the next 12 months as the affected population redirects their financial resources to recovery activities.

102. Impacts to tax revenue are expected to be minimal, and revenues may actually increase as value-added tax is imposed on goods and materials needed for reconstruction. For infrastructure (transport, water and sanitation, and housing), the recovery and reconstruction process will affect the public investment budget resources. With respect to balance of payments, impacts relate to the increase in required imports, including medical equipment as well as rehabilitation supplies for water and sanitation and roads.

103. Finally, if desperate persons seek relief through theft and similar crimes, there is the possibility of an increase in crime associated with the event. Such a trend could harm the tourism trade.

Chapter 5

Recovery, Reconstruction, and Risk Reduction Recommendations

5. Recovery, Reconstruction, and Risk Reduction Recommendations

104. The late December floods offer an important window of opportunity to address difficult development issues. More importantly, they provide a strong incentive to better understand the localized relationship between rainfall rates and runoff volumes as well as the watershed system response with respect to flood and landslide events. Improving this understanding will be useful in the application of more advanced hazard and risk modeling methodologies to inform future investment activities.

5.1 Key Recommendations

105. The following recommendations are offered to help focus government response activities, to improve recovery efforts, and to further strengthen national resilience to natural disaster. The recommendations are provided for five specific areas of interventions:

1) Resilient recovery and reconstruction
2) Improved resilience through disaster risk reduction measures
3) Risk identification and assessment
4) Strengthened disaster risk preparedness
5) Disaster risk financing strategy

106. Recommendations are presented for short- (6–12 months), medium- (12–24 months), and long-term (24+ months) activities. These recommendations include both engineering and institutional activities based on field observations and consultations with relevant government agencies. Of particular importance is the strengthening of the national hydrometeorological data management system, as these data and associated analyses are critical to improving infrastructure resilience and public safety. The recommended activities should be led and implemented by the government of Saint Lucia in consultation with relevant Ministries in the government, communities, and regional and international development partners.

1) Resilient Recovery and Reconstruction

1A. Short-term Actions (6–12 months)

- Conduct a comprehensive study of the Vieux Fort area that takes into account the impact of realigning the river.
- Repair or replace critical damaged river defense structures, based on sound hydrologic and hydraulic analysis and design principles, in order to improve structural performance and survivability. Decisions about repair and replacement should be based on a combination of expected service life and hazard event recurrence analysis.
- Using designs based on criteria derived from updated hydrologic and hydraulic studies, replace or repair damaged bridge components to improve structural resilience and future survivability.

- Clear debris and sediment deposits in the vicinity of critical bridges to improve the hydraulic capacity of rivers.
- Conduct a technical inspection of all damaged infrastructure for transportation and as well as water and sanitation.

1B. Medium-term Actions (12–24 months)

- Address river training works on the Vieux Fort River to mitigate future flood potential.
- In order to protect public investments and reduce future disasters, establish formal criteria for infrastructure design related to service life and resilience to disaster phenomena impacts (e.g., bridge service life of 100 years, resilience to 500-year storm event); apply these criteria to current reconstruction efforts.
- Remove and replace temporary structures (such as Bailey bridges) with permanent infrastructure.
- In order to build resilience against future hazard events, review and prioritize recovery investments for transportation and water infrastructure to include findings from pre-engineering studies (e.g., hydrology and hydraulics) as design criteria.
- Prioritize investments for execution over the long term.
- Provide alternative transport systems in times of road failure to ensure accessibility during and following a disaster.

1C. Long-term Actions (24+ months)

- Implement construction priorities established under medium-term actions.
- Inventory and assess high-risk areas, particularly with respect to flooding, and evaluate and prioritize public infrastructure relocation needs.
- Develop plans and programs for protecting the civilian population through enhanced civil protection works and relocation, particularly for population segments living near or below the poverty line.
- Improve urban drainage networks and develop a comprehensive drainage management/maintenance plan.
- Develop and implement relocation plans for settlements in high-risk areas.

2) Improved Resilience through Disaster Risk Reduction Measures

In an effort to ensure physical and socioeconomic resilience to catastrophic events, the following measures are suggested:

2 A. Short-term Actions (6–12 months)

- Continue improvements to the hydrometeorological system and advance a program for system rehabilitation to include the densification of the existing network of rain and stream gauges, together with improved data collection, analysis, and distribution among relevant government agencies. Attention should be focused on improving data resolution to include the ability to monitor events on a sub-hourly scale. Instruments should be located to provide islandwide coverage and account for topographic effects on rainfall.
- Identify and address the critical data gaps that must be bridged in order to generate hazard and risk assessments, particularly with respect to hydrometeorological monitoring systems.

