Saint Lucia Ministry of Agriculture, Fisheries, Food Security and Rural Development
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SECOND FOREST REFERENCE LEVEL / FOREST REFERENCE EMISSIONS LEVEL (FRL/FREL) 2021-2025

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[1] Photo: https://caribbeanwarehouse.co.uk/blog/2021/08/best-excursions-for-nature-lovers-st-lucia/

LIST OF ACRONYMS

AFOLU	Agriculture, Forestry, and Other Land Use
BUR	Biennial Update Report
BTR	Biennial Transparency Report
CfRN	Coalition for Rainforest Nations
CH_4	Methane
CO_2	Carbon dioxide
COP	Conference of the Parties
ETF	Enhanced Transparency Framework
FAO	Food and Agriculture Organization (of the United Nations)
FOLU	Forest and Other Land Use
Gg	Gigagrams
GHG	Greenhouse Gas
GHGI	Greenhouse Gas Inventory
GPG	Good Practice(s) Guidance
GWP	Global Warming Potential
Ha	Hectare
IPCC	Intergovernmental Panel on Climate Change
INDC	Intended National Determined Contributions
LULUCF	Land Use, Land Use Change and Forestry
LDC	Least Developed Countries
m^3	Cubic meter
MPG	Modalities Procedures and Gridlines
MRV	Monitoring, reporting, and Verification
N_2O	Nitrous oxide
NFI	National Forest Inventory
NIR	National Inventory Report
NAP	National Adaptation Plan
NDC	National Determined Contributions
NDVI	Normalized Difference Vegetation Index
PA	Paris Agreement
REDD+	Reducing Emissions from Deforestation and Forest Degradation
RRR+	Reporting for Results-based REDD+
SBSTA	Subsidiary Body for Scientific and Technological Advice

[2] Photo: https://www.pinterest.com/pin/142496775682465741/

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[3] Photo: https://www.sandalsresorts.eu/en/saint-lucia/

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1. CONTEXT

With the adoption of the Paris Agreement by the twenty-first Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCCC) the new international climate change regime for the post-2020 period is set. The Government of Saint Lucia recognises the challenges that climate change poses to its population, the country's natural resources and economy, and has taken considerable measures to identify and address, to the extent possible, current and future climate risks both at the policy and operational levels. Saint Lucia became a party of the United Nations Framework Convention on Climate Change (UNFCCC) in 1993, submitted its Initial National Communication to the UNFCCC in 2001, its Second National Communication in 2012 and its Third National Communication in 2017. Saint Lucia also submitted its first Nationally Determined Contributions (NDC) under the UNFCCC in 2015 and developed an NDC Partnership Plan in 2019, ratified the Paris Agreement in 2016 and has made significant progress in the integration of climate change into national policies, strategies and plans. Currently, the Saint Lucia Climate Change Adaptation Policy of 2015 embodies a key policy and guidance document on the matter and the country launched a comprehensive ten-year National Adaptation Plan (NAP) in 2018.

Complementing the NAP are a series of adaptation strategies and action plans for priority sectors and thematic areas, project concept notes portfolios, a communications strategy, monitoring and evaluation plan, climate financing strategy, private sector engagement strategy and other supplements. Saint Lucia has developed its multi-sectoral Country Programme and Project Pipeline under the Green Climate Fund (GCF), has submitted a water-focused project for consideration, accessed funding for its first GCF readiness project and is expecting to submit a number of project concepts within the four-year cycle of its Country Programme. Saint Lucia received approval from the Adaptation Fund in 2019 for a US$ 10 million project focused on the agricultural sector that aggregates a number of the initiatives proposed in its adaptation strategies and action plans. At the international climate change policy arena, Saint Lucia is actively seeking the rapid reduction of global greenhouse gas (GHG) emissions (mitigation) and fair agreements, collaboration and support for adaptation, including limits to adaptation (loss and damage), to build resilience and address climate change, while facilitating sustainable socioeconomic development under a changing climate.

[4] Photo: https://www.naturetrek.co.uk/tours/st-lucia

Regarding the forest sector, Article 5 of the Paris Agreement locks REDD+ (Reducing Emissions from Deforestation and Forest Degradation) guidance developed since COP13 into the new climate regime and provides guidance on how transparency is ensured in the implementation of REDD+ activities. It is important to recall that REDD+ Conference of the Parties (COP) guidance emphasizes the importance of accurate and robust national GHG inventories and puts in place a unique verification process compared to all other sectors responsible for GHG emissions.

Amongst others, the Paris Agreement introduced the Enhanced Transparency Framework (ETF) for action and support referred to in Article 13 and simplified as indicated below:

- Enhanced transparency framework for action and support established
- Build on and enhance the transparency arrangements under the Convention
- Purpose transparency of action: provide a clear understanding of climate change action, including clarity and tracking of progress towards achieving Parties' Intended Nationally Determined Contributions (INDCs)
- Purpose transparency of support: provide clarity on the support provided and received and full overview of aggregate financial support provided
- Each Party shall provide information: National Inventory Report and Information necessary to track progress in implementing and achieving its NDC (Article 13.7)
- Technical expert review
- CMA1 building on experience from the transparency arrangements under the Convention, adopt common modalities, procedures, and guidelines.

COP24 and CMA1 met simultaneously in Katowice in December 2018 to agree on the operational rules of the Paris Agreement. The Paris Agreement Work Programme or PA rulebook is the guidance to operationalize the new climate regime and was adopted by COP24 and CMA1 in Katowice in 2018. It is composed of the following elements:

- Further guidance on NDCs (decision 1/CP.21);
- Features of nationally determined contributions;
- Information to facilitate clarity, transparency, and understanding of nationally determined contributions;
- Accounting for Parties' nationally determined contributions;
- Further guidance in relation to the adaptation communication (art. 7.10/11);
- Modalities, procedures, and guidelines for the transparency framework for action and support (art. 13);
- Global stock-take (art. 14);
- Committee to facilitate implementation and promote compliance (art. 15.2); and,
- Article 6 PA under the SBSTA.

As indicated above, UNFCCC guidance on REDD+ is already defined in the period 2007 – 2015 and currently locked in the new climate regime thanks to Article 5 of the Paris Agreement. Thus, REDD+ was not included directly in the negotiations on the Paris Agreement rulebook as an agenda item under the subsidiary bodies. Nevertheless, several rules referred to it either directly or indirectly.

Specifically, on transparency, COP24 and CMA1 agreed on the modalities, procedures, and guidelines (MPGs) for the transparency framework for action and support established under Article 13 of the Paris Agreement. In particular,

- Decision 1/CP.24, section VI Matters related to the MPGs for transparency, paragraphs 38 – 46:
- The final biennial update reports (BUR) shall be those that are submitted to the secretariat no later than 31 December 2024 (decision -/CP.24, paragraph 38);
- The MPGs will supersede the Monitoring, Reporting and Verification (MRV) system under the Convention established by decision 1/CP.16, paragraphs 40–47 and 60–64, and decision 2/CP.17, paragraphs 12–62 (decision -/CP.24, paragraph 39);
- Biennial transparency reports (BTRs), technical expert review and facilitative, multilateral consideration of progress to replace biennial reports, biennial update reports, international assessment and review, and international consultation and analysis under the Convention (decision -/CP.24, paragraph 41);
- National Communication + BTR may be submitted as a single report (decision -/CP.24, paragraph 43).

One of the major compromises achieved by the international community in the climate talks is the applicability of the new regime to all Parties. The clear distinction between Annex I and non-Annex I Parties as indicated in the Convention is lost with the Paris Agreement (PA). As agreed in Durban by COP17 the new regime should be applicable to all Parties. Along with this basis what Parties were able to negotiate while drafting the Paris Agreement is the degree of flexibility to be granted to developing country parties, in particular, Small Island Developing States (SIDS) and least developed countries (LDCs). The result of this negotiation is clear and expressed in several parts of the Paris Agreement and its accompanying and implementing decisions.

In particular, flexibility is inscribed in the PA in the following sections:

- Decision 1/CP.21, paragraph 90: Also decides that all Parties, except for the least developed country Parties and small island developing States, shall submit the information referred to in Article 13, paragraphs 7, 8, 9 and 10, as appropriate, no less frequently than on a biennial basis, and that the least developed country Parties and small island developing States may submit this information at their discretion. LDCs and SIDs may comply with the requirements under Article 13 at their discretion. This means full flexibility.

- Article 4.6 of the Paris Agreement: the least developed countries and small island developing States may prepare and communicate strategies, plans and actions for low greenhouse gas emissions development reflecting their special circumstances.

- Article 11.1 of the Paris Agreement: Capacity-building under this Agreement should enhance the capacity and ability of developing country Parties, in particular, countries with the least capacity, such as the least developed countries, and those that are particularly vulnerable to the adverse effects of climate change, such as small island developing States, to take effective climate change action, including, inter alia, to implement adaptation and mitigation actions, and should facilitate technology development, dissemination and deployment, access to climate finance, relevant aspects of education, training and public awareness, and the transparent, timely and accurate communication of information.

Saint Lucia, as a member of the group of the Small Island Developing States (SIDS), is granted full flexibility in the fulfillment of the Paris Agreement and consequently also in the fulfillment of all its rules including transparency.

The enhanced transparency framework for action and support with built-in flexibility considers Parties' different capacities and builds upon collective experience (Article 13, paragraph 1 of the Paris Agreement). As such, 'the transparency framework shall provide flexibility in the implementation of the [transparency framework] to those developing country Parties that need it in the light of their capacities. The modalities, procedures, and guidelines referred to in paragraph 13 of this Article shall reflect such flexibility' (Article 13, paragraph 2 of the Paris Agreement). In particular:

- The enhanced transparency framework for action and support, with built-in flexibility which considers Parties' different capacities and builds upon collective experience, is hereby established (paragraph 1)
- The transparency framework shall provide flexibility in the implementation of the provisions of this Article to those developing country Parties that need it in the light of their capacities (paragraph 2)
- The modalities, procedures, and guidelines referred to in paragraph 13 of this Article shall reflect such flexibility (paragraph 2)
- The transparency framework shall build on and enhance the transparency arrangements under the Convention, recognizing the special circumstances of the least developed countries and small island developing States, and be implemented in a facilitative, non-intrusive, non-punitive manner, respectful of national sovereignty, and avoid placing an undue burden on Parties (paragraph 3)

Flexibility to LDCs and SIDS is confirmed by the Katowice decision on transparency (decision 18/CMA.1) as indicated below:

- Decision 18/CMA.1, Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement and Annex, Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement (MPG Annex):
- 'Parties shall submit their first biennial transparency report and national inventory report, if submitted as a stand-alone report, at the latest by 31 December 2024' (Decision 18/CMA.1, paragraph 3);
- Least developed country Parties and small island developing States may submit the following information at their discretion (Decision 18/CMA.1, paragraph 4 and Annex, paragraph 11):
    - National inventory report of anthropogenic emissions by sources and removals by sinks of greenhouse gases prepared using good practice methodologies accepted by the Intergovernmental Panel on Climate Change IPCC (as a stand-alone report or as a component of a biennial transparency report – MPG Annex, paragraph 12)
    - Information necessary to track progress made in implementing and achieving its NDC
    - information related to climate change impacts and adaptation
    - information on financial, technology transfer and capacity-building support needed and received
- Guiding principles:
    - Building on and enhancing the transparency arrangements under the Convention, recognizing the special circumstances of the least developed countries (LDCs) and small island developing States (SIDS), and implementing the transparency framework in a facilitative, non-intrusive, non-punitive manner, respecting national sovereignty and avoiding placing undue burden on Parties (Decision 18/CMA.1, Annex, paragraph 3a)
    - Providing flexibility to those developing country Parties that need it in light of their capacities (Decision 18/CMA.1, Annex, paragraph 3c)

Section C of the MPGs on transparency is dedicated to flexibility. In particular:

- These MPGs specify the flexibility that is available to those developing country Parties that need it in the light of their capacities pursuant to Article 13, paragraph 2, reflecting flexibility, including in the scope, frequency, and level of detail of reporting, and in the scope of the review, as referred to decision 1/CP.21, paragraph 89 (para 5)
- The application of flexibility provided for in the provisions of these MPGs for those developing country Parties that need it in light of their capacities is to be self-determined (paragraph 6)
- The developing country Party shall clearly indicate the provision to which flexibility is applied, concisely clarify capacity constraints, noting that some constraints may be relevant to several provisions, and provide self-determined estimated time frames for improvements in relation to those capacity constraints (paragraph 6)

- When a developing country Party applies flexibility provided for in these MPGs, the technical expert review teams shall not review the Party's determination to apply such flexibility or whether the Party possesses the capacity to implement that specific provision without flexibility (paragraph 6).

Considering all these Decisions and Considerations of the process agreed under the Paris Agreement. Saint Lucia has the honor to present to you the second Forest Reference Level/ Forest Reference Emission Level (FRL/FREL) of the country at the national level to be evaluated during the period of 2023. This second FRL/FREL was developed to comply with the requirements Art 6 of the Paris Agreement for the generation of Internationally transferred mitigation outcomes (ITMOs) following Decision 2/CMA.3, aligning with the Saint Lucia's Updated Nationally Determined Contribution submitted in 2021[5]. New methodological approaches were also incorporated improving accuracy of the estimations.

The FRL/FREL is in line with the timeline of actions that Saint Lucia presented in its Forest, Soil, and Water Conservation Act, The Water Policy, The Physical Planning Act, the Incentive in Agriculture policy, the Forests and Land Resourced Department Strategy 2015 – 2025, which all make reference in some to regulating land use; therefore, the historical period of the FRL/FREL is from 2016 to 2020 and the validity of the FRL/FREL will be for a period of 5 years (2021-2025).

The country has made its best effort to present all its information in a transparent, accurate, complete, comparable and consistent manner following the basic principles for preparing greenhouse gas inventories of the 2006 Intergovernmental Panel on Climate Change (IPCC).

[5] https://unfccc.int/sites/default/files/NDC/2022-06/Saint%20Lucia%20First%20NDC%20%28Updated%20submission%29.pdf

2. KEY ELEMENTS

Modalities for FRL/FREL according to 12/CP.17

- **Paragraph 7**. The FRL/FREL presented by Saint Lucia is expressed in **tons of CO_2 equivalent per year**, to serve as a benchmark for assessing the country's performance in implementing the REDD+ activities.

- **Paragraph 8.** As explained below (section 1.3.), St Lucia develop a **single database for the National GHG Inventory and the FRL/FREL**. This grants full consistency. All calculations are explicit to maximize transparency. This database also allows to easily check which emissions and removals from the National GHG Inventory are selected for the FRL/FREL.

- **Paragraph 10**. In this submission, Saint Lucia presents an improvement plan, which considers the gradual improvement of methods, as well as the future inclusion of additional carbon pools.

- **Paragraph 11**. Saint Lucia's FRL/FREL is presented at the national level.

- **Annex, chapeau**. the information provided by St Lucia is guided by the IPCC guidance and guidelines, specifically the **2006 IPCC guidelines for National GHG Inventories**.

- **Annex, paragraphs (a), (b)**. A comprehensive database is attached to this report[7]. Also, extensive descriptions of the methods and data used are provided below, as well as in technical annexes to facilitate understanding by the readers and the UNFCCC reviewers.

- **Annex, paragraph (c)**. Those carbon pools included and the reasons for those excluded are provided in Section 1.5. In terms of activities covered, emissions and removals are considered for Forest land and conversions to and from Forest land, which cover any type of REDD+ activity. In essence, this is equivalent to measuring and monitoring all activities in the FRL/FREL as a benchmark for performance.

- **Annex paragraph (d)**. The forest definition used for the FRL/FREL is the same as for the National GHG Inventory included in the 1 Biennial Update Report.

[6] Photo: https://www.naturetrek.co.uk/tours/st-lucia
https://1drv.ms/u/s!Atay4t_hQmrqgYBFY2sROFGpt9rY0Q?e=SHoaDg

3. REDD+ ACTIVITIES

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As indicated in the Decision 1/CP.16, paragraph 71, Saint Lucia has decided to develop a **national**[9] forest reference level/forest reference emissions level (FRL/FREL) in accordance with national circumstances and as a *benchmark* to assess the country's performance in implementing 4 of the 5 the activities referred to in decision 1/CP.16, paragraph 70: **reducing emissions from deforestation**, **reducing emissions from forest degradation**, **conservation** and **enhancement of forest carbon stocks**. **Sustainable forest management** is an activity that does not really apply to Saint Lucia's Forest management; therefore, it was not included. At present, St. Lucia is not engaged in large scale timber production, so this REDD+ activity is neither relevant nor significant for the country.

Definitions for the assessment of the FRL/FREL required defining key REDD+ terminologies within the Saint Lucian national context. The definitions for forest and the four (4) REDD+ activities considered are:

Forest

On the 5th of April 2018, the Forestry Department convened a meeting to discuss a definition which embodies Saint Lucia's forests. Present were the senior staff of Forestry, representatives from Sustainable Development Department, Physical Development, Water Resources Management Agency, Roger Graveson (Botanist) and Kurt Prospere (Interested Party).

The following characteristics were used during the land use and land use change assessment:

- Forest is determined both by the presence of trees, of which there are at least 8 woody species, and the absence of other predominant land uses.
- It includes areas that are temporarily un-stocked due to clear-cutting as part of a forest management practice or natural disasters, and which are expected to be regenerated within 5 years. Local conditions may, in exceptional cases, justify that a longer time frame is used.
- Includes forest roads, firebreaks and other small open areas; forest in national parks, nature reserves and other protected areas such as those of specific environmental, scientific, historical, cultural or spiritual interest.

[8] Photo: https://commons.wikimedia.org/wiki/File:Common_green_iguana.jpg

- Includes windbreaks, shelterbelts, riparian strips and corridors of trees that meet forest definition.
- Includes abandoned shifting cultivation land with a regeneration of trees that have or are expected to reach forest definition.
- Includes areas with mangroves in tidal zones, regardless whether this area is classified as land area or not.
- Includes Christmas tree plantations.
- Includes areas with bamboo, tree ferns and palms provided that land use, height and canopy cover criteria are met.
- Includes tree plantations which have not been utilized for harvesting and have been allowed to be overtaken by natural forest.
- Excludes tree stands in agricultural production systems, such as fruit tree plantations, oil palm plantations, olive orchards and agroforestry systems.

On August 25th – 28th 2019, 17 Saint Lucian national experts from the Departments of Forestry, Planning, Sustainable Development, Veterinary and Livestock Services, Economic Development, Agriculture Engineering, Customs and Excise, and Water Resource Management Agency, attended a training by Coalition for Rainforest Nations (CfRN). Forest definition was discussed and agreed on by all participants as 60% canopy cover, 1 ha and minimum 3m height.

Deforestation

Deforestation is when a forest is converted to another IPCC land use category (cropland, grassland, settlement, wetland, and other lands). For the visual interpretation in the Collect Earth tool, within the 1-hectare sample plot, deforestation required that less than 60% of the forest canopy remained after the human or natural intervention.

Forest degradation

Forest degradation is the process where a forest is disturbed but continues to remain as a forest. Forest disturbance can be caused by humans or natural causes. Natural forest disturbances were identified due to hurricanes, and thus were excluded from the calculations following the guidance of 2019 IPCC Refinement to the 2006 IPCC guidelines[10]. Human disturbances included are logging, fire and shifting cultivation. For degraded forest, within the 1-hectare visually interpreted in the Collect Earth tool, up to 40% of the plot can present a forest loss, but 60 % of the canopy need to have remained after the human or natural disturbance.

Enhancement of forest carbon stock

The enhancement of forest carbon stock lands converted to forest lands due to the creation or restoration of forest carbon pools through human intervention. This also includes restoration of degraded or disturbed areas in forest

[10] 2019 IPCC Refinement to the 2006 IPCC guidelines, Volume 4, Chapter 2, Section 2.6

lands, reforestation, afforestation and the use of agroforestry practices that enhance forest pools (e.g. agroforestry, silvopasture, intercropping, etc).

Conservation is defined as forest land remaining forest land that was not disturbed either by natural or human activity.

For the development of the FRL/FREL, Saint Lucia selected a **Land Based Approach**, which means that the REDD+ activities were assessed all together, and therefore, no specific FRL/FRELs were developed by activity, aiming at environmental integrity. Therefore, **REDD+ results will be evaluated as an integral outcome of national activities**. However, because of the structure of the analysis, each is activity is monitored and reported independently. The table below depicts the source category and associated REDD+ Activity using the IPCC suggested structure. Hence, this directly defines each REDD+ activity for Saint Lucia.

Table 1. Depicting associated REDD+ activity and source category

Associated REDD+ Activity	Source Category
Deforestation	Forest Land Converted to Croplands
	Forest Land Converted to Grassland
	Forest Land Converted to Wetlands
	Forest Land Converted to Settlements
	Forest Land Converted to Other Land
Forest Degradation	Forest Land Remaining Forest Land, disturbed by logging, fire and shifting cultivation.
Conservation	Forest land Remaining Forest Land (undisturbed)
Enhancement of C Stocks	Forest land remaining forest lands, disturbed (recovery)
	Croplands converted to Forest Land
	Grasslands converted to Forest Land
	Wetlands converted to Forest Land
	Settlements converted to Forest Land
	Other lands converted to Forest Land

4. CONSISTENCY WITH THE NATIONAL GHG INVENTORY

This FRL/FREL was developed following the guidance provided in Decision 12/CP.17, decision 4/CP.15, paragraph 7, and seeks to maintain consistency with the anthropogenic forest-related greenhouse gas emissions by sources and removals by sinks with the national greenhouse gas (GHG) inventory contained in the country's first Biennial Update Report, which has been submitted to the UNFCCC, following the reporting guidelines for Biennial Update Reports for Parties not included in Annex I to the Convention (decision 2/CP.17). However, few methodological improvements have been incorporated in this submission, which will be included in the following report to the UNFCCC.

This second FRL/FREL values and the underlying historical emissions and removals are derived from the updated national GHG inventory database (attached to this report as a Microsoft Excel file), to maintain full consistency and transparency in national reporting to UNFCCC. The national GHG inventory, developed annually from 2000 to 2020[12] and this FRL/FREL were estimated following the 2006 IPCC guidelines. Both the National GHG Inventory totals and the REDD+ emissions and removals are based on the same data, methods, and assumptions and come from the same estimation procedure for the as explicitly shown in the attached database.

[11] Photo: https://www.thestar.com/life/travel/2016/12/09/chocolate-island-celebrates-its-cocoa-related-heritage.html

[12] The GHG Inventory is included in the 1BUR, which is in the process of finalization to date and has not been submitted yet to UNFCCC.

5. FOREST REFERENCE LEVEL/ FOREST REFERENCE EMISSIONS LEVEL OF SAINT LUCIA

The current national FRL/FREL proposed by Saint Lucia is the net of Greenhouse gas (GHG) emissions and removals for Forest land remaining forest lands and forest lands conversions to and from the other IPCC land use categories and country specific subcategories. The analysis is done at national level, following the Gain-Loss method proposed in the 2006 Intergovernmental Panel on Climate Change (IPCC) guidelines for National GHG inventories, and implementing a country-specific excel calculation tool[14]. All lands were considered as managed. It includes the pools above-ground biomass, below-ground biomass, dead organic matter and soil organic carbon.

5.1.1 Carbon pools

The FRL/FREL includes the carbon pools: **above-ground biomass**, **below-ground biomass**, **dead organic matter and Soil Organic carbon.**

5.1.2 Gases Included

In addition to **carbon dioxide (CO_2)** emissions and removals, the FRL/FREL includes **methane (CH_4)** and **nitrous oxide (N_2O)** emissions from biomass burning in forest land categories. Emissions in carbon dioxide equivalents (CO_2e) are reported using the **100-year global warming potentials** (GWPs) contained in **IPCC's second Assessment Report (AR 2)**.

5.1.3 Scale

The scale of the FRL/FREL is National. The total land area is 616 square kilometers (km2) (61600 Ha). The country is divided into 11 districts. A systematic sampling grid of 2501 plots located 500m distance apart was used to allow a national coverage analysis of the island.

[13] Photo: https://www.bbcgoodfood.com/howto/guide/11-foodie-things-do-st-lucia

[14] This country specific tool is similar to the IPCC working sheets but adapted to capture country specific circumstances.