2B. *Medium-term Actions (12–24 months)*

- Strengthen the capacity of the WRMA in watershed analysis in order to produce analysis of rainfall-runoff relationships to inform infrastructure design and land-use planning at engineering scales.
- Strengthen the early warning system to improve risk communications, particularly at community level.
- Install additional meteorological and stream gauging stations and rehabilitate existing stations to provide data with a temporal resolution and density appropriate for engineering-scale analysis for design and planning. Consider installing stations with automatic recording and real-time reporting capabilities.
- Design and implement a hydrometeorological data management system that includes relevant line agencies as data users both in real-time and for long-term planning and engineering design. Such a system could be located with WRMA and would ultimately provide the basis for an early warning network.
- Develop a comprehensive watershed rainfall-runoff analysis and management plan to calibrate watershed behavior. Identify and map recurrent floodplains with respect to annual and 5-, 10-, 25-, 50-, 100-, and 500-year events. Assess rainfall flood response times and identify rainfall rates and durations that are relevant for local flood generation. Produce rainfall intensity, duration, and frequency curves for rainfall stations with sufficient data to support analysis. Develop land-use/land cover mapping based on classification systems that are useful for hydrologic modeling systems.
- Identify flood risk areas and develop the required policies and regulations to manage land use in floodplain zones.
- Develop an integrated flood management master plan for Castries to deal with the continuing vulnerability of the city and its surrounding areas to floods.
- Develop/improve and implement a waste management strategy to reduce flood risks.
- Incorporate watershed and flood risk management in the national land-use planning process.
- Develop preventive maintenance programs for critical infrastructure and establish formal requirements for new infrastructure design with respect to expected service life and disaster resilience requirements (e.g., survives 100-year, 200-year, 500-year wind, flood, seismic event).

2C. *Long-term Actions (24+ months)*

- Adopt a legal framework for watershed management.
- Strengthen the water supply system by increasing the infrastructure resilience to hydrometeorological events.
- Increase the disaster resilience of the health sector by improving the water and electricity reliability in hospitals and health centers and by strengthening emergency preparedness capacity to monitor and respond to emergency. This step should include the use of renewable energy (e.g., photovoltaic systems) and water conservation/storage mechanisms (such as treated rainwater harvesting).
- Analyze, plan, and implement reforestation activities to improve watershed performance in flood mitigation and water resources management. Improve institutional capacity to protect and manage public and private forests.

- Assess, identify, and implement rainfall-runoff management activities designed to reduce siltation and minimize pollution to safeguard coastal assets and marine resources.
- Continue development and implementation of building codes for housing and critical facilities (e.g., health centers and schools) and strengthen institutional capacity to enforce such codes.

3) Risk Identification and Assessment

In an effort to increase government capacity to understand and assess disaster risk, the following measures are suggested:

3A. Short-term Actions (6–12 months)

- Identify critical data gaps related to hazard and risk assessments, particularly with respect to hydrometeorological data.
- Identify challenges and barriers to systematic data and information sharing across data management agencies, and develop a national data management plan that provides data access to relevant line agencies.
- Develop an information management system that captures relevant studies, analysis, and data for archiving and interagency access. Such a system should include archiving of all reports that pertain to disaster management and risk assessment or that support engineering studies and disaster response experiences.

3B. Medium-term Actions (12–24 months)

- Address critical data gaps related to hazard and risk assessment, particularly with respect to hydrometeorological data.
- Review and update maps and data sets for all critical public infrastructure. Review and update infrastructure data to include parameters needed to analyze hazard and risk vulnerabilities.
- Develop a comprehensive hazard and risk monitoring framework and develop a strategy for its use and implementation.
- Strengthen and improve support for the WRMA as the national hydrometeorological agency.

3C. Long-term Actions (24+ months)

- Implement the hazard and risk monitoring framework.
- Implement recommendations included within the assessment on how to systematize information sharing across agencies.