5.1.4 Reference Period

The **reference period for this FRL/FREL is 2016-2020** and includes **yearly estimates of emissions and removals**, as included in the national GHG inventory. This reference period was selected based on the timeline of activities developed by the Forestry Department

5.1.5 Definition of the FRL/FREL

The FRL/FREL values were determined using an historical average of the latest 5 years, which can represent the most current conditions of land use, land use changes and anthropic disturbances. The proposed FRL/FREL values are:

Table 2. FREL Values (net emissions) in tCO2e

	YEAR	t CO_2 eq
HISTORICAL EMISSIONS AND REMOVALS	2016	-168,394
	2017	-336,952
	2018	-277,275
	2019	-199,802
	2020	-273,208
FRL/FREL	2021	-251,126
	2022	-251,126
	2023	-251,126
	2024	-251,126
	2025	-251,126

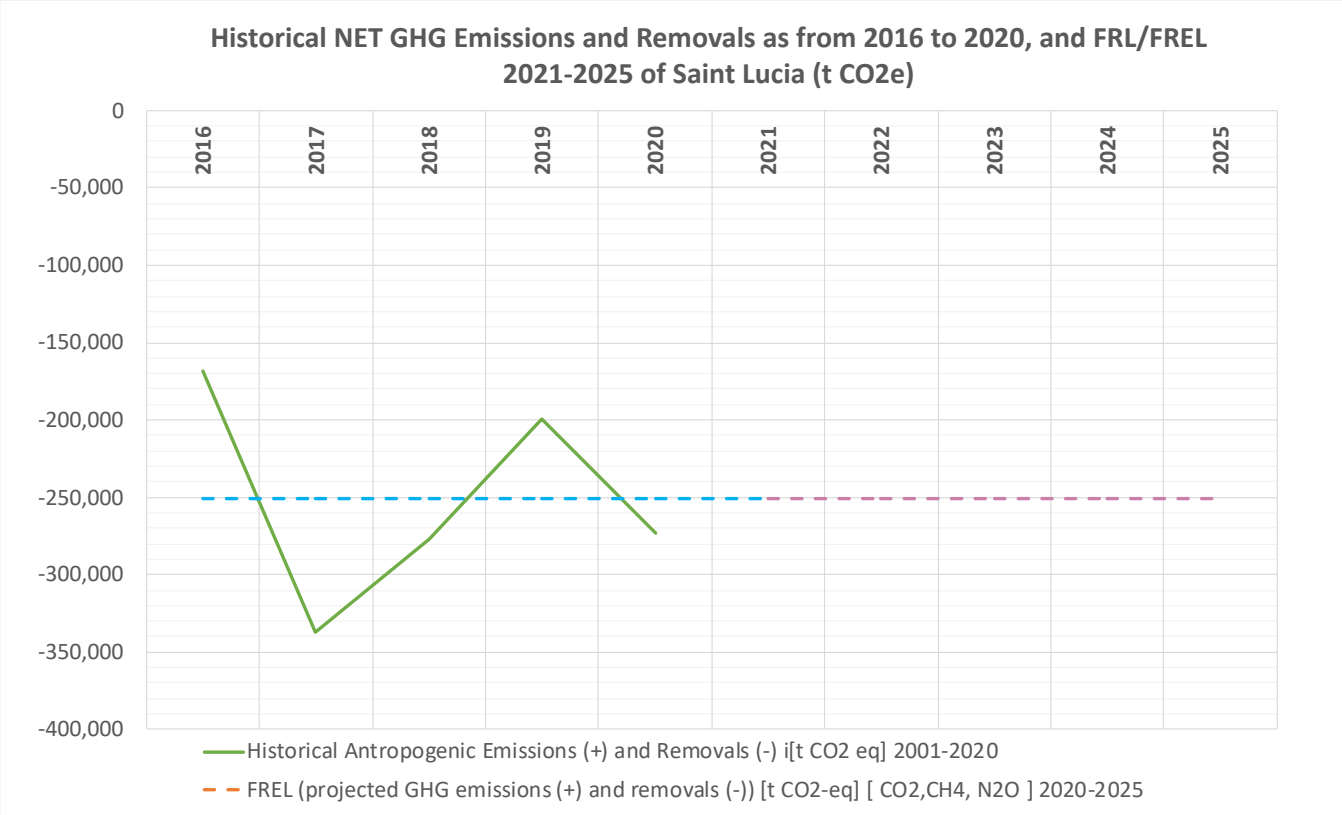


Figure 1. Historical NET GHG Emissions and Removals as from 2016 to 2020, and FRL/FREL 2021-2025 of Saint Lucia (t CO2e)

5.2 Forest sector Background

Saint Lucia is a Caribbean Island of volcanic origin defined by a large, central mountain range running north to south across most of the island. Saint Lucia's topography is on average very ridged, with limited areas of flat land. The mountains are home to unique misty cloud forests, while the valleys are inhabited by rare deciduous and semi-evergreen forests holding much of the island's biodiversity, and on the coasts behind the beaches there is shrubland, and also some small littoral evergreen forests. The islands flat areas are the most heavily effected by human activities, mainly agriculture, specifically plantations. Populated mostly with deciduous forests, today virtually all is secondary, and has seen heavy damage in the past and recently. While the other forest types located in the mountainous areas have been left a lot less disturbed, and areas within forest reserves are considered excellently persevered. With the decline of the banana industry, Saint Lucia is transitioning from an agricultural economy into a more service and tourism-based economy. Already many plantations have been left abandoned and are regenerating back into forests, and this is projected to escalate as the transition continues (Graveson, 2009)

5.3 National legislation related to Forest sector

Policies

Saint Lucia Forests and Land Resources Department Strategy 2015 – 2025.

This document presents a new strategy for the Saint Lucia Forests and Lands Resources Department, commonly known as the Forestry Division, to address the changing responsibilities of the Division and the demands on its resources over the next 10 years. The 2015–2025 Strategy was developed through a participatory process that involved all members of the staff of the Division, senior members of the Ministry of Sustainable Development, Environment, Science and Technology, representatives of other Ministries and Departments, NGOs, experts and the wider public. The document identified five strategies that are to be implemented and they include 1. Maintaining healthy ecosystems and thriving species, 2. Ensuring sustainable flows of products that support both local economies and biodiversity conservation, 3. Protecting water supplies, soils and coastal zones and ensuring resilience to climate change, 4. Promoting awareness, visitation and cultural enrichment, and 5. Organizational strengthening.

Nationally Determined Contribution of Saint Lucia.

This Saint Lucia'sNationally Determined Contribution (INDC) is a cross-sectoral policy document. Saint Lucia updated its NDC in January of 2021 and the targets set were to reduce greenhouse gases by 37 GgCO2e., compared to 2010 emissions, a deeper reduction in emissions than the first NDC, which effectively proposed to reduce GHG emissions by 10 GgCO2e. In terms of percentage decrease, the updated NDC translates to approximately 7% reduction in GHG emissions in the energy sector by 2030, relative to the 2010 emissions. In comparison, Saint Lucia's first NDC effectively resulted in an emissions reduction of 2%. In absolute terms, 2010 emissions in the energy sector were 505 GgCO2e, which will be reduced to 468 GgCO2e in 2030.

The Government of Saint Lucia has decided to include an Adaptation component as part of this mitigationfocused NDC to demonstrate its commitment to achieve the targets of the Paris Agreement as well as having in place better mechanisms for the adaptation to climate change impacts. According to the Intergovernmental Panel on Climate Change (IPCC), adaptation and mitigation can be understood as complementary components of countries' response to climate change and adaptation generates larger benefits to small islands when delivered in conjunction with other development activities.

Climate Change Adaptation Policy 2013.Date of text: 2013

The aim of this Climate Change Adaptation Policy (CCAP) is to foster and guide a national process of addressing the short, medium and long term effects of climate change in a coordinated, holistic and participatory manner in order to ensure that, to the greatest extent possible, the quality of life of the people of Saint Lucia, and opportunities for sustainable development, are not compromised. This Policy builds on Saint Lucia's National Climate Change Policy

and Adaptation Plan that was endorsed in 2002. It provides a strategic platform not only for use by policy and decision makers at all levels, but also for the development and strengthening of partnerships for implementation of national and regional initiatives by all stakeholders.

Legislation

Forestry

- Forest, Soil and Water Conservation Act Chapter 7.09.

  This is an ACT to make provision for the management of forests and forest produce, defined as all parts or produce of trees and plants in Saint Lucia. This Act defines the roles and responsibilities of the Chief Forest Officer, Forest officers, and *Ex officio* forest officers. It defines the lands that the Forestry Division has jurisdiction over and what constitutes as an offence on these lands. It provides details of these offences and the penalties to be discharged to persons who contravene the Act. Guidelines on declaration of protected areas are also provided in this Act and the activities that are permitted in these protected areas.

- Timber Industry Development Board Ordinance, 1963 (No. 24 of 1963).

  This Ordinance was for the establishment of a company to manage the timber industry in St. Lucia. This gave the Board power to acquire and hold property or lease property for their timber operations. The duties of the different board members and their tenure are also identified along with the power that the board possessed. This is no longer in effect.

- Forest, Soil and Water Conservation (Declaration of Protected Forests) Order (S.I. No. 31 of 1986).

  The Forest, Soil and Water Conservation (Declaration of Protected Forests) Order (S.I. No. 31 of 1986) was a proclamation by the government of St. Lucia that identified forests that had to be protected. The criteria used included areas that provided protection against storms, winds, rolling stones, floods and landslides, prevented soil erosion and land slippages, maintenance of water supplies in springs, rivers, canals and reservoirs, protection of roads, bridges, railways and other lines of communications and the preservation of health. The boundaries to the north, west, east, and south of these areas are also provided in this Statuary Instrument.

- Forest, Soil and Water Conservation (Declaration of Forest Reserves) Order (S.I. No. 53 of 1984).

  In 1984, The Minister declares under section 19 of the Forest, Soil and Water Conservation Ordinance Forest Reserves for purposes of protection against storms, winds, rolling stones, floods, landslides, prevention of soil erosion and the deposit of mud, stones, etc. on agricultural land, prevention of wastage of resources of timber and for securing the proper management of timber lands, the maintenance of water supplies in springs, rivers, canals and reservoirs, the protection of specified works, the preservation of health, and the protection of slopes over 35° of inclination.

- Prohibited Areas Proclamation (1949)

  This proclamation identifies two areas where forest reserves were declared. They were all that area of Crown lands in the Quarters of Castries, Dauphin and Dennery comprising of 2,600 acres which, forming the gathering grounds of the Castries Water Supply and all that area of Crown lands in the Quarter of Dennery comprising 365 acres and forming the gathering grounds of the Dennery Water Supply.

- Forest, Soil and Water Conservation Ordinance (Amendment) Act, 1983 (No. 11 of 1983).

  This Act amends the 1946 Ordinance essentially for purposes of updating obsolete provisions, such as penalties, fines and names of authorities. Honey, soil, rock and other minerals are added to the definition of forest produce in section 2 of the Ordinance. A definition of "forest was also added to this Ordinance". This definition has been updated for the purpose of REDD+ measuring, monitoring and reporting activities.

Land and soil

- Land Registration Act Chapter 5.01 (31 December 2008).

  The provisions of this Act shall apply only to land, interests in land, or dealings in land, registered under this Act. This Act sets forth organization, administration, duties, authorities and responsibilities of the Land Registry and registrars. A Registrar of Lands shall be appointed by the Public Service Commission to manage the Land Registry in accordance with this Act. The Land Registry includes a register in respect of every parcel which has been adjudicated in accordance with the Land Adjudication Act and a register in respect of each lease required by this Act to be registered. The Registry Map shall be in compliance with the demarcation maps under the Land Adjudication Act. The Registry Map may be corrected as a result of survey and new editions may be prepared with new boundaries and numbers for a parcel. Due to the application of the proprietors of contiguous parcels, the Registrars may carry out activities for land division and re-parcellation. In addition, this Act provides provisions on registration procedures, the effect of registration with absolute and provisional title, the effect of registration of leases and crown land, certification of land and lease, discharge of hypothec, disposition of land, servitudes, conditions for transmission, the effect of inhibition, restrictions and cautions, rectification by the Registrar or by court, jurisdictional proceedings, fees and sanctions

- Physical Planning and Development Act Cap. 5.12 (31 December 2005)

  This Act lays down rules for sustainable use of land, improvement of the quality of the physical environment, effective subdivision of land, and protection of human health and safety, the environment, natural resources and cultural heritage. This Act applies to all publicly-owned and privately-owned land in Saint Lucia. This Act identifies the duties of the Minister and the Head of the Physical Planning and Development Division, the establishment of Advisory Committees and Physical Planning and Development Appeals Tribunal in Part I. It also includes provisions on the content, preparation, approval, review, revision and status of physical plans under the responsibility of the Head of the Physical Planning and Development

Division. The Act provides procedures and principles for the permission required for land development, obligation to obtain environmental impact assessment for approval, declaration of zoned area, preservation of buildings, monuments and sites of special prehistoric, historic or architectural interest, and protection of natural areas. The fourth part of the Act presents the procedures and principles for the enforcement and compliance, and Part V the provisions on the compensation and acquisition. The miscellaneous provisions are provided in Part VI, including registration of land, powers of entry for the purposes of inspection and survey, liability of landowners, offences and penalties, qualification of existing law, and the power of the Minister to make regulations for giving effect to the provisions of this Act. Finally, Part VII comprises the transitional provisions, such as reference to the Development Control Authority, pending applications, and preservation of rights, claims, offences and proceedings.

- Land Conservation and Improvement Act
  The Act provides for the conservation of land in Saint Lucia and the establishment of the Land Conservation Board. Among its functions are to stimulate public interest in the conservation and improvement of land and water resources and to recommend to the Minister the nature of legislation deemed necessary for the proper conservation and improvement of land and water resources

- Special Development Areas Act, 1998
  An Act to rectify the uneven development of Saint Lucia by designating certain areas as special development areas, providing relief to persons carrying out specified activities in these areas and to persons financing such activities. Areas specified in the First Schedule are declared to be special development areas. The activities specified in the Second Schedule may be carried out in such areas. A person who wishes to become an approved developer may make an application to the Minister under section 4. No conditions to which the approval is subject are specified. Allowed activities include water-based activities, agricultural-based activities, and fisheries-based activities.

5.4 Procedures and arrangements for the preparation of the FRL/FREL

A brief description of procedures and arrangements undertaken to collect and archive data for the preparation of the FRL/FREL is included, with information on the role of the institutions involved.

5.4.1 Schedule of FRL/FREL tasks

The process started with review of reports and datasets, data collection, selection, processing and analysis, QC/QA procedures, and finalized with a compilation of the FRL/FREL. The process was completed by internal and external independent review.

Table 3. FREL tasks

Stages	Responsible
Identification and formation of the team	Forestry Division - Ministry of Agriculture, Fisheries, Physical Planning, Natural Resources and Co-operatives
Allocation of tasks	Forestry Division
Technical training	Forestry Division / CfRN/
Data collection	Forestry Division / CfRN
QC/QA procedures	Forestry Division / CfRN
Data analysis	Forestry Division / CfRN
Compilation of the FREL	Forestry Division / CfRN
QC/QA procedures	Forestry Division / CfRN/
Independent review	CfRN RRR+IP
Improvement plan	Forestry Division / CfRN/

CfRN: Coalition for Rainforest Nations. CfRN RRR+ IP: Coalition for Rainforest Nations Independent Panel of Review.

5.4.2 Means of data acquisition and management

Data acquisition

Activity Data:

- On August 25th – 28th 2019, 17 Saint Lucian national experts from the Departments of Forestry, Planning, Sustainable Development, Veterinary and Livestock Services, Economic Development, Agriculture Engineering, Customs and Excise, and Water Resource Management Agency, attended a training by CfRN aimed at increasing knowledge about standardized tools to be used for Agriculture, Forestry, and Other Land Use (AFOLU) greenhouse gas inventory (GHGI) preparation. Specifically, focus was given at collecting Activity Data through a Collect Earth Campaign, where key steps were discussed such as the protocol for standardizing interpretation and Land Use and Land Use Change Transition Matrix structure for quality control purposes. Furthermore, best practices and lessons learnt with other RRR+ (Reporting for Results-based REDD+) countries were shared with the view to enhance south-

south knowledge. Forest definition was discussed and agreed by all participants as well as the sub-divisions for all 6 IPCC categories of land use.

- On November 11th-15th 2019, 6 national experts from the Forestry department attended a joint-training with Dominica, Belize and Panama, led by CfRN, aimed at increasing knowledge about GHG tools and IPCC guidelines to be used for AFOLU-GHG inventory preparation. Specifically, focus was given to collecting LULUC Activity Data from 2000 to 2018 through a Collect Earth Campaign, where experts from Belize and Panama led a South-South exchange for the assessment of Land Use and Land Use Changes following the IPCC methods, resulting in a consistent time series as the main input for the GHG Inventory. The information collected was used in the preparation and submission of AFOLU-GHG Inventories to the UNFCCC via Biennial Update Reports (BURs)and was the for the REDD+ Forest Reference Emission Levels/Forest Reference Levels (FREL/FRL) and first REDD+ Technical Annex.

- On October 17th - 21st 2022, 4 national experts from the Forestry department attended a joint workshop with Dominica, led by CfRN. The team was introduced to a new land use and land use assessment tool (CfRN LUA APP) for the current LULUC assessment. Specifically, focus was given to collecting LULUC Activity Data for the years 2019-2020, following the same sampling approach used previously, resulting in a consistent annual time series from 2000 to 2020 as the main input for the updated GHG Inventory and second FRL/FREL.

Emission Factors:

- Country information was provided by the Forestry Division. Also, default values were used from the 2006 IPCC guidelines for GHG Inventories. With the emergence of new science and publications, the emission factors from the 2019 IPCC refinement to the 2006 IPCC guidelines and the 2013 IPCC Wetlands supplement were also used because were considered most appropriated to Saint Lucia circumstances. These factors were selected in a series of meetings where at 2 experts, usually 4 to 6, from the Forest Division participated.

List of data providers, roles and responsibilities

Table 4. List of data providers, roles and responsibilities

Institution	Department	Name	E-mail	Role (Data Provider/Data Archiving/ QA/AC/Inventory Prep)
Ministry of Agriculture, Fisheries, Physical Planning, Natural Resources and Co-operatives.	Forestry	Rebecca Rock	rebecca.rock@govt.lc	Technical Lead, Activity Data Collection for LULUC 2000-2020, FRL/FREL Preparation, Documentation, QC, Archives.
Ministry of Agriculture, Fisheries, Physical Planning, Natural Resources and Co-operatives.	Forestry	Chris Virginie Sealys	chris.sealys@govt.lc	Activity Data Collection for LULUC 2000-2020, FRL/FREL Preparation, Documentation, QC, Archives.
Ministry of Agriculture, Fisheries, Physical Planning, Natural Resources and Co-operatives.	Forestry	Tamisha Doxillie	tamisha.doxillie@govt.lc	Activity Data Collection for LULUC 2000-2020, FRL/FREL Preparation, Documentation, QC, Archives.
Ministry of Agriculture, Fisheries, Physical Planning, Natural Resources and Co-operatives.	Forestry	Odetta Lewis-James	Odetta.james@govt.lc	Activity Data Collection for LULUC 2000-2020, FRL/FREL Preparation, Documentation, QC, Archives.
Ministry of Agriculture, Fisheries, Physical Planning, Natural Resources and Co-operatives.	Forestry	Karl Augustine	karl.augustine@govt.lc	Technical advice as Senior forestry expert
Ministry of Agriculture, Fisheries, Physical Planning, Natural Resources and Co-operatives.	Forestry	Pius Haynes	pius.haynes@govt.lc	Technical advice as Senior forestry expert

Data management

All the relevant datasets that have been used during the analysis have been documented. The archives database contains; (a) all inputs datasets and datasheets; (b) country-specific excel calculation tool, including GHG emission and removals estimates (c) manuals and protocols, (d) literature reviewed, (e) completed QA/QC templates and protocols, and (f) all reports and documentation. Archives are held by the Forestry Division.

5.5 Methodologies for estimating GHG emission and removals

The table below summarizes the methods and emission factors used for the FRL/FREL. This FRL/FREL uses mostly Country Specific information for Activity data and Tier 1 and Tier 2 methods for Emissions Factors.

Table 5.Methods and EF used for the FREL

Category	CO_2		N_2O		CH_4	
	AD	EF	AD	EF	AD	EF
5. LULUCF						
A. Forest Lands	CS	T1, T2	CS	T1	CS	T1
B. Croplands	CS	T1	NO	NA	NO	NA
C. Grasslands	CS	T1	NO	NA	NO	NA
D. Wetlands	CS	T1	NO	NA	NO	NA
E. Settlements	CS	T1	NO	NA	NO	NA

T1 – Tier 1, T2 – Tier 2, T3 –Tier 3, CS – Country specific, D – IPCC default, IE – Included Elsewhere; NA – Not Applicable; NE – Not Estimates; NO – Not Occurring

5.5.1 Activity Data

The information on Activity Data (AD) used was obtained from land use and land-use change assessment, which was conducted on the basis of a sampling approach (IPCC approach 3) using Collect Earth Desktop for the years 2016 and 2018, which was then integrated to the CfRN LUA app to continue the assessment of the years 2019 and 2020, in which the land-use condition, including natural and/or human disturbance, was determined in the same way for each year of the time series 2016 - 2020. Forest land was stratified by forest type (Montane Forest -Elfin, Cloud montane, Montane Rainforest-, Seasonal Forest -Semi-Evergreen, Semi-Deciduous-, Littoral Evergreen, Mangroves and Plantation). Croplands are reported as annual and perennial crops. Grasslands do not have further sub-classification; Settlements are reported as Woody and Non-Woody. Wetlands do not have further sub-classification and Other lands divided into Other Lands and Mining.

The information on wood removals was derived from the sampling assessment as cover loss instead of volume loss, as the tools (Collect Earth Desktop and CfRN LUA App) do not allow that estimation yet. Losses due to Disturbances were also identified including Hurricanes, Fires, Logging and Shifting Cultivation, specifically on Forest lands. Emissions due to hurricanes were measured and reported but excluded from the historical average as these are considered a natural disturbance.

An improvement respect with the previous FRL/FREL is that collection of multiple land use changes and multiple disturbances on the same plot can be identified.

Land Representation Approach

According to the 2019 IPCC guidelines, Saint Lucia implemented the Land Representation Approach 3, as it is characterized by spatially explicit observations of land-use categories and land-use conversions, tracking patterns at specific point location. It is a sampling approach, different to wall-to wall approach (maps).

Collect Earth is a user-friendly, Java-based tool that draws upon a selection of other software to facilitate data collection. Collect Earth uses a Google Earth interface in conjunction with an HTML-based data entry form. Forms can be customized to suit country-specific classification schemes in a manner consistent with guidelines of the Intergovernmental Panel on Climate Change (IPCC).

Collect Earth facilitates the interpretation of high and medium spatial resolution imagery in Google Earth, Bing Maps and Google Earth Engine. Google Earth's virtual globe is largely comprised of 15-meter resolution Landsat imagery, 2.5m SPOT imagery and high-resolution imagery from several other providers (CNES, Digital Global, EarthSat, First Base Solutions, GeoEye-1, GlobeXplorer, IKONOS, Pictometry International, Spot Image, Aerometrex and Sinclair Knight Merz). Collect Earth synchronizes the view of each sampling point across all three platforms. The tool enables users to enter data regarding current land use and historical land use changes. Users can determine the reference period most appropriate for their land use monitoring objectives.

CfRN LUA app is a free, open-access image visualization and interpretation tool useful for projects requiring land cover and/or land use information. The CfRN LUA app allows simultaneous visual interpretations of satellite imagery such as Landsat 8, Sentinel 2 and Planet imagery, providing global coverage of MapBox and Bing Maps, a variety of satellite data sources from the Google Earth Engine. All of its functions are implemented online, no desktop installation is required. LUA app allows institutions to create projects and mobilize their teams to collect data using remotely sensed imagery. Uses include historical and near real-time interpretation of satellite imagery, data collection for validation of land cover and/or land use models.It is important to note that both Collect Earth Desktop and Collect Earth Online are compatible, therefore the databases of the results have methodological similarities.

National grid

A 500m by 500m national systematic grid consisted of 2051 sampling plots of 1Ha was selected. This systemic grid was used because of the small size of the island. This allowed for intense sampling that covered al forest types and all land use classes. This sample size was used to cover all forest and land use types. This assumption considered

that all forest types would be well represented in the sampling. Usually when the sampling is done a formula is used to determine the number of plots to be sampled by strata. However, in Saint Lucia this was not necessary as the entire country could be sampled with a very intense grid. Assistance was received from Belize and Panama to determine sampling size as these countries are very experienced in the use of Collect Earth. These sampling points were visually evaluated, and all available information on land uses and land use changes was collected and recorded between 2016 and 2020. Ground truthing was also done to validate the findings from the Collect Earth software.

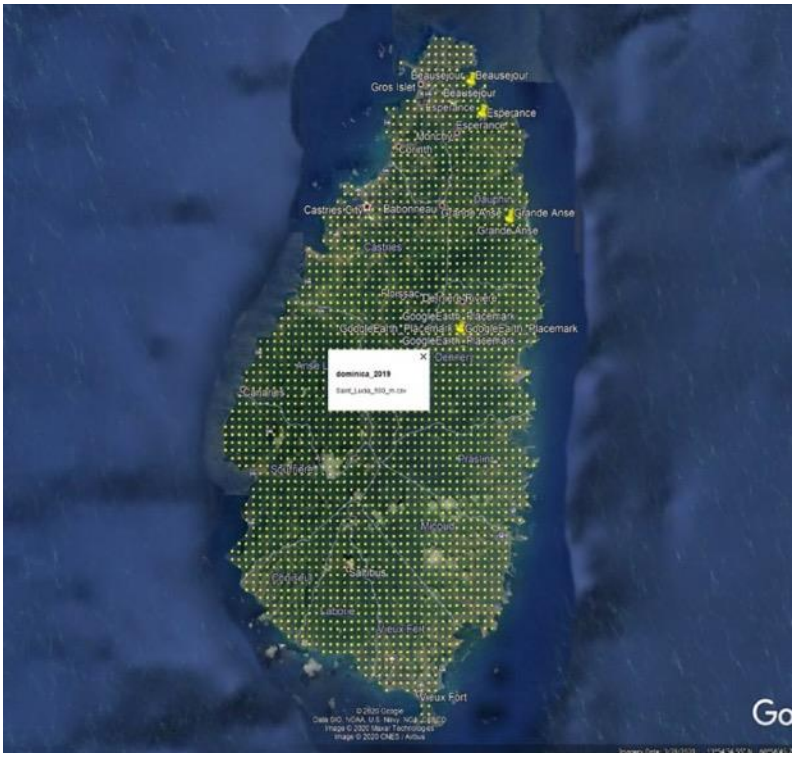


Figure 2 Saint Lucia National systematic sampling grid

Plot Size: 1Ha

Distance among plots: 500m

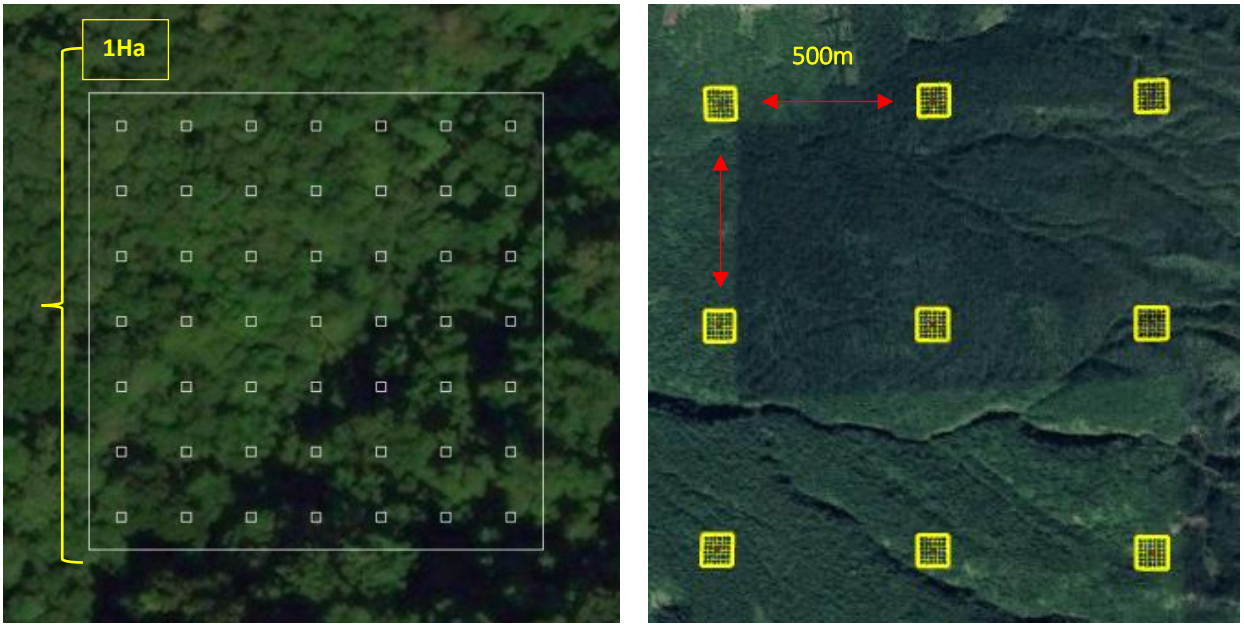


Figure 3. Plot size and distance among plots

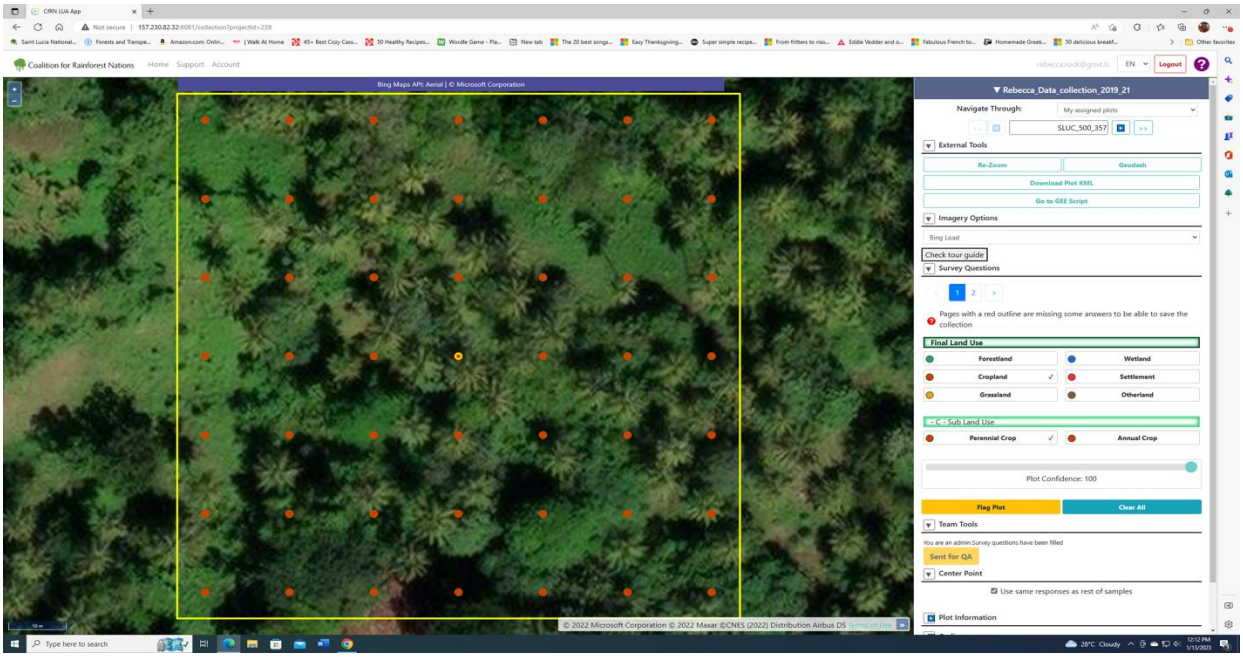


Figure 4 Sampling survey in CfRN LUA Ap

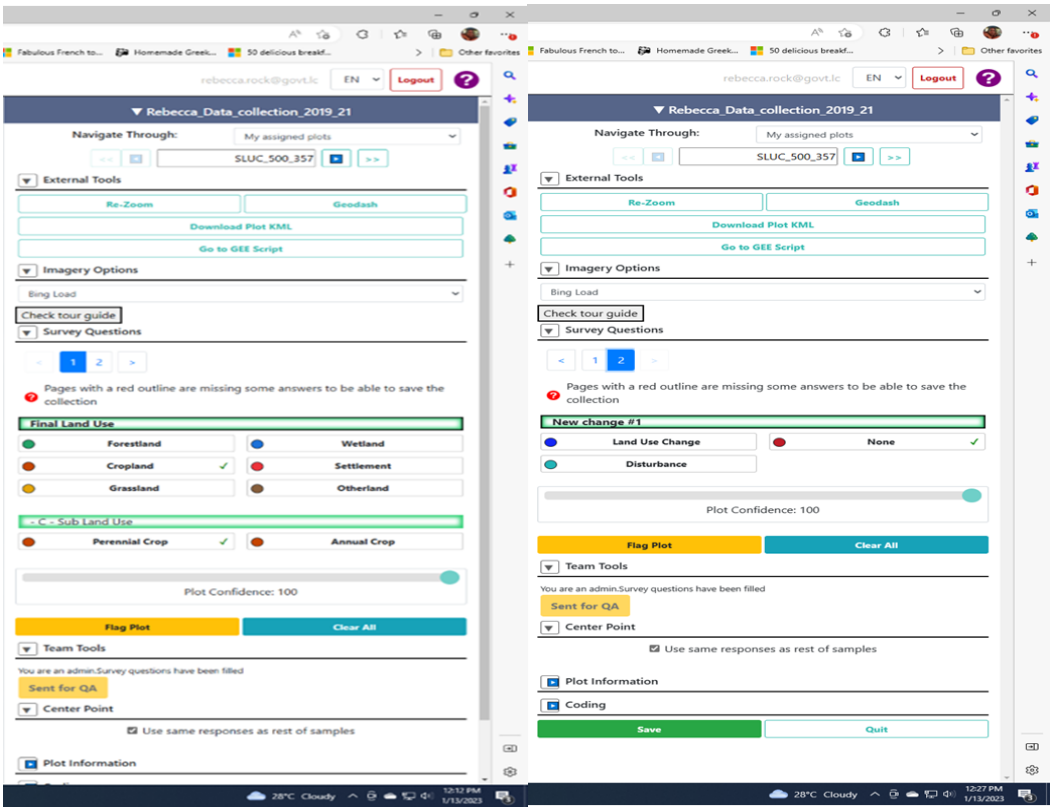


Figure 5 Example of survey questions

Plot analysis with support images (Sentinel, Landsat 8, Landsat 7, Vegetation Indices)

The following images indicate the steps for assessing land use with Collect Earth and its supporting software:

Google Earth, Bing Maps and Google Earth Engine. The diagram below provides an overview of the key steps:

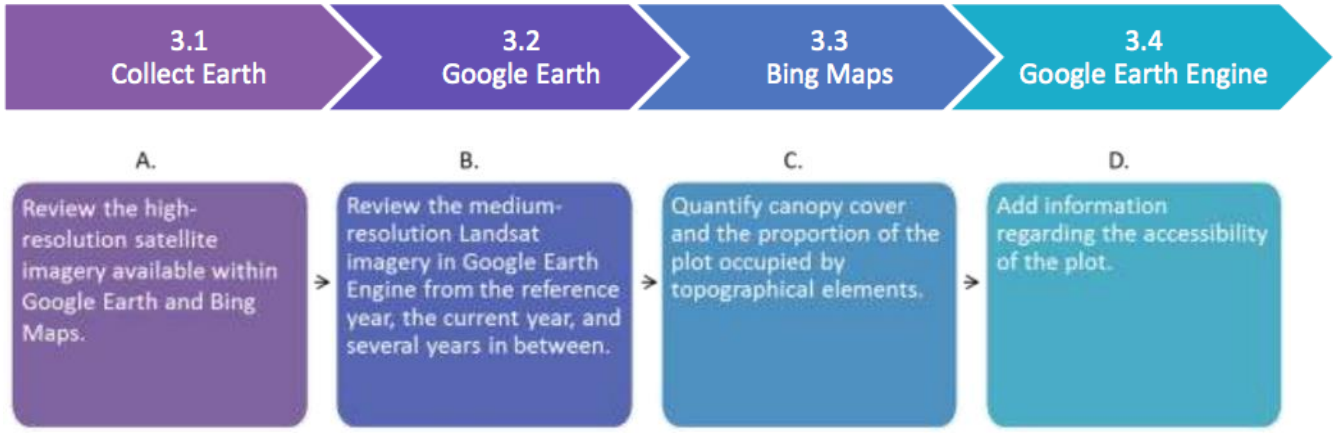


Figure 6. Steps for assessing land use with CE

Microsoft's Bing Maps presents imagery provided by Digital Globe ranging from 3m to 30cm resolution. Google Earth Engine's web-based platform facilitates access to United States Geological Survey 30m resolution Landsat imagery. Through Bing Map, high spatial resolution satellite imagery from Digital Globe can be viewed and used for land use assessments. Collect Earth plot locations have been linked with Bing Maps because the latter web mapping service has a slightly different geographic coverage. Through Google Earth Engine is the Landsat Greenest-Pixel top of atmosphere (TOA) reflectance composite. These composites, which are available for Landsat 4, 5, 7 and 8, are created by drawing upon all images of a site for a full calendar year. The greenest pixels, with the highest NDVI (normalized difference vegetation index) value, are compiled to create a new image. These composites are particularly useful in tropical forest areas that may be prone to frequent cloud cover. This infrared color composite presents forest with a reddish-brown color and agriculture, grass and shrubs in lighter shades of orange. Water appears purple and urban areas are shades of blue and green. These composite pools information from bands that are sensitive to different types of reflectance.

The vegetation indices are indicators that describe the greenness — the relative density and health of vegetation — for each picture element, or pixel, in a satellite image. Collect Earth displays through Google Earth Engine Playground a set of time-frame charts with different vegetation indices to help the user identify possible trends and seasonality for the area of interest.

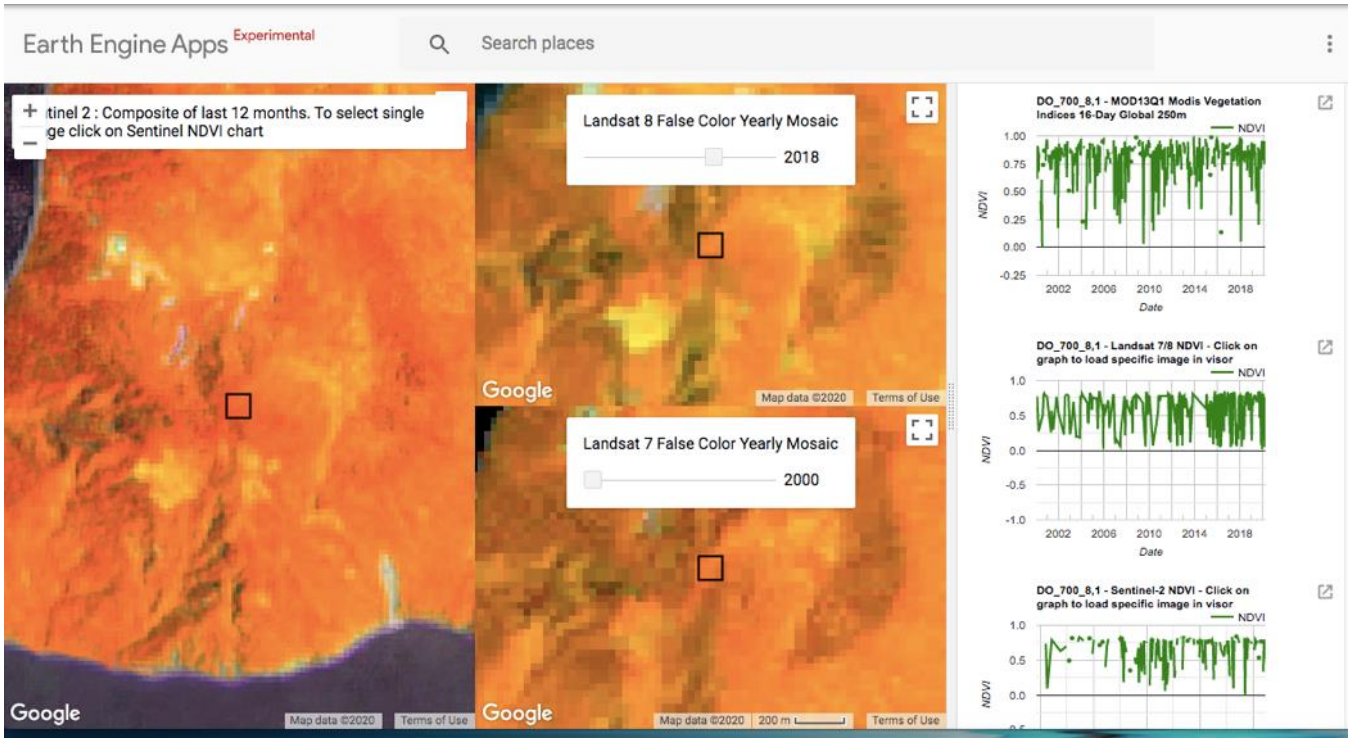


Figure 7. Google Earth Engine

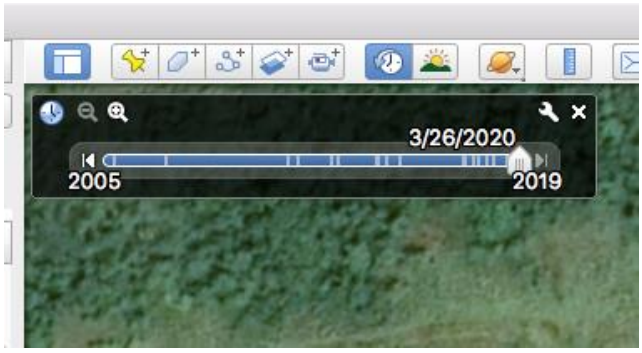


Figure 8. Historically Imagery on CE

Land Use Classes

Saint Lucia followed 2006/2019 IPCC guidelines structure for the FRL/FREL, including the six main land uses proposed: Forest lands, Cropland, Grassland, Wetlands, Settlement and other lands (Level 1).

Table 6. Land Use classes and sub-categories for Forest land

IPCC categories Level 1		sub-categories Level 2	Level 3	Code	Location m.a.s.l
Forest land	F	Montane	Elfin forest	FELF	>700
			Cloud montane	FCLOUD	500-900
			Montane Rainforest	FRAIN	200-700
		Seasonal	Semi-Evergreen Forest	FEVER	0-800
			Semi-Deciduous Forest	FDEC	0-500
		Littoral Evergreen, Mangroves	Dry Scrub	FDRYS	0-300
			Littoral Evergreen	FLIT	0-300
			Mangroves	FMAN	0-100

Level 1: FOREST LAND (F)

Level 2: Montane Forest

Level 3: Elfin forest

Slopes are extremely steep, rainfall is very heavy, there is little wind and landslides are very common. The steepest areas are covered with tree ferns and palms, with canopy height of about 4-6m, with some scattered taller trees on slightly less steep areas. canopy cover is often quite complete on gentler slopes, but broken on steep slopes; ferns, mosses, ground anthuriums, vines, and epiphytes vary from absent to abundant; trees with buttresses and prop roots are present in some areas and absent in others. At ground level, it varies from humid, quite dark and still, to rather breezy and bright. This variation results from natural factors, especially slope gradient, exposure to the prevailing wind, altitude (and therefore rainfall), and recent climatic disturbances. 3m high. Tropical or subtropical broad-leaved evergreen shrubland (includes bamboos and tuft-trees). In the windiest spots on the Mount Gimie/ Troumassée ridges and peaks, at an elevation above 700 metres, a shrubland vegetation class dominates. Relatively few species are found in this vegetation type: mainly a mixture of bromeliads, sedges and grasses and shrubs, with many Lesser Antillean endemics.

Level 3: Cloud montane

This vegetation class is found on the high summits of the Mount Gimie range, including Piton Troumassée (although not in the windiest spots), at an elevation of 700m or higher and possibly the eastern interior end of Mount Tabak ridge and a small area on the western end of the La Sorciere ridge. The canopy is about 8m high with occasional much taller trees. Terrestrial ferns, anthuriums, bromeliads, and epiphytes are very common; moss cover is often several centimeters thick. Cloud and mist cover, with heavy rainfall, is predominant, with only occasional and short periods of sunshine. Some species found in Montane and Lower Montane Rainforest are also found here.

Level 3: Montane Rainforest

Lower Montane Rainforest merges with Semi-evergreen Seasonal Forest at lower elevations and with Montane/ Cloud Montane Rainforest at higher elevations. Trees are evergreen because there is no water deficit most years in any month. In general, trees of all heights are found, without clear divisions into separate canopy layers. Although there may be a shrub, fern and herbaceous (mainly Anthurium) ground cover, this forest class is easy to walk through (if one ignores the incline) except where the canopy has been destroyed and ferns, vines and shrubs colonize the clearing.

Away from the edge of the forest, on comparatively gentle slopes without much wind, occasional very tall trees, reaching 45m, are found among the main 30-m canopy. This distinctive forest is often called the *Dacryodes-Sloanea* alliance and is often over-emphasized as being the „typical" rainforest. In fact, it occupies just a part of Saint Lucia's forest reserves. Exposed ridges often have a dwarfed vegetation because of high winds. Landslides are a natural phenomenon in Lower Montane Rainforest and can be seen at various stages of recovery.

In comparison to Semi-evergreen Seasonal Forest, the mean canopy height, wind, and incline are greater and there is a greater abundance of vines, epiphytes, ferns and mosses. The trees are more tightly packed, and the trees can be much wider in girth. This forest class has been recorded from 100- 680m above sea level.

Montane Rainforest is on the western side and sheltered eastern slopes of the Mount Gimie Range, including Piton Troumassée, above 650m. Slopes are extremely steep, rainfall is very heavy, there is little wind and landslides are very common. The steepest areas are covered with tree ferns and palms, with canopy height of about 4-6m, with some scattered taller trees on slightly less steep areas. This class is poorly differentiated from Lower Montane Rainforest in terms of species, but it has a very characteristic appearance. It is found only on very steep slopes at high elevation: where the slope is gentler Lower Montane Rainforest replaces it.

Level 2: Seasonal Forest

Level 3: Semi-Evergreen Forest

Occupies the zone between Deciduous Seasonal Forest and Lower Montane Rainforest. It is characterized by upper canopy trees with rather thin, often broad, and quite often compound leaves, which may lose some, but not all, of their leaves during a dry spell. There are no, or very few, epiphytes, ground ferns and mosses. Elevation ranges from almost sea-level in ravines to the summit of Gros Piton. Rare forest, all secondary. Upper canopy trees with thin, broad and compound leaves. Might lose some leaves during dry season. This forest class is found in agriculture areas, river valleys below Lower Montane. In comparison with Deciduous Seasonal Forest, this forest class has a higher canopy and greater canopy cover and trunks with a greater girth. It occurs in less windy areas, and generally at a higher elevation.

Level 3: Semi-Deciduous Forest

It merges inland with the Semi-evergreen Seasonal Forest: the upper slopes of high hills are often covered by Deciduous Seasonal Forest and their lower slopes, leading to ravines, covered by Semi-evergreen Seasonal Forest. This class is defined as deciduous because the taller trees tend to lose all their leaves in most dry seasons, although the smaller trees and shrubs are evergreen. Its overall appearance during a normal dry season is of a more or less leafless canopy. Lowland or sub-montane drought deciduous. This class occupies large areas in the country (up to summit of Petit Piton) in mainly secondary or degraded forest, and it is characterized by patchwork with small gardens, recently coppiced areas, shrub, small and large trees. They are also found in some hills as natural with smaller trees (Praslin and Bordelais Correctional Facility), and this forest class reaches an elevation of 700m on Petit Piton.

Level 2: Littoral Evergreen

Behind sandy beaches, rocky cliffs and pavements, an evergreen forest or shrubland is found, especially on the Atlantic coast. The harsh conditions caused by wind, salt-spray, often a thin soil and a water deficit even during most of the wet season, favour an evergreen arborescent flora with thick leathery leaves. *Coccoloba uvifera* (wézen, siwiz, sea grape) is commonly present in this vegetation class.[15]

Level 2: Mangroves

Mangrove is an evergreen forest of brackish water. This well-known vegetation class contains only a few widely distributed, salt tolerant species. In St. Lucia, Mangroves contain four tree species and are mainly on the Atlantic coast and they are found in shallow surface of brackish water or muddy areas. These species are tidally flooded tropical or subtropical broad-leaved evergreens *sclerophyllous* with closed tree canopy.

[15] National forest demarcation and bio-physical resource inventory Project Caribbean – Saint Lucia. The classification of the vegetation of Saint Lucia

Level 2: Plantation

In the late 1970s and early 1980s, many plantations were established in St. Lucia for the purpose of timber production. These plantations consisted of pure or mixed stands of Honduran Mahogany (*Swietenia macrophylla*), White Cedar (*Tabbuia pallida*), Caribbean Pine (*Pinus caribaea*), Teak (*Tectona* grandis) and Blue Mahoe (*Talipariti elatum*). These plantations were never utilized for they intended purposes. Once abandoned they grow back to Lower Montane Rainforest, Semi-Evergreen seasonal & Deciduous Seasonal Forest of species including sip blan *(Cordia sulcata),* gonmye modi (*Bursera simaruba),* ti savonnet (*Lonchocarpus heptaphyllus)* bwa tan (*Byrsonima spicata),* bwa kweyol (*Myrica deflexa)* bayleaf/bwaden (*Pimenta rascmosa),* mapou (*Guapira fragrans),* malenbe/bwa mal lestomak (*Piper dilatatum)*.