4) Strengthened Disaster Risk Preparedness

In an effort to increase government capacity for disaster preparedness and to implement appropriate immediate response mechanisms, the following measures are suggested:

4A. Short-term Actions (6–12 months)

- Review and revise as appropriate the annual shelter assessment methodology, particularly with respect to flood exposure.

- Conduct a post-disaster debriefing with NEMO, community disaster committees, and affected line agencies to identify strengths and challenges encountered during the Christmas trough event and develop an after-action report with recommendations for dealing with future events.
- Develop a uniform damage and loss reporting system for multiple agency use to assist in the rapid quantification of a disaster event's impact.
- Review the needs and capabilities of the Meteorological services and WRMA agencies in terms of the collection of hydrometeorological data. This review should not only examine the need to expand data collection but should also address the staffing and equipment (including the security of equipment) required to ensure that existing and future observation stations can be maintained.
- Integrate the new Caribbean Disaster Emergency Management Agency (CDEMA) model (available on agency website) into existing disaster response strategies—e.g., include contingency plans, drills, and training, emergency stockpiling at the community level.

4B. Medium-term Actions (12–24 months)

- Train relevant agencies on solid damage, losses, and needs assessment methodology, including socioeconomic impact and data management, particularly with respect to a national uniform reporting system.
- Review and improve as needed the national risk communications strategy, with particular emphasis on the community level.
- Review the Water Management Plan and update it based on experiences with the Christmas trough.
- Review the national disaster management plan, including response and operations of national disaster management entities; the review should also include analysis, gap identification, psychological impact, and accountability.

4C. Long-Term Actions (24+ months)

- Review and revise disaster preparedness planning exercises at the community level (e.g., deployment of resources, evacuation plans, and immediate response plans), particularly with respect to the experiences with the December 24–25 trough.

5) Disaster Risk Financing Strategy

In an effort to reduce the fiscal vulnerability of Saint Lucia to natural catastrophes while protecting its long-term fiscal balance, the following measures are suggested:

5A. Short-term Actions (6–12 months)

- Begin discussions with relevant parties to consider purchasing the excess rainfall coverage that is now available from the Caribbean Catastrophe Risk Insurance Facility (CCRIF) and/or making use of a contingent credit line, such as the World Bank CAT DDO (catastrophic deferred drawdown option).
- Conduct a feasibility Study for the development of options for disaster risk financing strategies in Saint Lucia (e.g., cash transfers for most vulnerable persons, revolving disaster funds, insurance, expansion of existing micro-insurance schemes such as the Livelihoods Protection Project).

5B. Medium-term Actions (12–24 months)

- Conduct institutional, legal, and technical assessments of the capacity of the Saint Lucia government to manage fiscal shocks associated with natural catastrophes.
- Increase government capacity to manage fiscal shocks associated with natural catastrophes as well as implement rapid disbursements and budget reallocations.

5C. Long-term Actions (24+ months)

- Engage the private sector in disaster recovery and overall climate resilience activities (e.g., outline the standards implemented from CDEMA for the hotel sector in particular).

5.2 Financing Needs

The financing needs for the 10 sectors discussed in this report are summarized in table 19. The table does not include the emergency recovery funds that were provided directly following the disaster but instead shows the rehabilitation efforts that are needed for greater national recovery from the date of this report onward.

Table 19: Financing Needs and Sources

Sectors	Financing Needs (US$ million)	Financing Available (US$ million)	Financing Gap (US$ million)	Source
Productive				
Agriculture	12.92	0	12.92	
Tourism	2.11	0	2.11	
Commerce	0.42	0	0.42	
Infrastructure				
Water & Sanitation	6.40	0	6.40	World Bank Crisis Response Window[a]
Roads & Bridges	71.90	17	54.90	
Electricity	NE	0	NE	
Telecommunications	0.53	0	0.53	
Social				
Housing	4.20	0	4.20	
Education	0.99	0	0.99	
Health	0.37	0	0.37	
Total	**$99.88**	**$17**	**$82.88**	

Note: NE = not evaluated.
[a] Board date: March 20, 2014.