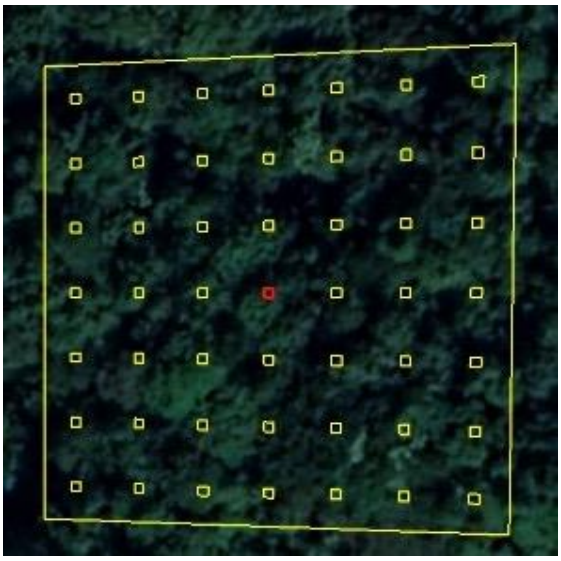


Figure 9. Mountain Forest observed rom Collect Earth

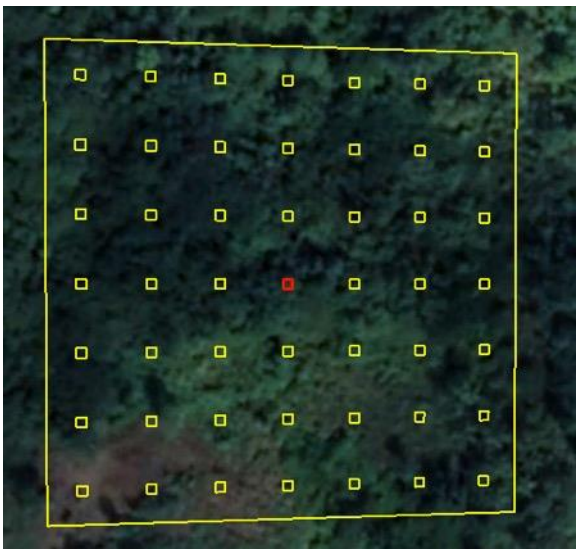


Figure 10 Semi-Evergreen Forest observed from Collect Earth

Figure 11 Semi-Deciduous Forest viewed from Collect Earth

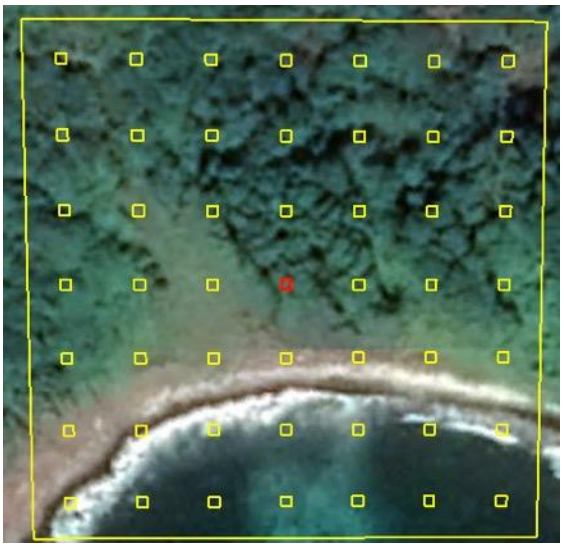


Figure 12 Littoral Evergreen viewed from Collect Earth

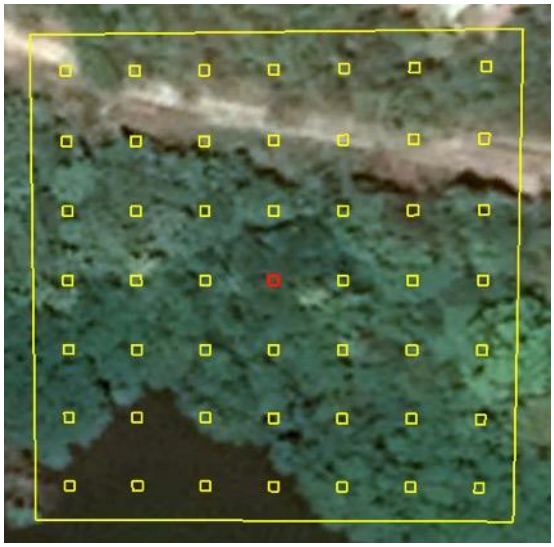


Figure 13 Mangroves viewed from Collect Earth

Level 1: CROPLANDS (C)

Crop lands and agroforestry systems where the vegetation structure falls below the thresholds used for the Forest Land category. 1 ha area with more than 20% cover of any type of planted crop, but less than 60% cover of forest or 20% cover of infrastructure.

Table 7. Land Use classes and sub-categories for cropland

IPCC categories Level 1		sub-categories Level 2	Code
Croplands	C	PERENNIAL CROP	CPER
		ANNUAL CROP	CANNUALC

Level 2: Perennial Crop

Land under permanent or medium-term crops. It is the land that during the reference year was mainly planted with crops which occupy it for a long period of time, and which do not have to be planted after each harvest. It includes all tree crops (bearing or not) banana, plantains, coconut, etc. In case of permanent crops inter-planted with temporary crops that land was reported here.

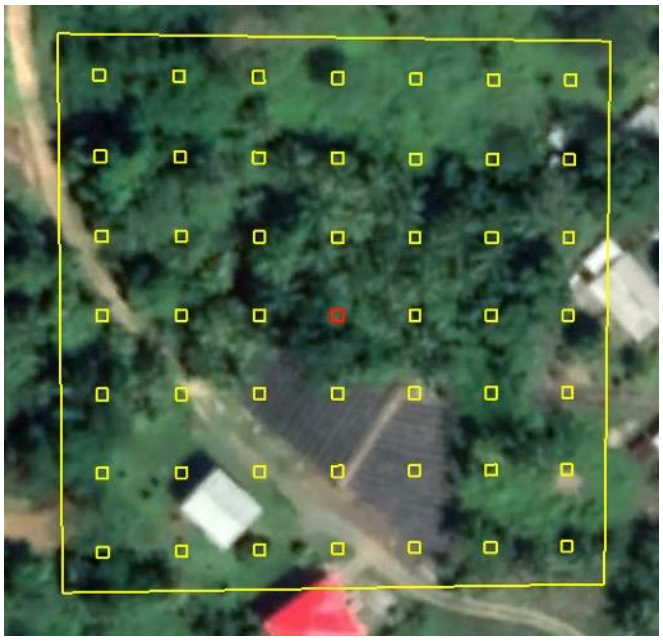


Figure 14 Perennial Crop viewed from Collect Earth

Level 2: Annual Crop

Land under temporary crops only. It is the land used exclusively for crops with a growing cycle of under one year, which needs to be newly sown or planted for further production after the harvest. It also includes some crops which remain in the field for more than one year and their harvest destroys the plant like cassava. Most common crops according to 2007 Agriculture Census [16] were: tannia, dasheen, christophene, sweet potatoes, yam, cassava, tomato, peas, sweet pepper, cucumber, ginger, chives.

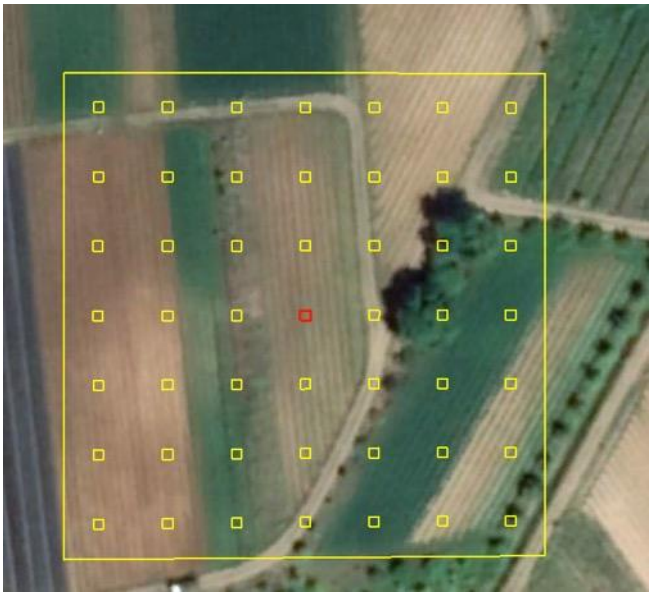


Figure 15. Annual crop viewed from Collect Earth

LEVEL 1: GRASSLANDS (G)

Open areas covered mostly by grasses or sedges, but other herbs and low shrubs are also present. Individual trees or small clumps of trees and taller shrubs may also be present. This vegetation class is most common near areas of Deciduous Seasonal Forest and is usually a result of extreme disturbance to that forest class. Abandoned gardens in wetter areas can temporarily take on this form, but quickly develop into secondary forest. This forest class is defined as a 1 ha area with more than 20% cover of any type of grassland, but less than 60% cover of forest or 20% cover of infrastructure.

[16] http://www.malff.com/images/stories/Census%20Data/2007%20Census%20of%20Agriculture%20Summary%20Report.pdf

Table 8. Land Use classes and sub-categories for Grassland

IPCC categories Level 1		Code
Grassland	G	GGRASS

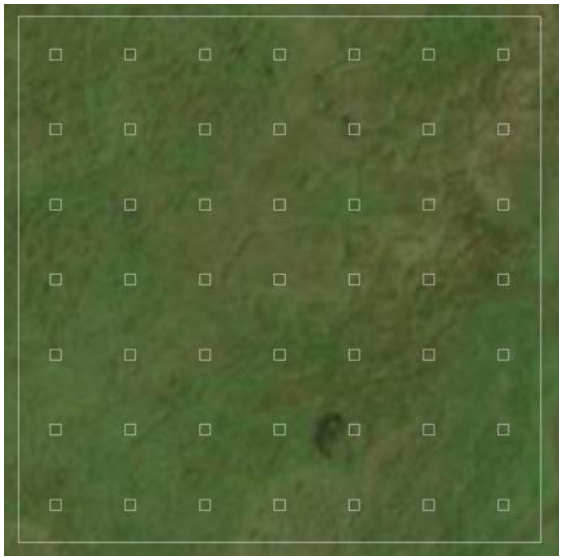


Figure 16. Grassland viewed from Collect Earth

LEVEL 1: WETLANDS (W)

Land that is covered or saturated by water for all or part of the year and does not fall into the Forest Land, Cropland, Grassland or Settlements categories. It includes reservoirs as a managed subdivision and natural rivers and lakes, reservoir of water, freshwater swamp seasonal (permanently depending on rainfall) and permanently muddy areas fall into this class. This class is defined as a 1 ha area with more than 20% cover, but less than 60% cover of forest or 20% cover of infrastructure.

Table 9. Land Use classes and sub-categories for Wetland

IPCC categories Level 1	Code	Code
Wetland	W	WWET

LEVEL 1: SETTLEMENTS (S)

1 ha area with at least 20% cover of infrastructure (houses, roads, etc.), but less than 60% forest canopy cover.

Table 10. Land Use classes and sub-categories for Settlement

IPCC categories Level 1	Code	sub-categories Level 2	Code
Settlement	S	Urban Areas	SSET
		Woody Settlements	SWOODS

Level 2: Urban areas

Development in relation to any land carrying out of building, engineering, mining or other operations in, on, over or under any land, the making of any material change in the use of any land or buildings, or the subdivision of any land, and "develops" and "developer" shall be construed accordingly.

Level 2: Woody Settlements

A woody settlement is defined as a rural community with woody trees where both forest types and perennial crops are interspersed. 1 ha area with more than 20% cover mixed with woody trees but with less than 60% cover of forest.

LEVEL 1: OTHER LANDS (O)

Bare area with less than 20% cover of grasses, shrubs, trees, wetland, crops or infrastructure and all land areas that do not fall into any of the other five categories. Mining is classified as other land category.

Table 11. Land Use classes and sub-categories for Other land

IPCC categories Level 1		sub-categories Level 2	Code
Other land	O	Other land	OOTHER
		Mining	OMIN

As canopy cover percentage was fundamental to determine the land use, a hierarchy for the land use categories was established for the visual interpretation during the CE/OF Assessment.

Table 12. Hierarchy of land use classification for Saint Lucia for the visual interpretation in the 2019 CE Assessment

Land Use	% Minimum
Forest Lands	60%
Croplands	20%
Grasslands	20%
Wetlands	20%
Settlements	20%
Other Lands	20%

According to the 'hierarchy of land use classification', if a sample plot had 60% or more forest canopy, its land use was be classified as "forest". If a sample plot has less than 60% of forest cover, a determination was made to classify the sample plot according to the hierarchy. For example, if a plot only has 10 % forest, 20 % of grassland, 20 % of cropland, and 50 % of other lands, according to the hierarchy, the classification was cropland.

Based on the fact that Saint Lucia applied a plot-by-plot annual analysis. In this submission, Saint Lucia considered multiple land use changes and multiple disturbances affecting a plot, comparing the final land use of the first assessment, which finalized in 2018, to changes in following years (2019 and 2020). Transition classes were not used; specifically in conversion to forest only when the forest reached the

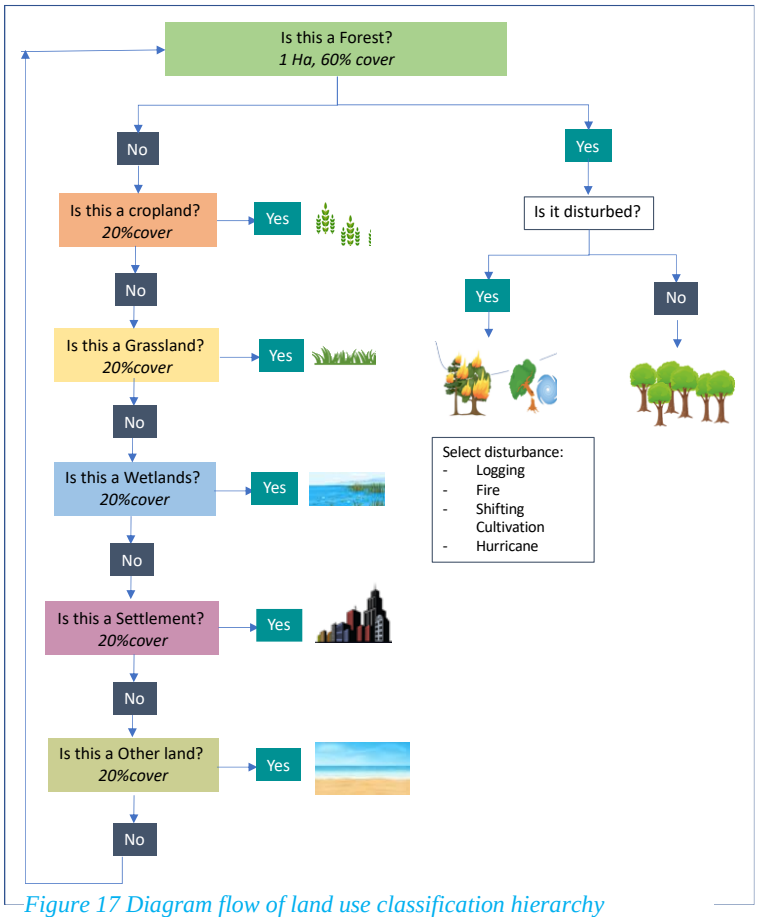


Figure 17 Diagram flow of land use classification hierarchy

definition that conversion would be registered; otherwise, it would remain in the initial land use. This approach was applied to all situations. In the case of where the conversion was forest to grassland, followed by a conversion from grassland to forest, only until the secondary forest reached the forest definition would it have been labeled as forest; otherwise, it would have remained as Grasslands.

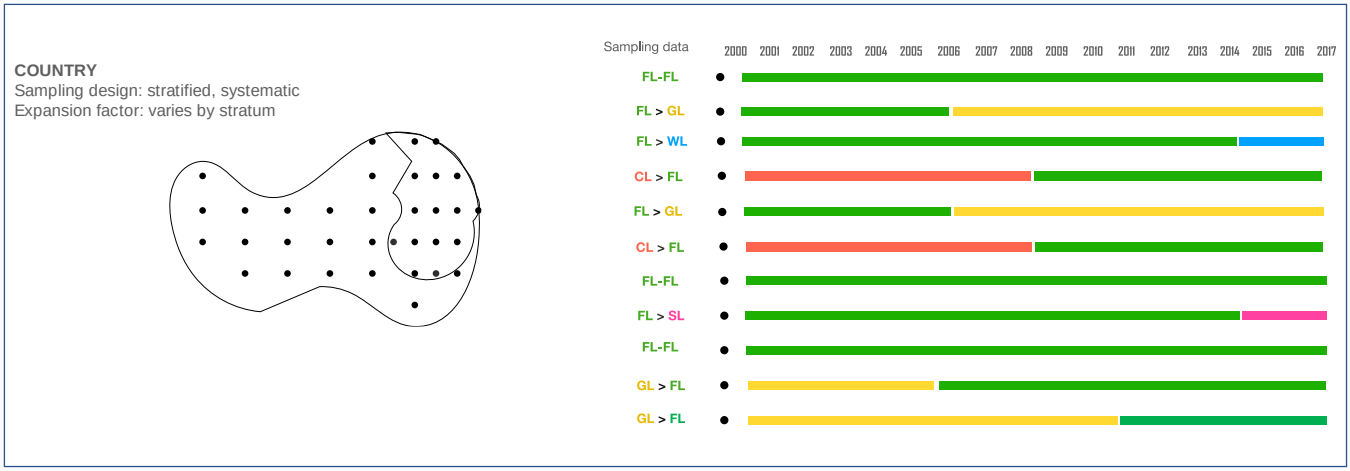


Figure 18 Plot by plot analysis of land use and land use change

Disturbances

Shifting Cultivation

Shifting cultivation can be found in almost every vegetation type in Saint Lucia. Graveson (2009)[17] stated that semi-evergreen seasonal forest and deciduous forests are the two forest types most frequently affected by shifting cultivation. Using this knowledge and the Forestry Division's expert knowledge of Saint Lucia's forest, the LULUC assessment team identified several areas of shifting cultivation in Saint Lucia. The pattern of small tracks of land being cleared for agriculture, with areas close by at various stages of regrowth were the most defining factors when identifying his disturbance.

[17] Graveson (2009). National Forest Demarcation and Bio-Physical Resource Inventory Project Caribbean – Saint Lucia: The Classification Of The Vegetation Of Saint Lucia. FCG International Ltd in association with AFC Consultants International GmbH

Figure 19. Shifting cultivation seen through Collect Earth

Most of the shifting cultivation observed were on privately owned lands. In Saint Lucia, a land tenure system exits where large parcels of land are owned by individuals or families. In the case of family-owned land, the area is usually farmed by different family members resulting in many areas being cleared for agriculture purposes. As more members of a family engage in agricultural activities, they shift to new areas on the property to meet the demands of their agricultural operations. Many landowners also lease lands to persons who are landless and want to go into agricultural production. In many instances, they lease land to more than one individual and this may have contributed to the trends in shifting cultivation observed using Collect Earth software.

In the forest reserve shifting cultivation can be attributed to encroachment for crop production or illegal cultivation of marijuana. Many persons do not own land or have access to land, so they encroach into the reserve to conduct agricultural activities. The illicit nature of marijuana cultivation results in persons not utilizing the same area more than once in fear of their activities being identified by law enforcement officers of the Forest and Lands Division.

Semi-evergreen Seasonal Forest has almost been completely destroyed for agriculture with most of the areas currently occupied by banana plantations and other crops would have had Semi-evergreen Seasonal Forest. Semi-evergreen Seasonal Forest is now mainly found in small pockets among fields, by roads and as a thin line along rivers, and is virtually all secondary, with the possible exception of the upper third of Gros Piton, Mount Parasol and the northern slope of Mount Souf. These habitats are steep and rocky, and therefore not necessarily typical of the main Semi-evergreen Seasonal Forest zone as it used to be. However, there are signs that the forest area may be increasing as a result of the recent decline in agriculture.

While large areas of Deciduous Seasonal Forests remain on both coasts, virtually all is secondary, with disturbances still common. The result is often a patchwork, with small gardens, recently coppiced areas, shrubs, small trees and larger trees. The first, massive disturbance to Saint Lucia's Deciduous Seasonal Forests was caused by sugar cane cultivation and the need to collect wood as fuel. Subsequent coconut cultivation and the practice of charcoaling, clearing for seasonal gardens and creating pasture for livestock, has continued the disturbance, but to a lesser extent, so that there is now more dry forest now than a century ago. A new and continuing threat is the clearance of dry forest for tourist developments, including golf courses.

Open grassy areas are probably not a natural vegetation class in Saint Lucia, except perhaps as small patches in rocky coastal cliffs and pavement. The Choiseul to La Pointe area has extensive tracts of Grassland on what was originally Deciduous Seasonal Forest. This has in some cases been caused by clearance for farming and subsequent abandonment.

Logging

Logging can be identified in various areas within Saint Lucia's forest. Within the forest reserve in Saint Lucia clear cut logging is not allowed; however, selective logging of various species is allowed by the Forestry Division. Areas identified in Collect Earth as logging disturbance are generally areas where persons clear lands within the forests for charcoal production, roundwood and the production of illegal substances.

In some areas of the littoral evergreen woodland has clearly been degraded by charcoal production and also by subsequent grazing by goats and fires. The result can be Grassland with clumps of trees and shrubs. This is not a natural savanna in Saint Lucia, but man-made. Carpets of grasses probably would not have existed naturally

With the exception of the Pitons, which are protected, Deciduous Seasonal Forest is under threat. It is home to a large number of species, many of which have become very rare. Most of it is already secondary, disturbed and often degraded. The purchase of plantations for tourist developments threatens huge areas of the Atlantic coast. The Praslin development of 2006 bulldozed the coastline and eroded the surrounding hills to bare rock.

Much of Saint Lucia's Mangroves have disappeared and the rest are still being damaged, sometimes by clearing, more often by drainage. Even a slight drying out makes it easier for charcoal makers to move into the area, exacerbating the Mangrove's destruction. A final stage is a seasonally muddy open area, often burnt during the dry season. This creates a type of Herbaceous Swamp. Mangrove forest is under great threat despite its apparent protection. The main reason is the deliberate modification of the flow of water in rivers, thus changing the flow of freshwater to mangrove. For example, the rerouting of the river between Escap and Micoud may be the cause of the dead mangrove now visible from the highway.

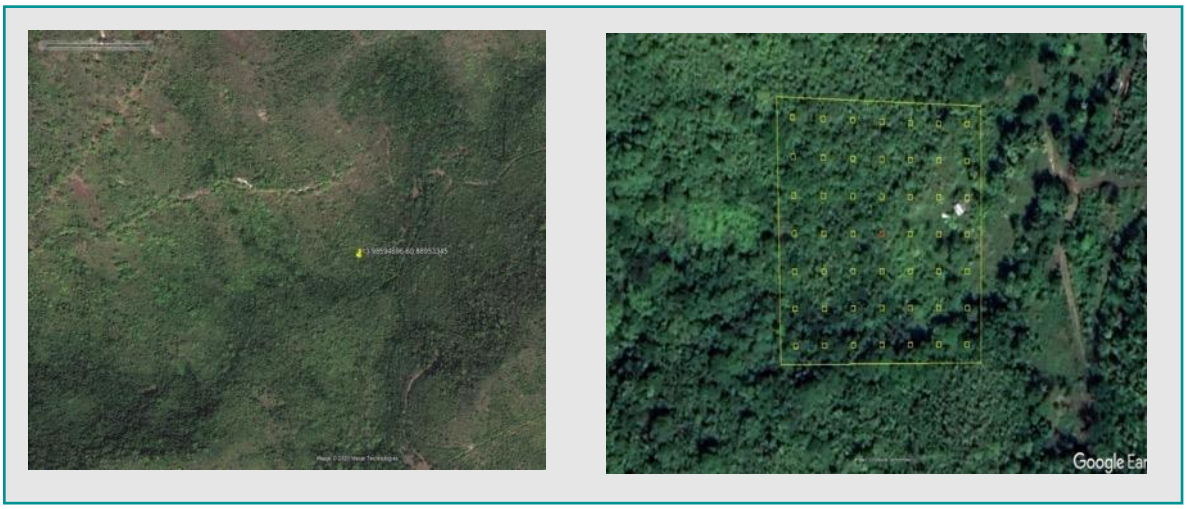


Figure 20. Logging as seen through Collect Earth

Fires

Saint Lucia has been experiencing drought conditions since 2012. The decreased rainfall has adverse effects on agriculture and forestry. Fires and other continual disturbances produce degraded "grassy" areas (including sedges) with some shrubs and trees. More severe degradation is evident where only an occasional tree survives. A major area of what used to be Deciduous Seasonal Forest is found between Dennery and Vieux Fort. This forest has become very degraded south of Micoud, with grassy areas becoming commoner and tree cover less. This is probably due to a greater degree of disturbance from the higher population density and possibly a longer tradition of livestock grazing. Fires are frequent in the dry season, further degrading the forest. Because of the now-extensive grassy areas we classify this man-made savanna in the next vegetation class, Grassland, but is just an extreme form of a degraded Deciduous Seasonal Forest and could potentially regenerate if left undisturbed.

Data on fires have been collected for approximately seven years by the Forestry Division. This data collection began, because of the increase in fires over the years, as Saint Lucia recorded warmer temperatures. It has been observed that fires occur within the same areas every year, and the cause is anthropogenic activity, for slash and burn agriculture, general land clearing and arson. In collect earth because of the knowledge of where these fires occur the team was able to identify this disturbance.

Figure 21. Fires seen through Collect Earth

Hurricane

Saint Lucia is located in the hurricane belt but is left relatively unscathed compared to its neighboring islands. Most of the hurricanes pass over north of the island, but they have been hit badly a few times in the past, most recently with hurricane Tomas (2010).

In Collect Earth hurricane disturbances were usually identified by the scars left in the landscape caused by landslides during the passage of a hurricane. Most of these areas would have also undergone a rapid assessment after the passage of the hurricane and therefore known to the staff of the Forestry Division.

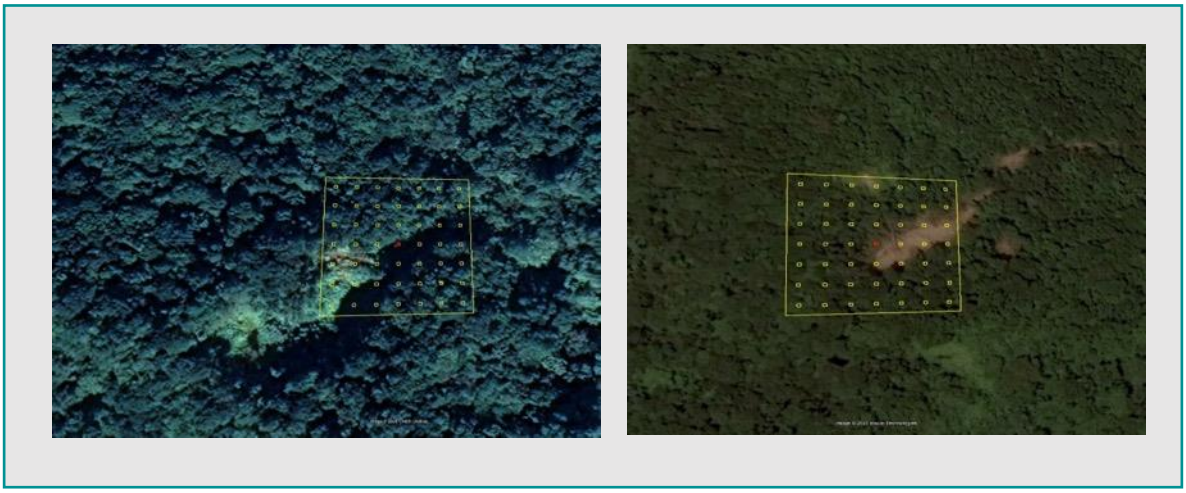


Figure 22. Hurricane/Storms seen through Collect Earth

Area estimation

After the assessment was finished, CVS database from the LULUC assessment with all information recorded for each of the 2051 plots from 2000 to 2020 was extracted. For data analysis of the 2051 plots, a coding system was created to aggregate plots with the same land use or land use change. It includes a Pivot Table counting the codes, described in the land Use classes tables above *(Excel file sheet "AD-coding").* Codes depict a single trajectory or dynamic of each plot informing land use, land use change (if any) and disturbances (if any). These trajectories in the form of a code were created to simplify the analysis as it sums up all plots with the same trajectory, represented in the same code, reducing considerably the number of plots for which IPCC equations were applied. Each trajectory area represented is estimated by multiplying the number of plots of each trajectory by the expansion factor, which was calculated diving the total surface of the country (61.600 Ha) by the total number of plots of the grid (2501). A systematic grid was used (500m x 500m). For the case of Saint Lucia, the expansion factor was 24.63 Ha for all plots. Then, for facilitating understanding by Land Use Classes, the Pivot table information was distributed by F, C, G, W, S, O. This approach allows including all the previews descriptions in one single analysis, reason why it is used for the calculations, instead of using the LUC and Disturbance Matrices.

These areas were also adapted to be presented as Land Use Change Matrices for Land Use and Land Use Change and also for Disturbances[18].

Land use and land use change matrices [area in ha]

Figure 23. Land use and land use change matrices

2016-2017	Row Labels	Montane – Cloud Forest	Montane – Rainforest	Seasonal Semi Evergreen	Seasonal Deciduous	Dry Scrub	Littoral Evergreen Forest	Mangrove	Annual Crops	Perennial Crops	Pastures	Shurblands	Natural Water Bodies	Artificial water bodies	Urban Areas	Woody Settlement	Beaches, rocky areas	Mining	Grand Total
	Montane – Cloud Forest	74																	74
	Montane – Rainforest		6,946																6,946
	Seasonal Semi Evergreen			13,103					25										13,128
	Seasonal Deciduous				12,143														12,143
	Dry Scrub					2,980													2,980
	Littoral Evergreen Forest						2,980												2,980
	Mangrove							222											222
	Annual Crops			49					4335	25	25	99							4,532
	Perennial Crops			49	25					3374									3,448
	Pastures										1,724				74				1,798
	Shurblands		25	25	49				25			4,360			25				4,507
	Natural Water Bodies												197		25				222
	Artificial water bodies													74					74
	Urban Areas														4,704				4,704
	Woody Settlement															3,374			3,374
	Beaches, rocky areas																271		271
	Mining																	197	197
	Sum of Area	74	6,970	13,226	12,217	2,980	2,980	222	4,384	3,399	1,749	4,459	197	74	4,828	3,374	271	197	61,600
	Grand Total							38,669		7,783		6,207		271		8,202		468	61,600

[18] The LU and LUC matrices cannot be used for estimations, as these ones do not incorporate the disturbances. To replicate calculations, the information pf the pivot table must be used.

2017-2018

Row Labels	Montane – Cloud Forest	Montane – Rainforest	Seasonal Semi Evergreen	Seasonal Deciduous	Dry Scrub	Littoral Evergreen Forest	Mangrove	Annual Crops	Perennial Crops	Pastures	Shurblands	Natural Water Bodies	Artificial water bodies	Urban Areas	Woody Settlement	Beaches, rocky areas	Mining	Grand Total
Montane – Cloud Forest	74																	74
Montane – Rainforest		6,970																6,970
Seasonal Semi Evergreen			13,202						25									13,226
Seasonal Deciduous				12,217														12,217
Dry Scrub					2,956			25										2,980
Littoral Evergreen Forest						2,980												2,980
Mangrove							222											222
Annual Crops								4360	25									4,384
Perennial Crops				25					3374									3,399
Pastures								25		1,724								1,749
Shurblands		25	25	25						25	4,360							4,458
Natural Water Bodies												197						197
Artificial water bodies													74					74
Urban Areas														4,828				4,828
Woody Settlement															3,374			3,374
Beaches, rocky areas																271		271
Mining																	197	197
Sum of Area	74	6,995	13,226	12,242	2,956	2,980	222	4,409	3,424	1,749	4,385	197	74	4,828	3,374	271	197	61,600
Grand Total							38,719		7,832		6,108		271		8,202		468	61,600

2018-2019

Row Labels	Montane – Cloud Forest	Montane – Rainforest	Seasonal Semi Evergreen	Seasonal Deciduous	Dry Scrub	Littoral Evergreen Forest	Mangrove	Annual Crops	Perennial Crops	Pastures	Shurblands	Natural Water Bodies	Water Bodies	Urban Areas	Woody Settlement	Beaches, rocky areas	Mining	Grand Total
Montane – Cloud Forest	74																	74
Montane – Rainforest		6,995																6,995
Seasonal Semi Evergreen			13,202					25										13,226
Seasonal Deciduous				12,266														12,266
Dry Scrub					2,956													2,956
Littoral Evergreen Forest						2,980												2,980
Mangrove							222											222
Annual Crops			25					4384										4,409
Perennial Crops									3424									3,424
Pastures										1,724	25							1,749
Shurblands											4,335			25				4,360
Natural Water Bodies												25	172					197
Artificial water bodies													74					74
Urban Areas														4,828				4,828
Woody Settlement															3,374			3,374
Beaches, rocky areas																271		271
Mining																	197	197
Sum of Area	74	6,995	13,226	12,266	2,956	2,980	222	4,409	3,424	1,724	4,360	25	246	4,852	3,374	271	197	61,600
Grand Total							38,719		7,832		6,084		271		8,226		468	61,600

2019-2020

Row Labels	Montane – Cloud Forest	Montane – Rainforest	Seasonal Semi Evergreen	Seasonal Deciduous	Dry Scrub	Littoral Evergreen Forest	Mangrove	Annual Crops	Perennial Crops	Pastures	Shurblands	Natural Water Bodies	Water Bodies	Urban Areas	Woody Settlement	Beaches, rocky areas	Mining	Grand Total
Montane – Cloud Forest	74																	74
Montane – Rainforest		6,995																6,995
Seasonal Semi Evergreen			13,226															13,226
Seasonal Deciduous				12,241				25										12,266
Dry Scrub					2,956													2,956
Littoral Evergreen Forest						2,980												2,980
Mangrove							222											222
Annual Crops								4384									25	4,409
Perennial Crops									3424									3,424
Pastures								25		1,699								1,724
Shurblands			49						25		4,261		25					4,360
Natural Water Bodies												25						25
Water Bodies													246					246
Urban Areas														4,852				4,852
Woody Settlement															3,374			3,374
Beaches, rocky areas																271		271
Mining																	197	197
Sum of Area	74	6,995	13,275	12,241	2,956	2,980	222	4,433	3,449	1,699	4,261	25	271	4,852	3,374	271	222	61,600
Grand Total							38,743		7,882		5,960		296		8,226		493	61,600

5.5.2 Emission Factors

The information on Emission Factors (EFs) was obtained from country specific research, scientific literature, and default values of the 2006 IPCC Guidelines, 2013 IPCC Wetlands supplement and 2019 Refinement to the 2006 IPCC Guidelines *(Excel file > EF values).*

National Forest Inventory (Tier 2)

In 2009, two hundred plots were surveyed, each 20 meters in radius, covering a wide range of elevations in all parts of the country. Both floristic and biophysical data were recorded within every plot. To guide the selection of field sites, a simple starter map was produced, dividing Saint Lucia into 24 cells and showing approximate elevational zones and known areas of botanical interest (Graveson, 2009).[19] The floristic data were analyzed using Two-way Indicator Species Analysis (TWINSPAN), supported with a manual floristic analysis, to assign the plots to distinct vegetation classes. Each vegetation class is described and illustrated in some detail in the report.

A simple method to sample quite rapidly the vegetation, the physiognomy and the habitats throughout the cells and vegetation zones on the starting map was developed. A standardized method that could be applied to all types of forest was required, from secondary xeric woodland with small tightly packed trees, to rainforest where some tree trunks are extremely wide. After preliminary trials in contrasting xeric and wet forest types, a 20-metre radius circular plot with a 7m radius subplot in the center was chosen. The prime focus of the standardized survey was the 7m subplot.

Table 13. The biophysical and floristic information recorded from every plot

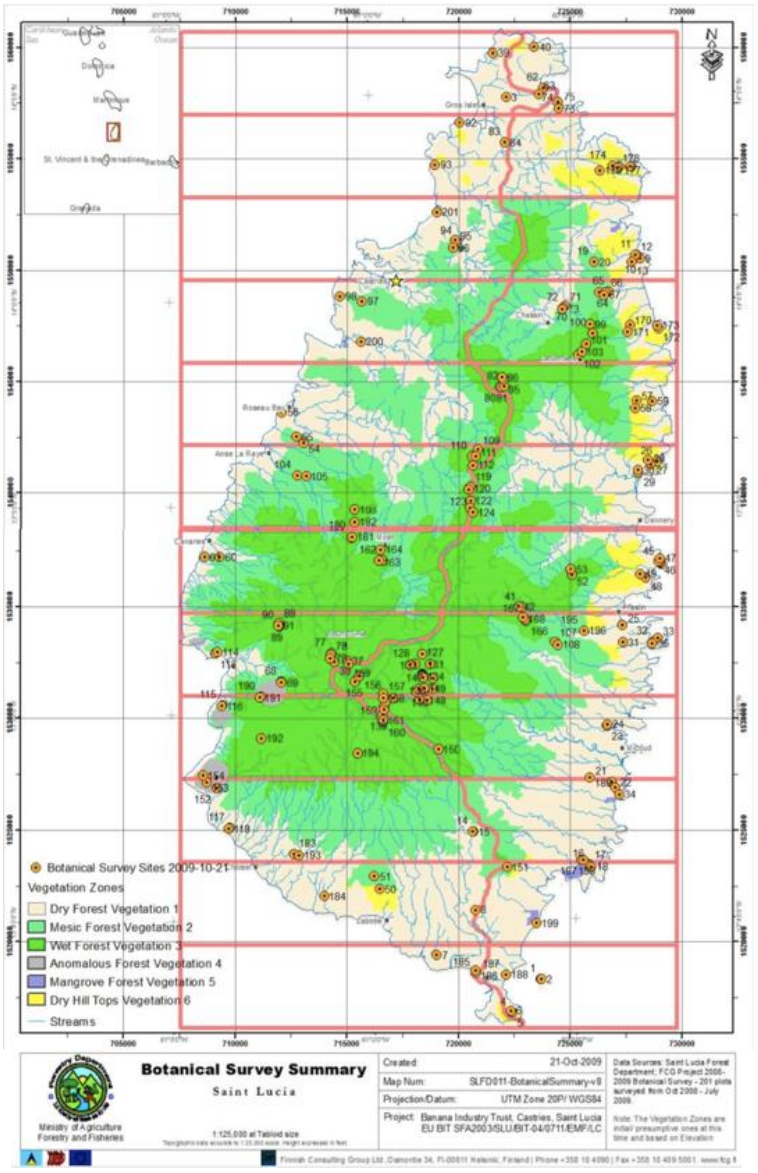
Plot measurements	Description
Plot	Plot number.
Date	Date of survey.
Location	Name of area plot is located in.
Tea m	Initials of surveyors present on this plot survey.
Description	Simple habitat type: e.g. river valley, degraded dry woodland, rainforest.
GPS N	Northing (UTM) of plot center point as read from GPS.
GPS E	Easting (UTM) of plot center point as read from GPS.
Rockiness	1=1-10% of ground covered by rocks; 2=10-30% of ground covered by rocks; 3=>30% of ground covered by rocks
Canopy (m)	Measured using a clinometer.
Canopy (%)	Estimated visually, using a mirror to reflect the canopy.
Number of stumps ≥5cm	0=no stumps of ≥5cm diameter found in plot; 1=1-4 stumps of ≥5cm diameter found in plot; 2=more than 4 stumps of ≥5cm diameter in plot.
Number of logs ≥5cm	0=no logs of ≥5cm diameter on ground; 1=1-4 logs ≥5cm diameter on ground; 2=more than 4 logs of ≥5cm diameter on ground.

[19] Graveson (2009). National Forest Demarcation and Bio-Physical Resource Inventory Project Caribbean – Saint Lucia: The Classification Of The Vegetation Of Saint Lucia. FCG International Ltd in association with AFC Consultants International GmbH

Wind	Assessment based on canopy wind noise and sculpturing of vegetation. 0=no wind noise; 1=slight wind noise; 2=moderate wind noise; 3=full exposure - sculptured vegetation.
Slope (%)	Measured using a clinometer.
Direction (°)	Slope aspect. Measured using a compass.
Elevation (m)	As read from GPS, occasionally with later corrections from map. 1=1-30% of trees in plot have vines; 2=31-70% of trees in plot have vines; 3>70% of trees in plot have vines.
Epiphytes, including ferns	1=1-30% of tree have epiphytes; 2=31-70% of tree have epiphytes; 3>70% of trees have epiphytes.
Herbs (%)	% ground cover, visually estimated to nearest 5%
Ferns terrestrial (%)	% ground cover of non-arborescent ferns, visually estimated to nearest 5%.
Mosses/filmy ferns	0 = absent from trees; 1=surface cover present on most trees; 2=cover with depth on some trees; 3=surface cover with depth on most trees; 4=depths of 2cm present.
DBH1 (cm)	Measurement of the diameter at breast height of the widest trunk in the 7m subplot.
DBH2 (cm)	Measurement of the diameter at breast height of the second widest trunk in the 7m subplot.
Notes	Notes possibly useful for analysis, including details if the plot survey was not standard.
Species names of all trees DBH ≥5cm	Genus and species name for woody species with stem DBH≥5cm.
Number of trees	Number of individuals of every species with stem DBH≥5 cm (including arborescent herbs with trunks ≥5cm).
Species names of all saplings, herbs, vines and terrestrial ferns	Genus and species names.
Species names of all epiphytes	Genus and species names (dry forest areas only).
Other tree species	Additional tree species in the area, within the 20m plot radius.

All of the plot measurements shown in this table were made in the 7m subplot, with the exception of the "other tree species", which were recorded throughout the 20m plot. A stratified sampling approach was selected to decide where to conduct the plots, guided by the zones shown on the starter map to ensure not to miss any rare vegetation types. Plots were not chosen randomly but selected to illustrate the variety within each destination. Thus, in rainforest area, a steep slope, a gentle slope, a ridge top, a gulley, exposed positions, and/or sheltered positions might be chosen. The plot locations are shown on Figure 24.

Figure 24. National Forest Inventory _ Plot Location



For major forest classes analysis Stehle's (1945)[20] method was followed. For example, some species are typically found in the Deciduous Seasonal Forest where the upper canopy tends to lose its leaves in the dry season; these species were assigned a value of 1. Other species are typically found in moister environments, e.g. by rivers, and the trees lose some leaves during the dry season in proportion to the severity of the drought; these Semi-evergreen Seasonal Forest species were assigned a value of 2. Some species are typically found in the forest reserve and rarely

[20] Stehlé, H. (1945) Fores t types of the Caribbean Is lands . Caribbean Forester,66,27 3-408.

outside, and do not have a seasonal leaf fall; these Lower Montane Rainforest trees were assigned a value of 3. Plants typically only found in Cloud Montane Rainforest were assigned a value of 4. Thus, following this method every plot was placed in a specific vegetation class.

Table 14. Attributed recorded by Forest Class

Attribute (Average by Forest Class)	Cloud Montane Rainforest (n=4)	Lower Montane and Montane Rainforest (rainforest) (n=75)	Semi-evergreen Seasonal Forest (n=22)	Deciduous Seasonal Forest (n=72)
Mean Forest Class Average (FCV)	3.5	2.9	1.9	1.1
Mean Number of Trees DBH≥5cm	25.0	30.0	17.0	19.0
Mean Rocks Score (0-3)	0.3	0.5	1.3	1.3
Mean Canopy Height (m)	5.3	27.6	22.8	11.2
Mean Canopy (%)	72.0	63.5	64.3	46.5
Mean Stumps Score (O-2)	0.3	1.1	1.1	0.8
Mean Logs Score (0-2)	1.0	1.4	1.5	1.0
Mean Wind Score (0-3)	2.0	1.2	0.6	1.2
Mean Slope (%)	28.0	26.0	20.0	16.0
Mean Elevation (m)	851	445	155	103
Highest Elevation (m)	869	680	390	413
Lowest Elevation (m)	824	102	15	4
Mean Vines Score (0-3)	1.3	1.4	1.0	0.8
Mean Epiphytes Score (0-3)	3.0	0.9	0.2	0.4
Mean Herbaceous (non-fern) ground cover (%)	10.0	4.1	5.9	13.4
Mean Ferns Ground Cover (%)	22.0	15.9	0.6	0.0
Mean Moss Score (0-4)	4.0	0.8	0.1	0.0
Mean DBH 1 and 2 (cm)	17.0	38.3	31.3	21.1

5.5.3 IPCC Methodologies applied

Information on the specific category-level methodologies employed, including a description of the data and assumptions used to estimate GHG emissions and absorptions are provided in this section.

For the estimation of GHG emissions and removals for the Forest and Land Use Change Sector, St. Lucia has followed the methodologies proposed in the 2006 IPCC guidelines, Volume 4, Chapter 2 "*Generic Methodologies Applicable*

to Multiple Land-use Categories", for change in biomass carbon stocks (above-ground biomass, below-ground biomass, dead organic matter and soil organic carbon) and Non-CO_2 emissions from fires (CH_4 and N_2O). It includes the analysis for Land remaining in a land-use category and lands converted to a new land-use category. The Saint Lucia's GHG inventory was conducted from a series of steps and using a range of data from diverse sources. The estimation of the emissions and removals used a combination of: (a) country-specific methods and data; (b) IPCC methodologies and (c) emission factors (EFs). IPCC methodology tiers 1, and 2 were applied. All definitions, methods and assumptions are described *(Excel file> Forest lands, F in Croplands, Grasslands, Wetlands, Settlements, Other Lands).*

5.5.3.1 Annual carbon stock changes for the entire AFOLU sector estimated as the sum of changes in all land-use categories

Annual Carbon Stock Changes for the entire AFOLU Sector estimated as the sum of changes in all land-use categories (Equation 2.1, Ch2, V4)

$$\Delta C_{AFOLU} = \Delta C_{FL} + \Delta C_{GL} + \Delta C_{WL} + \Delta C_{SL} + \Delta C_{O}$$

Where:

ΔC = carbon stock change

Indices denote the following land-use categories:

AFOLU = Agriculture, Forestry and Other Land Use
FL = Forest Land
CL = Cropland
GL = Grassland
WL = Wetlands
SL = Settlements
OL = Other Land

Table 15. Land use categories

Land-use categories	
LU	Category
F	Forest lands
C	Croplands
G	Grasslands
W	Wetlands
S	Settlements
O	Other lands

Annual carbon stock changes for a land-use category as a sum of changes in each stratum within the category (Equation 2.2, Ch2, V4)

$$\Delta CLU = \sum_{i} \Delta C\ LUi$$

Where:

ΔC_{LU} = carbon stock changes for a land-use (LU) category as defined in Equation 2.1.

i = denotes a specific stratum or subdivision within the land-use category (by any combination of species, climatic zone, ecotype, management regime etc., see Chapter 3), i = 1 ton.

Annual carbon stock changes for a stratum of a land-use category as a sum of changes in all pools (Equation 2.3, Ch2, V4)

$$\Delta C_{LUi} = \Delta C_{AB} + \Delta C_{BB} + \Delta C_{DW} + \Delta C_{Li} + \Delta C_{HWP}$$

Where:

ΔCLU_i = carbon stock changes for a stratum of a land-use category. subscripts denote the following carbon pools:

AB = above-ground biomass

BB = below-ground biomass

DW = deadwood

LI = litter

SOC = soils

HWP = harvested wood products

Table 16. Pools included

	Included
ΔC_{AB}	Yes
ΔC_{BB}	Yes
ΔC_{DOM_LI}	Yes
ΔC_{SOC}	Yes
ΔC_{HWP}	No

Clarification Notes

Data on HWP is not available as yet.