Annex 1: List of People Consulted in the Preparation of the JRDNA Report

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Annex 2: Summary of Saint Lucia's Legal and Institutional Disaster Risk Management Framework

1. Saint Lucia's 1978 constitution[34] forms the legal and regulatory framework for disaster risk management in the country, with further detail on roles and responsibilities in the management of emergency situations provided in the Emergency Powers (Disaster) Act of 1995.[35] In 2000, the Disaster Preparedness and Response Act was enacted "to provide for a more effective organization of the mitigation of, preparedness for, response to and recovery from emergencies and disasters."[36] This law was followed in 2006 by the Disaster Management Act,[37] which aimed "to provide for disaster management in Saint Lucia and for related matters" and which has become the foundation of the country's legislative framework for disaster management. Also in 2006, the Hazard Mitigation Policy was completed; its focus extends beyond disaster preparedness and response toward planning, mitigation, and prevention, and it has guided formulation and implementation of the National Hazard Mitigation Plan, also finalized in 2006. Finally, the National Emergency Management Plan, devised August 1996, provides the regulatory framework for DRM activities.[38]

2. Around 1980, a body was set up to deal with disasters in Saint Lucia. In 1990, this body became the Office of Disaster Preparedness under a national disaster coordinator; later, as part of the 2000 Disaster Preparedness and Response Act, it became the National Emergency Management Office.[39] Finally, under the Disaster Management Act, it was renamed the National Emergency Management Organisation and tasked by the government with mitigation of, preparedness for, response to and recovery from emergencies and disasters in Saint Lucia. NEMO is a three-tiered disaster management system consisting of (a) the NEMO Secretariat, (b) the committees, and (c) the National Emergency Management Advisory Committee (NEMAC).[40] The NEMO Secretariat is responsible for coordinating all response activities before, during, and after a change of alert level. NEMO is strongly supported by volunteers organized in 13 National Disaster Committees and 18 District Disaster Management Committees.[41] The NEMAC, established under the Disaster Preparedness and Response Act, is chaired by the prime minister; NEMAC's director serves as committee secretary, and committee members include ministers and representatives of multiple public sectors. NEMAC plays an important role in the preparedness and response policy and in the National Disaster Response Plan review process.[42]

3. In addition to the NEMAC, there is a National Hazard Mitigation Council that is chaired by the minister of works and whose members include the permanent secretaries of the ministries of education, health, agriculture, and tourism as well as representatives of NEMO and the Chamber of Commerce and Industry.[43] The council coordinates government programs for vulnerability reduction; enhances

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[34] Constitution of Saint Lucia (1979), http://www.oas.org/juridico/mla/en/lca/en_lca-int-text-const.pdf.
[35] Emergency Powers (Disaster) Act of 1995, http://www.preventionweb.net/files/8454_5of95.pdf.
[36] Disaster Preparedness and Response Act of 2000, http://www.preventionweb.net/files/9478_845413of2000.pdf.
[37] Disaster Management Act of 2006, http://www.preventionweb.net/files/8454_Disaster.Management.Act.pdf.
[38] For the National Emergency Management Plan, see http://archive.stlucia.gov.lc/nemp/index.htm.
[39] Government of Saint Lucia, "National Emergency Management System," 2011, http://archive.stlucia.gov.lc/nemp/general/NEMP-Executive.pdf.
[40] Ibid.
[41] U.N. International Strategy for Disaster Reduction, "St. Lucia Country Profile for Disaster Risk Reduction," 2012.
[42] Disaster Preparedness and Response Act of 2000, http://www.preventionweb.net/files/9478_845413of2000.pdf.
[43] U.N. International Strategy for Disaster Reduction, "St. Lucia Country Profile for Disaster Risk Reduction," 2012.

knowledge in order to reduce damage and loss; develops measures for assessment, prediction, prevention, and mitigation of natural disasters; and prepares the National Mitigation Plan.

4. While the policy, legal, regulatory, and institutional framework for disaster risk reduction has a strong focus on emergency preparedness, response, and recovery,[44] a number of public and sectoral policies and regulations include DRM concepts that are implicitly addressed and support hazard mitigations. These include the draft Physical Planning Regulations under the Physical Planning and Development Act (2001), the National Environmental Policy and Strategy, the National Land Policy, the Coastal Zone Policy, and the Climate Change Policy and Adaptation Plan.[45]

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[44] Ibid.

[45] Theresa Louis, "Government of Saint Lucia Hazard Mitigation Policy," document no. 0204 of the Saint Lucia National Emergency Management Plan, 2006, http://www.caribank.org/wp-content/uploads/2012/03/St.-Lucia-Final-National-Hazard-Mitigation-Policy-May-2006.pdf.

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