Annual carbon stock change in a given pool as a function of gains and losses (gain-loss method) (Equation 2.4, Ch2, V4)

$$\Delta C = \Delta C_G + \Delta C_L$$

Where:

ΔC = annual carbon stock change in the pool, tonnes C yr^{-1}

ΔC_G = annual gain of carbon, tonnes C yr^{-1}

ΔC_L = annual loss of carbon, tonnes C yr^{-1}

5.5.3.2 Change in biomass carbon stocks (above-ground biomass and below-ground biomass) in land remaining in the same category

Annual change in carbon stocks in biomass in land remaining in a particular land-use category (gain-loss method) (Equation 2.7, Ch2, V4)

$$\Delta C_B = \Delta C_G + \Delta C_L$$

Where:

ΔC_B = annual change in carbon stocks in biomass for each land sub-category, considering the total area, tonnes C yr^{-1}

ΔC_G = annual increase in carbon stocks due to biomass growth for each land sub-category, considering the total area, tonnes C yr^{-1}

ΔC_L = annual decrease in carbon stocks due to biomass loss for each land sub-category, considering the total area, tonnes C yr^{-1}

Annual increase in biomass carbon stocks due to biomass increment in land remaining in the same land-use category (Equation 2.9, Ch2, V4)

$$\Delta C_G = \sum_{i,j} (A_{i,j} \bullet G_{TOTAL\ i,j} \bullet CF_{i,j})$$

Where:

ΔC_G= annual increase in biomass carbon stocks due to biomass growth in land remaining in the same land-use category by vegetation type and climatic zone, tonnes C yr^{-1}

A = area of land remaining in the same land-use category, ha

G_{TOTAL}= mean annual biomass growth, tonnes d. m. ha^{-1} yr^{-1}

i = ecological zone (i = 1 to n)

j = climate domain (j = 1 to m)

CF = carbon fraction of dry matter, tonne C (tonne d.m.)$^{-1}$

Table 17. . A: area of land remaining

A: area of land remaining in the same land-use category			
LU	**Sub-Category**	**Source**	**Notes**
F	Forest lands	Forestry Division	Collect earth assessment - Annual time series 2000-2020
C	Croplands	Forestry Division	Collect earth assessment - Annual time series 2000-2020
G	Grasslands	Forestry Division	Collect earth assessment - Annual time series 2000-2020
W	Wetlands	Forestry Division	Collect earth assessment - Annual time series 2000-2020
S	Settlements	Forestry Division	Collect earth assessment - Annual time series 2000-2020
O	Other lands	Forestry Division	Collect earth assessment - Annual time series 2000-2020

Table 18. carbon fraction of dry matter, tonne C (tonne d.m.)-1

CF: Carbon Fraction t C (t d.m.)$^{-1}$						
LU	Category	Value	Default Value (tier 1)	Error o range reported	Source	Comments and assumptions
F	**Elfin and Cloud forest**	**0.47**	X	(0.44 - 0.49)	2006 IPCC, Vol 4, Ch4, Table 4.3. Carbon fraction of aboveground forest biomass	Tropical/Subtropical forest.
	Montane Forest	**0.47**	X	(0.44 - 0.49)	2006 IPCC, Vol 4, Ch4, Table 4.3. Carbon fraction of aboveground forest biomass	Tropical/Subtropical forest
	Semi-evergreen Forest	**0.47**	X	(0.44 - 0.49)	2006 IPCC, Vol 4, Ch4, Table 4.3. Carbon fraction of aboveground forest biomass	Tropical/Subtropical forest

	Deciduous - Coastal Forest	0.47	X	(0.44 - 0.49)	2006 IPCC, Vol 4, Ch4, Table 4.3. Carbon fraction of aboveground forest biomass	Tropical/Subtropical forest
	Mangrove	0.45	X	Range: 0.422 - 0.502; 95%CI 0.429 - 0.471	2013 IPCC Wetlands Supplement. Table 4.2	Tropical Wet 75%, Tropical Dry: 25% (Expert Judgement, Forestry Division)
C	Annual Crops	0	X		Assumption	
	Perennial Crops	0.5	X	(0.4-0.6)	IPCC 2006, V4, Ch5, p.5.11 (Step 4)	
G	Grasslands	0.47	X		IPCC 2006, V4, Ch6, page 6.29. Step 5 - herbaceous	
W	Wetlands	0	X		Assumption	
S	Non-Woody Settlements	0	X		Assumption	
	Woody Settlements (moist/dry)	0.47	X	(0.44 - 0.49)	2006 IPCC, Vol 4, Ch4, Table 4.3. Carbon fraction of aboveground forest biomass	Tropical/Subtropical Forest
O	Mining and Other Lands	0	X		Assumption	

Clarification Notes

IPCC 2006/2019 Default values are used as to date no country-specific research has been carried out. Agreed on May 21st with Forestry Division Team.

Table 19. R: ratio of below-ground biomass to above-ground biomass, in tonne d.m. below-ground biomass (tonne d.m. above-ground biomass)$^{-1}$

R: Ratio of below ground biomass to above ground biomass							
LU	Category	Type	Value	Default Value (tier 1)	Error o range reported	Source	Comments and assumptions
F	Elfin and Cloud forest	Natural	0.221	X	SD: 0.036	2019 IPCC RF, Vol 4, Ch4, Table 4.4	Tropical Rainforest, South America, secondary >20yr
	Montane Forest	Natural	0.221	X	SD:0.036	2019 IPCC RF, Vol 4, Ch4, Table 4.4	Tropical Rainforest, South America, secondary >20yr

	Semi-evergreen Forest	Natural	0.284	X	SD:0.061	2019 IPCC RF, Vol 4, Ch4, Table 4.4	Tropical moist deciduous forest, South America, Secondary >20yr
	Deciduous - Coastal Forest	Natural	0.379	X	SD:0.04	2019 IPCC RF, Vol 4, Ch4, Table 4.4	Tropical dry forest, South America, Secondary >20yr
	Mangrove		0.49	X	Range: 0.04 - 1.1; 95%CI 0.47 - 0.51	2013 IPCC Wetlands Supplement. Table 4.5	
C	Annual Crops		0				
	Perennial Crops		0.284	X	SD:0.061	2019 IPCC RF, Vol 4, Ch4, Table 4.4	Tropical moist deciduous forest, South America, Secondary >20yr
G	Grasslands		0				
W	Wetlands		0				
S	Non-Woody Settlements		0				
	Woody Settlements (moist/dry)		0.284	X	SD:0.061	2019 IPCC RF, Vol 4, Ch4, Table 4.4	Tropical moist deciduous forest, South America, Secondary >20yr
O	Mining and Other Lands						

Average annual increment in biomass [Tier 1] (Equation 2.10, Ch2, V4)

$$G_{TOTAL} = \sum_{i,j} \{ G_W \bullet (1 + R) \}$$

Where:

G_{TOTAL} = average annual biomass growth above and below-ground, tonnes d. m. ha^{-1} yr^{-1}

G_W = average annual above-ground biomass growth for a specific woody vegetation type, tonnes d. m. ha^{-1} yr^{-1}

R = ratio of below-ground biomass to above-ground biomass for a specific vegetation type, in tonne d.m. below-ground biomass (tonne d.m. above-ground biomass)$^{-1}$.

Table 20. Average annual above-ground biomass growth for a specific woody vegetation type, tonnes d. m. ha^{-1} yr^{-1}

GW: Net biomass growth tonnes d. m. ha-1 yr-1							
LU	Category	Type	Value	Default Value (tier 1)	Error o range reported	Source	Comments and assumptions
F	Elfin and Cloud forest	Undisturbed	0.00	X			Expert Judgement, Forestry Division. Gw is 0 as it is considered stable forest. (See annex VI, Reference number for judgement #1 in Excel file)
		Disturbed (Hurricane, fire, logging, Shift.Cult)	NO	-		Collect Earth Assessment	
	Montane Forest	Undisturbed	1.80	X		2019 IPCC RF, Vol 4, Ch4, Table 4.9	Tropical Montane Systems, South America, secondary >20yr
		Disturbed (Hurricane, fire, logging, Shift.Cult)	4.40	X	SD: 0.8	2019 IPCC RF, Vol 4, Ch4, Table 4.9	Tropical Rainforest, South America, secondary <20yr
	Semi-evergreen Forest	Undisturbed	2.70	X	SD: 1.1	2019 IPCC RF, Vol 4, Ch4, Table 4.9	Tropical moist deciduous forest, South America, Secondary >20yr
		Disturbed (Hurricane, fire, logging, Shift.Cult)	5.20	X	SD: 2.3	2019 IPCC RF, Vol 4, Ch4, Table 4.9	Tropical moist deciduous forest, South America, Secondary <20yr
	Deciduous - Coastal Forest	Undisturbed	1.60	X	SD: 1.1	2019 IPCC RF, Vol 4, Ch4, Table 4.9	Tropical dry forest, South America, Secondary >20yr
		Disturbed (Hurricane, fire, logging, Shift.Cult)	3.90	X	SD: 2.4	2019 IPCC RF, Vol 4, Ch4, Table 4.9	Tropical dry forest, South America, Secondary <20yr
	Mangrove	Undisturbed	0.00	X			Expert Judgement, Forestry Division. Gw is 0 as it is considered stable forest. (See annex VI, Reference number for judgement #1 in Excel file)
		Disturbed (Hurricane, fire, logging, Shift.Cult)	9.9	X	Range: 0.1 - 27.4; 95%CI 9.4 - 10.4	2013 IPCC Wetlands Supplement. Table 4.4	Mangroves: Tropical Wet
	Croplands	Annual	0	X			Assumed to be 0 for Annual Croplands remaining Annual Croplands following Tier 1 approach and for lands converted to annual croplands.

		Perennial (Moist)	5.2	X		IPCC 2006, V4, Ch5, Table 5.1	Assumed to be 0 for Perennial Croplands remaining Perennial Croplands following Tier 1 approach and for lands converted to Perennial croplands the value is equal to 5.2. For Tropical moist (Value 2.6 of C, this value is divided for the CF=0.5, to obtain de d.m)
		Perennial (Dry)	3.6	X		IPCC 2006, V4, Ch5, Table 5.1	Assumed to be 0 for Perennial Croplands remaining Perennial Croplands following Tier 1 approach and for lands converted to Perennial croplands the value is equal to 3.6. For Tropical dry (Value 1.8 of C, this value is divided for the CF=0.5, to obtain de d.m)
	Grasslands	Dry	2.3	X		IPCC 2006, V4, Ch6, Table 6.4	Assumed to be 0 for Grasslands remaining Grasslands, following Tier 1 approach and for lands converted to Grasslands, depending on the category
		Moist	6.2	X		IPCC 2006, V4, Ch6, Table 6.4	
	Wetlands		0	X			Assumed to be 0 for Wetlands remaining Wetlands following Tier 1 approach and lands converted to Wetlands
	Settlement	**Settlement**	0	X			Assumed to be 0 for Settlements remaining Settlements following Tier 1 approach and lands converted to Settlements
		Woody Settlement (dry)	1.30	X			Assumed to be 0 for Woody Settlements remaining Woody Settlements following Tier 1 approach and for lands converted to Woody Settlements (dry), Gw is equal to 70% is the same value as settlements, 10% is same value a Perennial Crops, 20% is same value as Deciduous Forest. These was decided based on expert knowledge on the composition of the woody component in settlements.
		Woody Settlement (moist)	1.56	X			Assumed to be 0 for Woody Settlements remaining Woody Settlements following Tier 1 approach and for lands converted to Woody Settlements (dry), Gw is equal to 70% is the same value as settlements, 10% is same value a Perennial Crops, 20% is same value as Semi-Evergreen Forest. These

							was decided based on expert knowledge on the composition of the woody component in settlements.
	Mining and Other Lands		0	X			Assumed to be 0 for Other Lands remaining Other Lands following Tier 1 approach and lands converted to Other Lands

Clarification Notes

These values were agreed to on May 21st 2020 by Forestry Division Team. Also, for the application of the equation, a maximum stock value was used, meaning that the Gw was applied annually until that maximum stock was reached. Time [years] was estimated by dividing ABG/Gw.

Table 21. Time to reach maximum stock by type of vegetation

Forestland	Time to reach max stock [years]
Montane Forest (FRAIN)	64
Semi-evergreen Forest (FEVER)	44
Deciduous - Coastal Forest (FDEC)	11
Mangrove (FMAN)	23
Croplands	
Perennial (CPER) (Moist)	8
Perennial (CPER) (Dry)	5
Grassland	
Grassland (GGRASS)(Dry)	1
Grassland (GGRASS)(Moist)	1
Settlement	
Woody Settlement (SWOOD) (dry)	8
Woody Settlement (SWOOD) (moist)	30

Annual decrease in carbon stocks due to biomass losses in land remaining in the same land-use category (Equation 2.11, Ch2, V4)

$$\Delta C_L = \Delta L_{wood\text{-}removals} + \Delta L_{fuelwood} + \Delta L_{disturbance}$$

Where:

ΔC_L = annual decrease in carbon stocks due to biomass loss in land remaining in the same land-use category, tonnes C yr^{-1}

$L_{wood\text{-}removals}$ = annual carbon loss due to wood removals, tonnes C yr^{-1} (See Equation 2.12)

$L_{fuelwood}$ = annual biomass carbon loss due to fuelwood removals, tonnes C yr^{-1} (See Equation 2.13)

$L_{disturbance}$ = annual biomass carbon losses due to disturbances, tonnes C yr^{-1} (See Equation 2.14)

Annual carbon loss in biomass of wood removals (Equation 2.12, Ch2, V4)

$$L_{wood\text{-}removals} = \{ H \bullet BCEF_R \bullet (1+R) \bullet CF \}$$

Where:

$L_{wood\text{-}removals}$ = annual carbon loss due to biomass removals, tonnes C yr^{-1}

H = annual wood removals, roundwood, m^3 yr^{-1}

R = ratio of below-ground biomass to above-ground biomass, in tonne d.m. below-ground biomass (tonne d.m. above-ground biomass)$^{-1}$. R must be set to zero if assuming no changes of below-ground biomass allocation patterns (Tier 1).

CF = carbon fraction of dry matter, tonne C (tonnes.m.)$^{-1}$

$BCEF_R$ = biomass conversion and expansion factor for conversion of removals in merchantable volume to total biomass removals (including bark), tonnes biomass removal (m^3 of removals)$^{-1}$

Table 22. H. annual wood removals, roundwood, m3 yr-1

H: Annual wood removals, roundwood, m^3 yr^{-1}				
LU	Year	Hardwood -m3	Fuelwood -m3	Source
F		IE		

Clarification Notes

Data on annual wood removals from 2016 to 2020 is not available. However, losses due to wood removals were estimated as an area of cover loss, through the LULUC assessment, and allocated as “Land clearing”, where a fraction (fd) was determined and then used in eq. 2.14

Table 23. biomass conversion and expansion factor for conversion of removals in merchantable volume to biomass removals (including bark), tonnes biomass removal (m3 of removals)-1

$BCEF_R$: biomass conversion and expansion factor, t biomass removal (m^3 of removals)$^{-1}$				
LU	Sub-Category	Value	Range/Error	source
F		NE		

Annual carbon loss in biomass of fuelwood removal (Equation 2.13, Ch2, V4)

$$L_{fuelwood} = [\{ FG_{trees} \bullet BCEF_R \bullet (1+R) \} + FG_{part} \bullet D] \bullet CF$$

Where:

$L_{fuelwood}$ = annual carbon loss due to fuelwood removals, tonnes C yr^{-1}

FG_{trees} = annual volume of fuelwood removal of whole trees, m^3 yr^{-1}

FG_{part} = annual volume of fuelwood removal as tree parts, m^3 yr^{-1}

R = ratio of below-ground biomass to above-ground biomass, in tonne d.m. below-ground biomass (tonne d.m. above-ground biomass)$^{-1}$

CF = carbon fraction of dry matter, tonne C (tonned.m.)$^{-1}$

D = basic wood density, tonnes d.m. m^{-3}

$BCEF_R$ = biomass conversion and expansion factor for conversion of removals in merchantable volume to biomass removals (including bark), tonnes biomass removal (m^3 of removals)$^{-1}$

Clarification Notes

Data on fuelwood removals is not available as yet.

Table 24. annual volume of fuelwood removal of whole trees, m3 yr-1 and annual volume of fuelwood removal as tree parts, m3 yr-1

FG_{trees} = annual volume of fuelwood removal of whole trees				
LU	Sub-Category	Source	years	Notes
F	NE	NE		
FG_{part} = annual volume of fuelwood removal as tree parts				
LU	Sub-Category	Sources		Notes
F	NE	NE		

Table 25. basic wood density, tonnes d.m. m-3

D: wood density, g / cm^3				
LU	**Sub-Category**	**Value**	**Range/Error**	**Source**
F	Cloud Montane Rainforest	0.598	0.290 – 0.990	Graveson (2009), Reyes *et* al (1992) and Chave *et* al (2007).
	Lower Montane and Montane Rainforest	0.672	0.360 – 0.820	
	Semi-evergreen Seasonal Forest	0.601	0.470 – 0.871	
	Deciduous Seasonal Forest	0.655	0.482 -0.700	

Clarification Note

Graveson (2009)[21], in Appendix 3, added a table of species identified per Forest Class Values (FCV). Therefore, wood density was assigned to these species based on Specie, Genus or Family. Wood Density values were assigned based on Reyes *et* al (1992)[22] and Chave *et* al. (2007)[23] *(Excel file > Annex IV. Wood Density by FCV in the).*

Annual carbon losses in biomass due to disturbances (Equation 2.14, Ch2, V4)

$$L_{disturbance} = A_{disturbance} \bullet B_W \bullet (1+R) \bullet CF \bullet fd$$

Where:

$L_{disturbances}$ = annual other losses of carbon, tonnes C yr^{-1}

$A_{disturbance}$ = area affected by disturbances, ha yr^{-1}

B_W = average above-ground biomass of land areas affected by disturbances, tonnes d.m. ha^{-1}

R = ratio of below-ground biomass to above-ground biomass, in tonne d.m. below-ground biomass (tonne d.m. above-ground biomass)$^{-1}$.

CF = carbon fraction of dry matter, tonne C (tonnesd.m.)$^{-1}$

fd = fraction of biomass lost in disturbance

[21] Graveson (2009). National Forest Demarcation and Bio-Physical Resource Inventory Project Caribbean – Saint Lucia: The Classification Of The Vegetation Of Saint Lucia. FCG International Ltd in association with AFC Consultants International GmbH

[22] Reyes, G., Brown, S., Chapman, J., Lugo, Ariel E. 1992. Wood densities of tropical tree species, Gen. Tech. Rep. SO-88 New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station. 1992, 15p.

[23] Chave, Jérôme & Muller-Landau, Helene & Baker, Timothy & Easdale, Tomás & ter Steege, Hans & Webb, Campbell. (2007). Regional and phylogenetic variation of wood density across 2456 Neotropical tree species. Ecological applications : a publication of the Ecological Society of America. 16. 2356-67. 10.1890/1051-0761(2006)016[2356:RAPVOW]2.0.CO;2.

Figure 25. Matrices Adisturbance: area affected by disturbances, ha yr-1

Forest Disturbance	2016	2017	2018	2019	2020	Total	%
F>F Disturbance Fire	0	0	0	25	296	320	28%
F>F Disturbance Hurricane	0	0	0	0	0	0	0%
F>F Disturbance Logging	0	99	99	197	74	468	40%
F>F Disturbance Shifting C.	0	25	148	74	123	369	32%
Total Annual Disturbance [Ha]	0	123	246	296	493	1,158	
Total cumulative disturbance [Ha]		123	369	665	1,158		

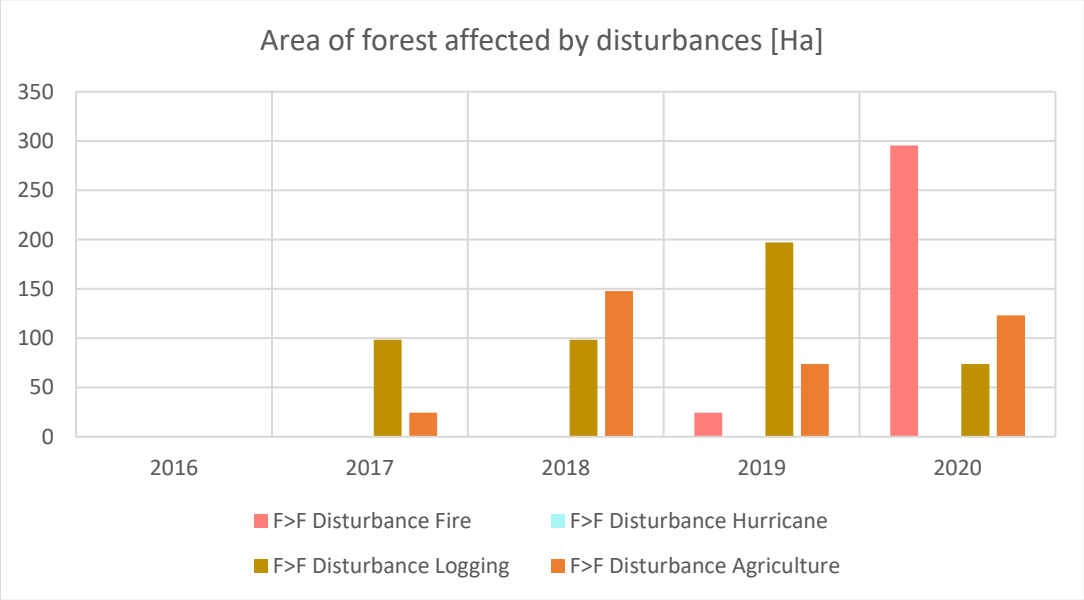


Figure 26 Area of forest affected by disturbances [Ha]

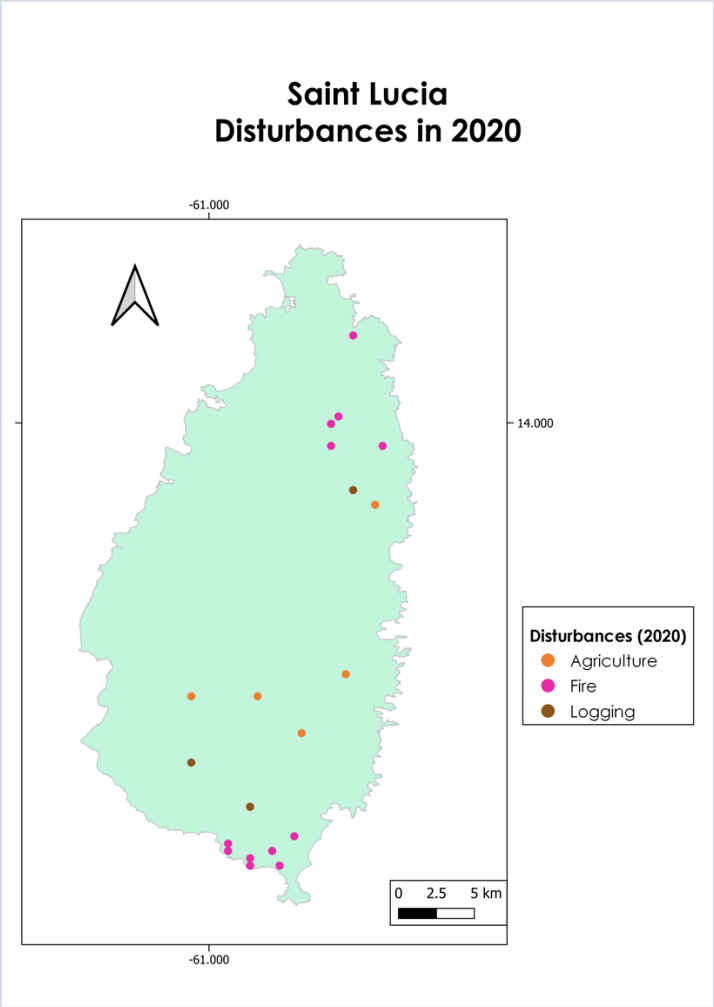


Figure 27 Disturbances in Forest lands [2020] in Saint Lucia

Table 26. average above-ground biomass of land areas affected by disturbances, tonnes d.m. ha-1

B_W = average above-ground biomass of land areas affected by disturbances							
LU	Category	Value	Country Specific (tier 2)	Default Value (tier 1)	Error o range reported	Source	Comments and assumptions
F	Elfin and Cloud forest	19	X		Range (4-34)	Estimated using equation by Chave (2014) using NFI data and Forest Classes	ABG=0.0673*(WD*D^2*H)^0.976, where D is in cm, H is in m, and WD is in g/cm-3
	Montane Forest	280	X		Range (80-480)	Estimated using equation by Chave (2014) using NFI data and Forest Classes	ABG=0.0673*(WD*D^2*H)^0.976, where D is in cm, H is in m, and WD is in g/cm-3
	Semi-evergreen Forest	228	X		Range (128-328)	Estimated using equation by Chave (2014) using NFI data and Forest Classes	ABG=0.0673*(WD*D^2*H)^0.976, where D is in cm, H is in m, and WD is in g/cm-3
	Deciduous - Coastal Forest	41	X		Range (11-71)	Estimated using equation by Chave (2014) using NFI data and Forest Classes	ABG=0.0673*(WD*D^2*H)^0.976, where D is in cm, H is in m, and WD is in g/cm-3
	Mangrove	192		X	Range (187-204)	2013 IPCC Wetlands Supplement. Table 4.3	Tropical Wet
	Plantations	100		X	±90%	2019 IPCC RF, Vol 4, Ch5, Table 4.8	Tropical moist deciduous, Americas, Other Broadleaf
C	Annual Crops	0		X			Assumed to be 0 following Tier 1 approach
	Perennial Crops (Moist)	42		X	75%	IPCC 2006, V4, Ch5, Table 5.1	For Tropical moist (Value 21 of C, this value is divided for the CF=0.5, to obtain de d.m). Assumed to be 0 for Croplands remaining Croplands, following Tier 1 approach
	Perennial Crops (Dry)	18		X	75%	IPCC 2006, V4, Ch5, Table 5.1	For Tropical dry (Value 9 of C, this value is divided for the CF=0.5, to obtain de d.m) Assumed to be 0 for Croplands remaining Croplands, following Tier 1 approach
G	Grasslands (Dry)	2.3		X		IPCC 2006, V4, Ch6, Table 6.4	Assumed to be 0 for Grasslands remaining Grasslands, following Tier 1 approach
	Grasslands (Moist)	6.2		X		IPCC 2006, V4, Ch6, Table 6.4	Assumed to be 0 for Grasslands remaining Grasslands, following Tier 1 approach
W	Wetlands	0		X			Assumed to be 0

S	Non-Woody Settlements	0		X			Assumed to be 0
	Woody Settlements (dry)	10		X			70% is the same value as settlements, 10% is same value a Perennial Crops, 20% is same value as Deciduous Forest. These was decided based on expert knowledge on the composition of the woody component in settlements.
	Woody Settlements (moist)	47.4		x			70% is the same value as settlements, 10% is same value a Perennial Crops, 20% is same value as Semi-Evergreen Forest. These was decided based on expert knowledge on the composition of the woody component in settlements.
O	Mining and Other Lands	0		X			Assumed to be 0

Clarification Notes

Chave et al (2014)[24] pantropical biomass allometric equation was selected to estimate biomass in Saint Lucia. They regressed tree AGB (kg) against the product ρ *D^2 * H. [D is in cm, H is in m, and WD is in g/cm3]. They found the best-fit pantropical model to be:

$$AGB_{est}: 0.0673 * (\rho * D^2 * H)^{0.976}$$

(σ =357; AIC =3130; df =4002)

Table 27. Estimation of biomass for different forest classes using Chave et al (2014)

Atribute (Avergae by Forest Class)	Cloud Montane Rainforest (n=2)	Lower Montane and Montane Rainforest (rainforest) (n=77)	Semi-evergreen Seasonal Forest (n=22)	Deciduous Seasonal Forest (n=76)

[24] Chave, Jérôme & Réjou-Méchain, Maxime & Burquez, Alberto & Chidumayo, Emmanuel & Colgan, Matthew & Delitti, Welington & Duque, Alvaro & Eid, Tron & Fearnside, Philip & Goodman, Rosa & Henry, Matieu & Martinez-Yrizar, Angelina & Mugasha, Wilson & Muller-Landau, Helene & Mencuccini, Maurizio & Nelson, Bruce & Ngomanda, Alfred & Nogueira, Euler & Ortiz, Edgar & Vieilledent, Ghislain. (2014). Improved allometric models to estimate the aboveground biomass of tropical trees. Global Change Biology. 20. 3177-3190. 10.1111/gcb.12629.

Mean Number of Trees DBH≥5cm	25.0	30.0	17.0	19.0
Mean Canopy Height (m)	5.3	27.6	22.8	11.2
Mean DBH 1 and 2 (cm)	17.0	38.3	31.3	21.1
Wood density by FCV (g /cm3)	0.598	0.672	0.601	0.655

KG AGB per plot (Plot area: 1366m2): AGB_{est}: 0.0673 * (ρ *D^2 * H)$^{0.976}$* Ntrees	1309	43021	12240	3435
KG AGB per Ha (10.000m2)	9583.6	314942.0	89601.3	25143.9
t AGB per Ha	9.58	314.94	89.60	25.14

This model performed well across forest types and bioclimatic conditions. The destructive harvest dataset assembled for the study was distributed across the tropics and across vegetation types. They compiled tree harvest studies that had been carried out in old-growth or secondary woody vegetation, excluding plantations and agroforestry systems. Sites included harvest experiments reported from the Afro-tropical realm (n=1429, including Madagascar), data from Latin America (n=1794), and from Southeast Asia and Australia (n=781). It is acknowledged that forest dynamics in Caribbean islands are different compared to continental lands, especially because of the constant influence of Hurricanes and storms, which tend to lead to shorter trees.

Table 28.. Values for fraction of biomass loss due to disturbances

Fd: Fraction of biomass loss due to disturbances				
Forest Type	**Disturbance**	**Fd**	**Tier 2**	**Notes**
Elfin and Cloud forest	Affected by hurricane	**NO**	x	Forestry Division, Collect Earth Assessment
	Affected by Fire	**NO**	x	Forestry Division, Collect Earth Assessment
	Affected by Logging	**NO**	x	Forestry Division, Collect Earth Assessment
	Affected by Shifting Cultivation	**NO**	x	Forestry Division, Collect Earth Assessment
Montane Forest	Affected by hurricane	**0.20**	x	Forestry Division, Collect Earth Assessment and Expert Judgement
	Affected by Fire	**NO**	x	Forestry Division, Collect Earth Assessment
	Affected by Logging	**0.20**	x	Forestry Division, Collect Earth Assessment and Expert Judgement
	Affected by Shifting Cultivation	**0.10**	x	Forestry Division, Collect Earth Assessment and Expert Judgement
Semi-evergreen Forest	Affected by hurricane	**0.15**	x	Forestry Division, Collect Earth Assessment and Expert Judgement

	Affected by Fire	NO	x	Forest Division, Collect Earth Assessment
	Affected by Logging	0.20	x	Forestry Division, Collect Earth Assessment and Expert Judgement
	Affected by Shifting Cultivation	0.25	x	Forestry Division, Collect Earth Assessment and Expert Judgement
Deciduous - Coastal Forest	Affected by hurricane	0.15	x	Forestry Division, Collect Earth Assessment and Expert Judgement
	Affected by Fire	0.20	x	Forestry Division, Collect Earth Assessment and Expert Judgement
	Affected by Logging	0.40	x	Forestry Division, Collect Earth Assessment and Expert Judgement
	Affected by Shifting Cultivation	0.30	x	Forestry Division, Collect Earth Assessment and Expert Judgement
Mangrove	Affected by hurricane	NO	x	Forest Division, Collect Earth Assessment
	Affected by Fire	0.20	x	Forestry Division, Collect Earth Assessment and Expert Judgement
	Affected by Logging	0.20	x	Forestry Division, Collect Earth Assessment and Expert Judgement
	Affected by Shifting Cultivation	0.50	x	Forestry Division, Collect Earth Assessment and Expert Judgement

Clarification Notes

During the collect earth assessment, the interpreters can identify the canopy cover loss due to the disturbance. This fraction is less than the percentages assigned as hierarchies for classification. For example, a plot mixed of forest and settlements, with 20% or more settlements, was classified as settlement; however, if the percentage was less than 20%, the plot was classified as Forest land disturbed. These disturbances were Hurricane, Fire, land clearing understood as a piece of land cleared or canopy cover lost, and other disturbances such as grazing, infrastructure and other human impacts. These fractions are the average of what was identified as fraction lost during a disturbance in all plots classified as such. The information observed in CE was crosschecked with National Experts *(see Expert Judgment Table # 1, Excel file)*

5.5.3.3 Change in biomass carbon stocks (above-ground biomass and below-ground biomass) in land converted to a new land-use category

Annual change in biomass carbon stocks on land converted to other land-use category (tier 2) (Equation 2.15, Ch2, V4)

$$\Delta C_B = \Delta C_G + \Delta C_{CONVERSION} - \Delta C_L$$

Where:

ΔC_B= annual change in carbon stocks in biomass on land converted to other land-use category, in tonnes C yr^{-1}

ΔC_G= annual increase in carbon stocks in biomass due to growth on land converted to another land-use category, in tonnes C yr^{-1}

$\Delta C_{CONVERSION}$ = initial change in carbon stocks in biomass on land converted to other land-use category, in tonnes C yr^{-1}

ΔC_L = annual decrease in biomass carbon stocks due to losses from harvesting, fuel wood gathering and disturbances on land converted to other land-use category, in tonnes C yr^{-1}

Table 29. Area of land converted

A: area of land converted to a land-use category			
LU	Sub-Category	Source	Notes
Non-F>F	Non-Forest Lands > Forest Lands	Forestry Division	LULUC assessment - Annual time series 2016-2020
Non-C>C	Non-Croplands > Croplands	Forestry Division	LULUC assessment - Annual time series 2016-2020
Non-G>G	Non-Grasslands > Grasslands	Forestry Division	LULUC assessment - Annual time series 2016-2020
Non-W>W	Non-Wetlands > Wetlands	Forestry Division	LULUC assessment - Annual time series 2016-2020
Non-S>S	Non-Settlements > Settlements	Forestry Division	LULUC assessment - Annual time series 2016-2020
Non-O>O	Non-Other lands > Other lands	Forestry Division	LULUC assessment - Annual time series 2016-2020

Annual increase in biomass carbon stocks on land converted to other land-use category (tier 2) (Equation 2.9, Ch2, V4)

Annual increase in carbon stocks in biomass due to land converted to another land-use category was estimated following same methods as forest land remaining forest land.

Initial change in biomass carbon stocks on land converted to another land category (Equation 2.16, Ch2, V4)

$$\Delta C_{CONVERSION} = \sum_{i} \{ (B_{AFTER} - B_{BEFORE}) \bullet \Delta A_{TO\_OTHERS} \} \bullet C$$

Where:

$\Delta C_{CONVERSION}$ = initial change in biomass carbon stocks on land converted to another land category, tonnes C yr^{-1}

B_{AFTER_i} = biomass stocks on land type i immediately after the conversion, tonnes d.m. ha^{-1}

B_{BEFORE_i} = biomass stocks on land type i before the conversion, tonnes d.m. ha^{-1}

$\Delta A_{TO\_OTHERS_i}$ = area of land use i converted to another land-use category in a certain year, ha yr^{-1}

CF = carbon fraction of dry matter, tonne C (tonnesd.m.)$^{-1}$

i = type of land use converted to another land-use category

Clarification Notes

Change in biomass carbon stocks on land converted to another land category was estimated using the values of Area, Biomass and Carbon Fraction as described above for lands remaining forest lands.

As described in Section 5.1 on land representation, only the initial Land Use and the Final land use was captured, and only when that second land use reached the definition. In conversion to forest, only when the forest reached the definition that conversion was registered; otherwise, it would remain in the initial land use. When relating this method to emissions factors, the B_After selected was the biomass of a mature forest, and the full stock was input in the equation 2.16. Saint Lucia recognizes that this may be leading to an over or under estimation of emissions or removals due to deforestation and post-carbon stocks post-deforestation. Technical discussions were held and each conversion was analyzed and attempt to estimate the biomass at 5 or 10 years was done; however, the technical team does not have field data to support such assumption.

Annual decrease in carbon stocks in biomass due to losses, ΔCL (Equation 2.11-2.14, Ch2, V4)

Note: The annual decrease in C stocks in biomass due to losses on converted land (wood removals or felling, fuelwood collection, and disturbances) was estimated using Equations 2.11 to 2.14, as described above for lands remaining in a category.

5.5.3.4 Change in dead organic matter carbon stock in land remaining in the same category

The Tier 1 assumption for both dead wood and litter pools for all land-use categories is that their stocks are not changing over time if the land remains within the same land-use category. Thus, the carbon in biomass killed during a disturbance or management event (less removal of harvested wood products) is assumed to be released entirely to the atmosphere in the year of the event.

5.5.3.5 Change in dead organic matter in Carbon stock in land converted to a new land category

Land converted from forest to another land-use category (Equation 2.23, Ch2, V4)

$$\Delta C_{DOM} = \frac{(Cn - Co) * Aon}{Ton}$$

Where:

ΔC_{DOM} = annual change in carbon stocks in dead wood or litter, tonnes C yr-1
C_o = dead wood/litter stock, under the old land-use category, tonnes C ha-1
C_n = dead wood/litter stock, under the new land-use category, tonnes C ha-1
A_{on} = area undergoing conversion from old to new land-use category, ha
T_{on} = time period of the transition from old to new land-use category, yr. The Tier 1 default is 20 years for carbon stock increases and 1 year for carbon losses.

Table 30. Values for dead wood and litter stock

Dead wood/litter stock tonnes C ha-1 (For conversion only)						
Pool	Land Use	Value	Tier 1	Error	Source	Note
Litter	Elfin and Cloud forest	NO			n.a	
	Montane Forest	4.800	x	Range: 2.1-16.4	2019 IPCC RF, Vol 4, Ch2, Table 2.2	Tropical rainforest
	Semi-evergreen Forest	5.900	x	Range: 1.9-14.8	2019 IPCC RF, Vol 4, Ch2, Table 2.2	Tropical moist
	Deciduous - Coastal Forest	2.4	x	Range: 2.1-2.7	2019 IPCC RF, Vol 4, Ch2, Table 2.2	Tropical dry
	Mangrove	0.70	x	Range: 0-1.3	2013 IPCC Wetlands Supplement. Table 4.7	
	Plantations	0.00			n.a	

Dead wood	Elfin and Cloud forest	3.3		n.a	2019 IPCC RF, Vol 4, Ch2, Table 2.2	Tropical mountain System
	Montane Forest	14.8	x	Range: 0.6 - 218.9	2019 IPCC RF, Vol 4, Ch2, Table 2.2	Tropical rainforest
	Semi-evergreen Forest	8.0	x	Range: 1.9-14.8	2019 IPCC RF, Vol 4, Ch2, Table 2.2	Tropical moist
	Deciduous - Coastal Forest	9.0	x	Range:1.3-17.3	2019 IPCC RF, Vol 4, Ch2, Table 2.2	Tropical dry
	Mangrove	10.70	x	Range:6.5-14.8	2013 IPCC Wetlands Supplement. Table 4.7	
Litter	Annual	0	x		IPCC 2006, V4, Ch5, page 5.13. Tier 1	
	Perennial	0	x		IPCC 2006, V4, Ch5, page 5.13. Tier 1	
Dead wood	Annual	0	x		IPCC 2006, V4, Ch5, page 5.13. Tier 1	
	Perennial	0	x		IPCC 2006, V4, Ch5, page 5.13. Tier 1	
Litter	Grassland	0	X		IPCC 2006, V4, Ch6, page 6.31. Tier 1	
Dead wood	Grassland	0	X		IPCC 2006, V4, Ch6, page 5.31. Tier 1	
Litter	Wetlands	NO				
Dead wood	Wetlands	NO				
Litter	Settlement	NO				
	Woody Settlement	NO				
Dead wood	Settlement	NO				
	Woody Settlement	NO				
Litter	Other Lands	NO				
Dead wood	Other Lands	NO				

Clarification Note

For lands converted to Forest lands, T=20, until Forest lands is considered stable (F>F), then changed to DOM=0. For other conversions, T=1, meaning the loss on DOM happens the year of conversion.

5.5.3.6 Change in Carbon stock in soils in land converted to a new land category

Annual change in carbon stocks in mineral soils, tonnes C yr-1 (Equation 2.25, Ch2, V4)

$$\Delta C_{\text{Mineral}} = \frac{(SOCo - SOC_{o-t})}{D}$$

$$\Delta SOC = \sum_{c,s,i} \{ (SOC_{REF} * F_{LU} * F_{MG} * F_I * A$$

Where,

$\Delta C_{\text{Mineral}}$ = annual change in carbon stocks in mineral soils, tonnes C yr^{-1}

SOC_0 = soil organic carbon stock in the last year of an inventory time period, tonnes C

$SOC_{(0-T)}$ = soil organic carbon stock at the beginning of the inventory time period, tonnes C

T = number of years over a single inventory time period, yr

D = Time dependence of stock change factors which is the default time period for transition between equilibrium SOC values, yr.

c = represents the climate zones, *s* the soil types, and *i* the set of management systems that are present in a country.

SOC_{REF} = the reference carbon stock, tonnes C ha^{-1}

FLU = stockchangefactorforland-usesystemsorsub-systemforaparticularland-use,dimensionless

FMG = stock change factor for management regime, dimensionless

FI = stock change factor for input of organic matter, dimensionless

A = land area of the stratum being estimated, ha.

Table 31 SOC ref values by Land use and sub-categories of land use

Land use	Average SOC1	Máx. SOC1_5	Mín. SOC1_2	SD SOC1_4	n
Forestland					

Elfin and Cloud forest (FCLOUD)	212.92	214.67	212.05	1.51	3
Montane Forest (FRAIN)	148.51	214.75	97.21	22.98	284
Semi-evergreen Forest (FEVER)	120.83	214.67	73.03	22.12	539
Deciduous - Coastal Forest (FDEC)	109.34	164.64	67.89	18.79	497
Deciduous - Coastal Forest (FDRYS)	106.70	155.40	73.84	24.35	120
Deciduous - Coastal Forest (FLIT)	114.85	175.26	67.89	26.66	121
Mangrove (FMAN)	96.80	133.87	73.84	20.65	9
Croplands					
Annual (CANNUALC)	105.34	179.08	73.03	18.54	180
Perennial (CPER)	104.38	154.55	72.74	15.97	139
Grassland					
Grassland (GGRASS)	101.53	169.80	69.30	20.60	121
Grassland (Pastures)	98.53	153.85	70.71	20.38	69
Grassland (Shurblands)	104.53	185.74	67.89	20.82	173
Wetland					
Wetlands (WWET)	102.01	150.23	67.89	29.20	11
Settlement					
Settlement (SSET)	88.31	118.90	67.89	10.97	196
Woody Settlement (SWOOD) (dry)	94.12	146.05	70.71	14.49	137
Otherland					
Other Lands (OTHER)	129.11	168.66	79.08	27.78	11
Mining (OMIN)	91.67	107.91	75.50	9.64	9

Table 32. FLU, FMG and FI Values for values by Land use and sub-categories of land use

Notation	*FLU*	*FMG*	*FI*		
Parameter	**Factor for land use systems**	**Factor for management regime**	**Factor for input of organic matter**	**Tier 1**	**Source**
Units	**Dimensionless**	**Dimensionless**	**Dimensionless**		
Forestland					
Elfin and Cloud forest (FCLOUD)	1.00	1.00	1.00	X	IPCC 2006, Vol 4, Ch 4, pg 4.40
Montane Forest (FRAIN)	1.00	1.00	1.00	X	IPCC 2006, Vol 4, Ch 4, pg 4.40
Semi-evergreen Forest (FEVER)	1.00	1.00	1.00	X	IPCC 2006, Vol 4, Ch 4, pg 4.40

Deciduous - Coastal Forest (FDEC)	1.00	1.00	1.00	X	IPCC 2006, Vol 4, Ch 4, pg 4.40
Deciduous - Coastal Forest (FLIT)	1.00	1.00	1.00	X	IPCC 2006, Vol 4, Ch 4, pg 4.40
Deciduous - Coastal Forest (FDRYS)	1.00	1.00	1.00	X	IPCC 2006, Vol 4, Ch 4, pg 4.40
Mangrove (FMAN)	1.00	1.00	1.00	X	IPCC 2006, Vol 4, Ch 4, pg 4.40
Plantations (FPLANT)	1.00	1.00	1.00	X	IPCC 2006, Vol 4, Ch 4, pg 4.40
Croplands					
Annual (CANNUALC)	0.48	1.00	0.92	X	IPCC 2006, V4, Ch.5, table 5.5 dry, Moist wet, Long-term Cultivated / Full tillage / Low, tropical, moist wet
Perennial (CPER) (Moist)	1.00	1.15	0.92	X	IPCC 2006, V4, Ch5, Table 5.5 Perennial / Reduce tillage, moist wet, tropical / Low, tropical, moist wet
Perennial (CPER) (Dry)	1.00	1.15	0.92	X	IPCC 2006, V4, Ch5, Table 5.5 Perennial / Reduce tillage, moist wet, tropical / Low, tropical, moist wet
Grassland					
Grassland (GGRASS)(Dry)	1.00	1.00	1.00	X	
Grassland (GGRASS)(Moist)	1.00	1.00	1.00	X	
Settlement					
Settlement (SSET)	0.00	0.00	0.00	x	
Woody Settlement (SWOOD)	1.00	1.00	1.00	x	

Clarification Notes

Currently St Lucia does not have enough information regarding content of carbon on soils. There are some maps of soil classification, which originates from 1966 soil map by UWI Imperial College of Tropical Agriculture. Therefore, Saint Lucia estimates emissions and removals in soils following the Tier 1. Hence, soil information was obtained from the Global Soil Organic Carbon Map -GSOCmap-, from FAO (2019).

The web address of the portal is http://54.229.242.119/GSOCmap/. The island was selected, and information was downloaded through the "crop & Download" function. The result of the process is a TIFF file.

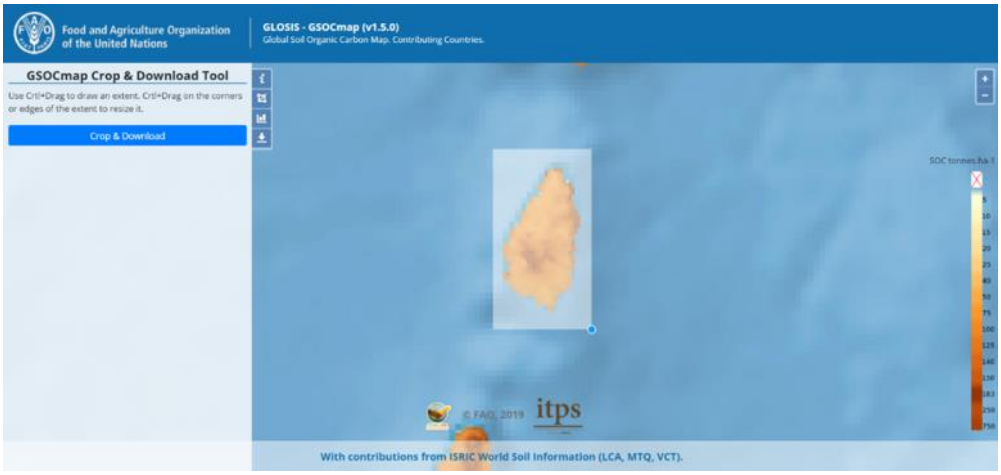
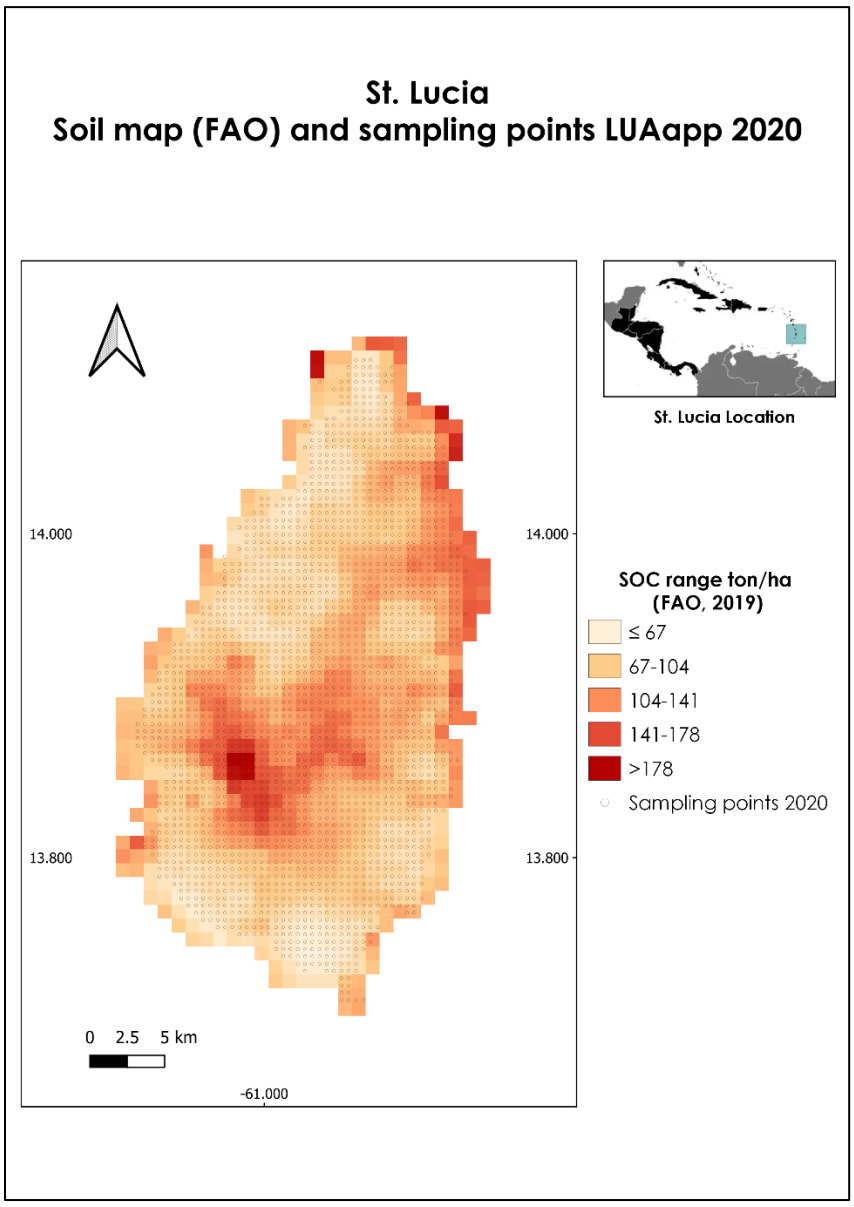


Figure 28 Saint Lucia on GSOCmap (FAO, 2019)

The TIFF image processing was done in QGIS Desktop version 3.1.6. Santa Lucia has information on land uses obtained through Collect earth assessment described in the activity data section (5.1). Thus, the objective is to link the SOC information for each of the plots, which will then allow allocating the SOC ref value by land use and sub-categories of land use.

The TIFF image was processed with the Samples Raster Values tool for the process of linking Collect Earth plots to the SOC raster (TIFF).

The result of this process is a SOC value for each plot. Then, information is organized by land use and sub-category and an average value is estimated *(See excel file > soils).*



The final SOC ref value is reported In table 31.

5.5.3.7 Non-CO2 Emissions

Estimation of Greenhouse Gas Emissions from fire (Equation 2.27, Ch2, V4)

$$Lfire = A \bullet MB \bullet Cf \bullet Gef \bullet 10{-}3$$

Where:

Lfire = amount of greenhouse gas emissions from fire, tonnes of each GHG (CH_4, N_2O).

A = area burnt, ha

MB = mass of fuel available for combustion, tonnes ha^{-1}.

Cf = combustion factor, dimensionless

Gef = emission factor, g kg-1 dry matter burnt

Table 33. Values for estimation Non CO2 emissions

		MB	Cf	Gef CH_4	Gef N_2O
LU	Sub-Category	Mass of fuel available for combustion	Combustion factor	Emission factor- CH_4	Emission factor- N_2O
		tonnes ha^{-1}	Dimensionless	g kg-1 dry matter burnt	g kg-1 dry matter burnt
F	Deciduous-Coastal Forest	18.1	0.2	6,8	0,2

Clarification notes

Estimated as: MB [Bw (AGB+Litter+DW)]*Cf [Fd (Fire)]

6. RESULTS OF HISTORICAL GHG EMISSIONS AND REMOVALS

The current national FRL/FREL proposed is based on the net greenhouse gas (GHG) emissions and removals for forest lands remaining forest lands, forest lands converted to other land uses, and other land uses converted to forest lands, based on the 2006 Intergovernmental Panel on Climate Change (IPCC) categories and subcategories of land use at national level. All lands were considered as managed. The analysis includes the pools above-ground biomass, below-ground biomass, dead organic matter and soil organic carbon. Harvested wood products were excluded due to lack of data. In addition to carbon dioxide (CO_2) emissions and removals, methane (CH_4) and nitrous oxide (N_2O) emissions from fires in forest lands were also included.

[25] Photo: https://www.brookstropicals.com/all-about-papayas/

2501 plots of 1ha distributed in a systematic grid were analyzed annually from 2016 to 2020 to determine land use, land use changes, year of land use change, disturbance and year of disturbance. The information collected, along with emission factors provided estimations of annual GHG emissions and removals for the reference period.

The analysis of the annual historical emissions and removals indicates that **Saint Lucia's balance average** is tCO2eq for the period 2016 to 2020, indicating the country is still a carbon sink. Detailed information is reported in table 38.

Emissions from deforestation average 18,820 tCO2eq for the period 2016-2020. Maximum emissions were 23,545 tCO2eq in 2019. Major emissions came from SOC when Forest lands are converted to settlements (29%), followed by emissions in the AGB and BGB pools when forest lands are converted to croplands (29%) and to grasslands (13%). Detailed information is reported in table 38.

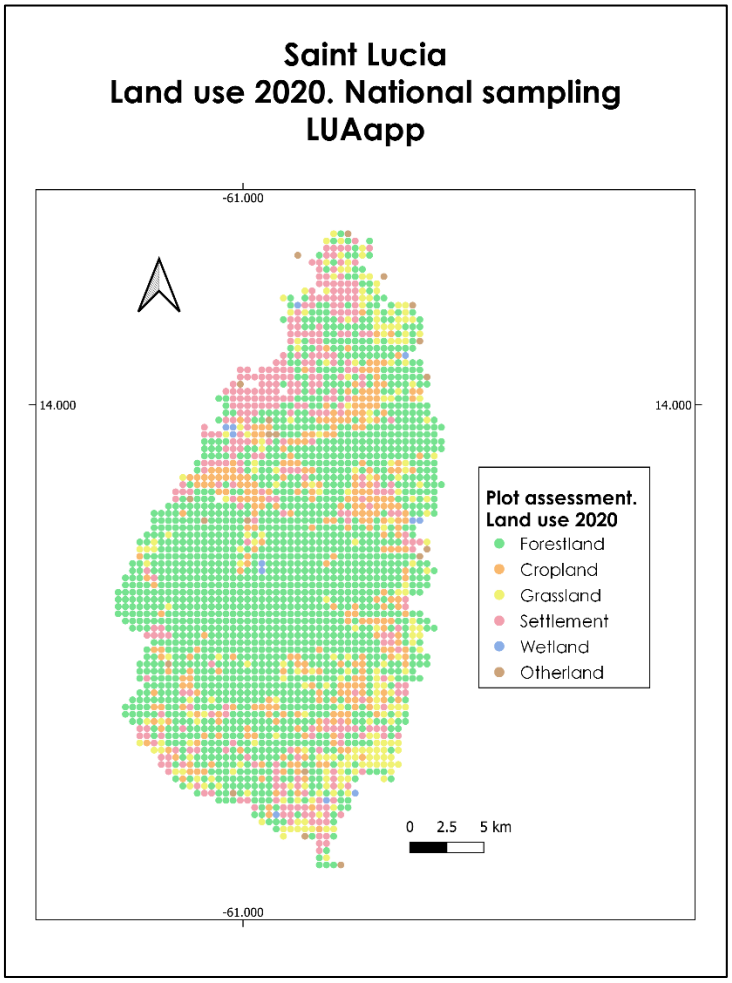


Figure 29 Land use by IPCC land use categories in 2020

Results indicate that a total of 123 Ha of Forest were converted to other land uses, and only conversion to croplands were reported (See table 34)

Table 34. Area of forest land converted to other land uses (2016-2020) in tCO2eq

Land use conversion	2016	2017	2018	2019	2020
Forest Land Converted to Cropland		25	49	25	25
Forest Land Converted to Grassland		0	0	0	0
Forest land Converted to Wetlands		0	0	0	0
Forest Land Converted to Settlements		0	0	0	0
Forest Land Converted to Other Land		0	0	0	0
Total Annual Conversion [Ha]		25	49	25	25
Total cumulative conversion [Ha]		25	74	99	123

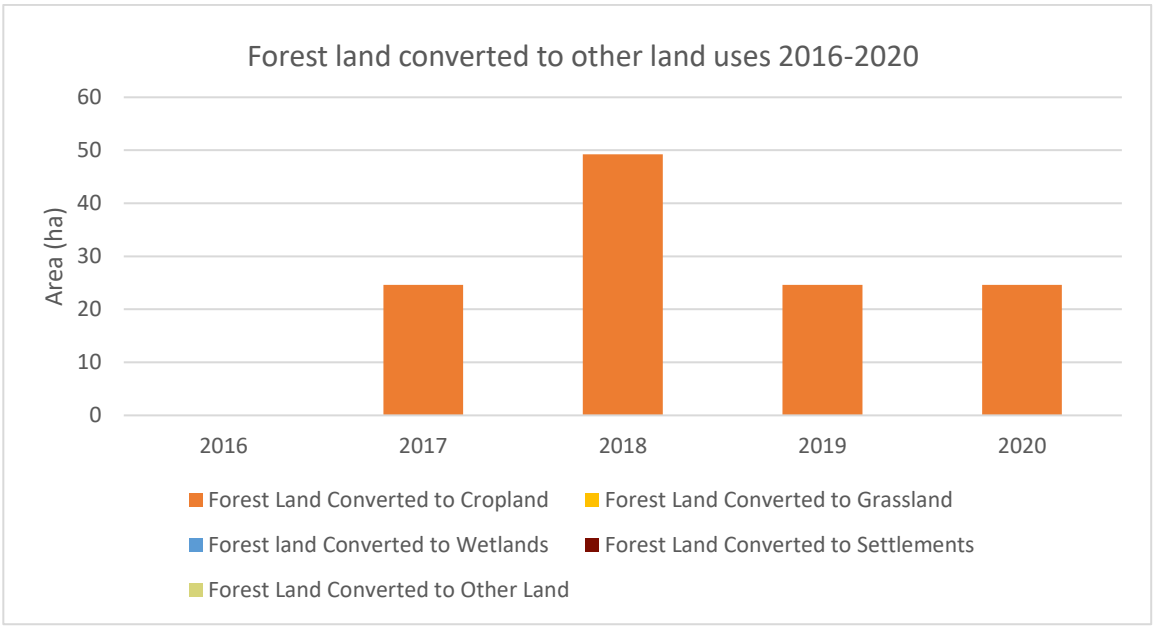


Figure 30 Forest land converted to other land uses 2016-20120 [Ha]

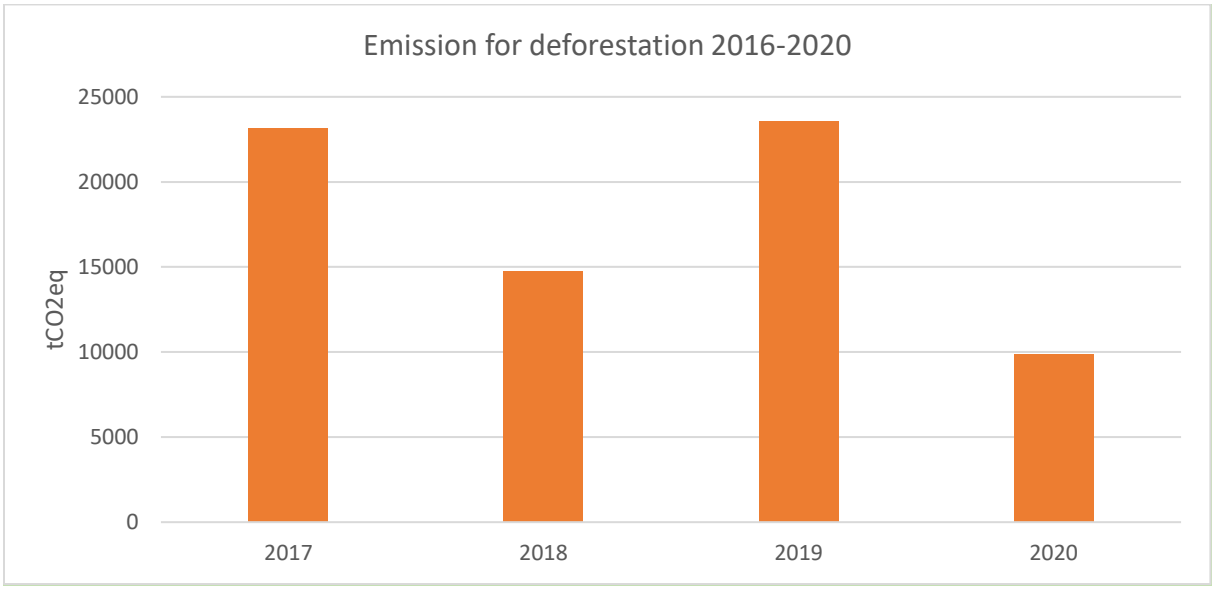


Figure 31. Emission from deforestation (2016-2020) in tCO2eq

Emissions from disturbances in forest lands remaining forest lands are due to **land clearing, agriculture and fires** (81%, 8%, 11%, respectively). Average emissions due to land clearing are 29,318 tCO2eq, agriculture 3,958tCO2eq and fires 2,912 tCO2eq. Detailed information is reported in table 38.

Previously, it was identified that disturbances did not happen on a constant basis but that there was a trend towards impacts in certain years, specifically when hurricanes and storms had been reported. For instance, the highest emissions from logging in 2007 of 5,486 tCO2eq, 2010 of 44,248 tCO2eq and 13,833 tCO2eq showed correlation with the effects of storms and hurricanes that happened in the same years (Hurricane Dean 2007, Hurricane Thomas 2010, Tropical Storm 2013). During the period of the current FRL/FREL disturbance due to land clearing happened every year from 2016-2020, disturbance due Agriculture happened in 4 years out of 5, and fires only happened in 2020. For this period also seems to be a correlation between hurricanes/storms/heavy rains and land clearing. The higher the losses due to hurricanes/storms/heavy rains, also higher losses due to land clearing.

Agriculture was also previously associated to storms and hurricanes because the shift in cultivation happens after landslide, storms, or hurricane where the farmers go in and plant fast-yield crops while the soil particles has been weakened; root crops would be planted instead of slow growing crops. Also, the farms near rivers had been inundated with silt and debris from landslides and hurricanes so farmers had to find other areas to plant. Moreover, due to unstable soil and the topography, which was impacted due to the storms, farmer will move the crops to more suitable planting areas. During the period of this FRL/FREL this correlation was not identified, possibly because no major hurricanes happened during this period.

Removals in forest lands remaining forest lands average -166,980 for undisturbed forest tCO2eq and -17,324 for disturbed forests. Removals are higher for the period of this FRL/FREL compared to the ones reported in the 1st FRL/FREL, which average was estimated as -141,187 for undisturbed forest tCO2eq and -5,217 for disturbed forests. Because of the storms, and landslides and floods associated, some of Saint Lucian forests, such as the semi-evergreen and deciduous forests, are under constant regeneration. Thus, these removals come from the gains after a natural or anthropogenic disturbance event, which mostly happened in years previous to the historical period of this FRL/ FREL. For instance, hurricane Thomas that affected the island in 2010 and the forest reserve and forests in general suffered tremendous damage due to several massive landslides which occurred during the passage of the storm. After Tomas Saint Lucia received funding to conduct several reforestation projects which had the aim of rehabilitating the landscapes degraded by Tomas.

- **The Australian Aid Project:** 200,000 trees were planted during the life of this project, within forested areas, on steep slopes and along degraded riverbanks.
- **Iyanola project:** This is a GEF funded project focused on the North-East region of Saint Lucia. The project is in its final stages having received an extension of a year. The project's Forestry component is rehabilitation of degraded lands. Approximately 200ha of lands are being rehabilitated.

- **EU Global Climate Change Alliance (GCCA) Project:** This project focused on the re-introduction of rare mango species in various communities on the island. There was also a focus on the rehabilitation of riverbanks
- **Roseau Watershed Restoration Project:** This project is focused on rehabilitation of degraded lands above Saint Lucia's only dam.

The Forestry Division has always been cognizant of its responsibility for the rehabilitation and reforestation of degraded lands. The Forest Management Plan 1992 – 2002 speaks to expansion of Forest Reserves and protected areas, reforestation of non-forested lands and planting of trees on steep slopes and riverbanks. The Forestry Division throughout the years have included in its yearly plans all those activities, generally focusing on areas impacted by weather events and severe deforestation.

Forest land in 2000 was 38891Ha, which equals to 63.1% with respect the total national area. It was noted a decrease of 0.6% with net loss of 345Ha by 2013. In 2016, forest area was 38,448 and by 2020 was 38,743. Due to the conversion of lands to Forest, the net loss between 2000 and 2020 was only 148 Ha (*Table 38)*

Table 35 Area of Forest lands (Disturbed and Undisturbed) [Ha]

Forest Type	2016	2017	2018	2019	2020
Montane – Cloud Forest	74	74	74	74	74
Montane – Rainforest	6,946	6,970	6,995	6,995	6,995
Seasonal Semi Evergreen	13,103	13,202	13,202	13,226	13,276
Seasonal Decidious	12,143	12,217	12,266	12,241	12,241
Dry Scrub	2,980	2,956	2,956	2,956	2,956
Littoral Evergreen Forest	2,980	2,980	2,980	2,980	2,980
Mangrove	222	222	222	222	222
TOTAL Ha	38,448	38,620	38,694	38,694	38,743
Cover Percentage with respect to National area	62.4%	62.7%	62.8%	62.8%	62.9%
Annual difference [Ha] (- loss, + gain)		172.4	73.9	0.0	49.3

In 2009 the Government of Saint Lucia vested an additional 1,899 ha of land into the forest reserve. This brought the area of forest reserve up from 7,408ha to 9,308ha (15.1% with respect to total national area), lands the Division has been reforesting and rehabilitating since then.

Removals from enhancement of carbon stocks average -85,838 tCO2eq. These removals come mostly from croplands, grasslands, wetlands and settlemts converted to Forest Lands. average Removals during this period are much higher that the ones reported in the 1st FRL/FREL estimated -3,401 tCO2eq. Detailed information is reported in table 38.

In the past, Saint Lucia was a major banana producer, and this saw lands which were typically left under forest cover because of topography, deforested, for banana production. The reserves themselves were also being threatened and the Forestry Division had to play a strong conservation role to ensure that the reserves were kept intact. However, in the late 80s to early 90s the banana industry collapsed. Saint Lucia saw a reversal of sorts, as lands which were used for banana production were abandoned and left to regenerate. The Forestry Division made some deliberate attempts to reforest some of these areas while others were left to natural regeneration.

Table 36. Area of other land uses converted to forestland

Land use conversion	2016	2017	2018	2019	2020
Cropland Converted to Forest Land		123	25	25	0
Grassland Converted to Forest Land		99	74	0	49
Wetland Converted to Forest Land		0	0	0	0
Settlement Converted to Forest Land		0	0	0	0
Other Lands Converted to Forestland		0	0	0	0
Total Annual Conversion [Ha]		222	99	25	49
Total cumulative conversion [Ha]		222	320	345	394

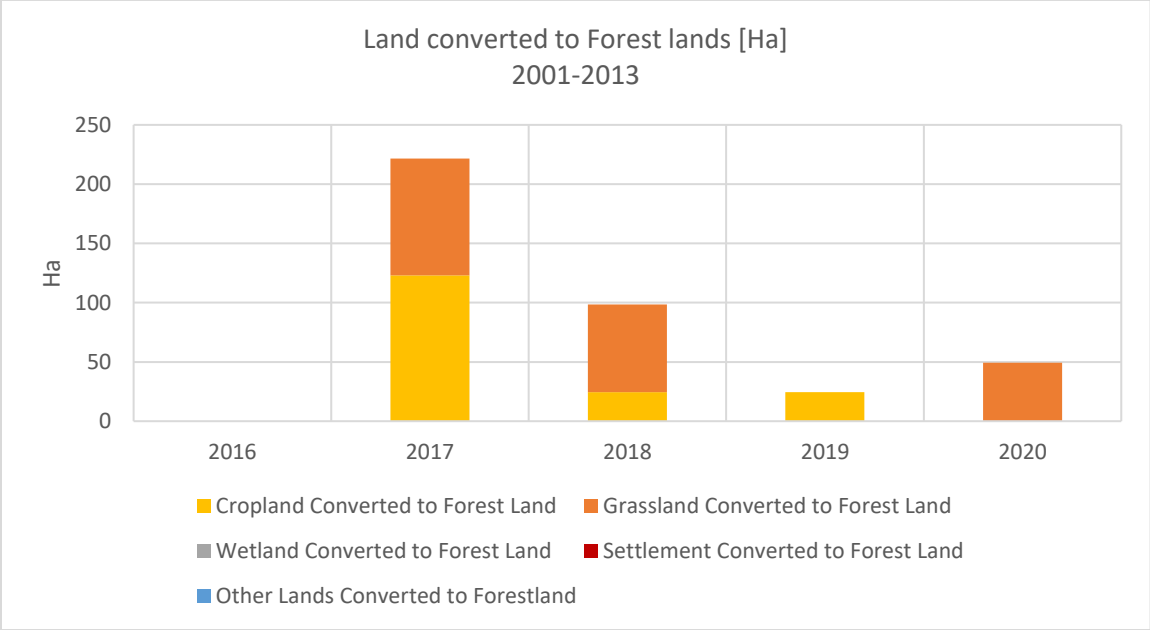


Figure 32 Land converted to Forest lands [Ha]

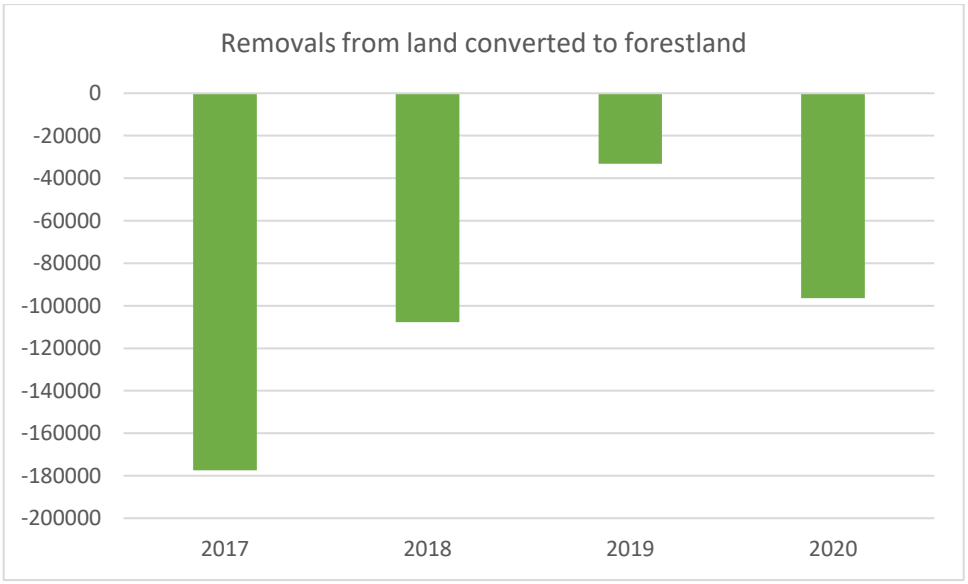


Figure 33. Removals from land converted to forestland

The Forestry Division has also done a significant amount of social engagement. These include the building of partnerships such as the "One Day on Earth" activity which took place on the 11 of November 2011. This activity helped to build a social coalition of about 60 groups which included NGOs, CSOs, environmental clubs and groups and other organizations such as the Rotary and Lion Clubs. These groups have participated in forest rehabilitation work in degraded areas and along denuded riverbanks.

Within the Forestry Division annual work plans, we regularly include working with organizations such as the Rotary club, schools, Atlantic Rally for Cruisers and other groups to conduct tree planting activities. The Division also works closely with the GEF Small Grants Program grantees where approved projects include significant reforestation/rehabilitation work. Because of these activities the Forestry Division has tailored its nurseries to become a cheap source of germplasm for both forest trees and tree crops for distribution to farmers and other interested parties.

Table 37. [NET BALANCE GAIN AND LOSS] Historical GHG emissions and Removals [t CO2-eq] [CO2, CH4, N2O] 2016-2020

Forest lands - Totals for Managed Lands (whole territory)											
Historical Antropogenic Emissions (+) and Removals (-) i[t CO2 eq] 2001-2020							-168,394	-337,030	-277,275	-199,802	-273,277
Reference	Category	Sub-category	Carbon Pool	Gas	Units	Equation	2016	2017	2018	209	2020
Section 1							-167,292	-167,197	-167,014	-166,705	-166,696
	Forest land	F >F (Undisturbed)	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.7	-167,292	-167,197	-167,014	-166,705	-166,696
	Forest land	F >F (Undisturbed)	Biomass (AGB+BGB)	CO2		Equation 2.9	-167,292	-167,197	-167,014	-166,705	-166,696
	Forest land	F >F (Undisturbed)	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.11	0	0	0	0	0
	Forest land	F >F (Undisturbed)	DOM	CO2	t CO2e	Equation 2.23	0	0	0	0	0
	Forest land	F >F (Undisturbed)	SOC	CO2	t CO2e	Equation 2.24	0	0	0	0	0
	Forest land	F >F (Undisturbed)	Non-CO2 emissions due to biomass burning (CH4)	CH4	t CO2e	Equation 2.27	0	0	0	0	0
	Forest land	F >F (Undisturbed)	Non-CO2 emissions due to biomass burning (N2O)	N2O	t CO2e	Equation 2.27	0	0	0	0	0

Reference	Category	Sub-category	Carbon Pool	Gas	Units	Equation	2016	2017	2018	209	2020
							-9,485	-15,505	-17,206	-23,522	-20,068
Section 2	Forest land	F >F (Disturbance, Sub Type)	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.7	-9,485	-15,505	-17,206	-23,522	-21,046
	Forest land	F>F Disturbance land clearing	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.9	-3,724	-3,898	-4,231	-4,763	-5,055
	Forest land	F>F Disturbance Hurricane/Storms/Heavy Rains	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.9					
	Forest land	F>F Disturbance Fire	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.9	-5,761	-5,693	-5,693	-5,579	-5,579
	Forest land	F>F Disturbance Agriculture	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.9	0	0	0	0	-462
	Forest land	F>F Disturbance land clearing	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.11	0	5,914	6,191	11,360	5,930
	Forest land	F>F Disturbance Hurricane/Storms/Heavy Rains	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.11					
	Forest land	F>F Disturbance Fire	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.11	0	0	1,091	1,820	0
	Forest land	F>F Disturbance Agriculture	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.11	0	0	0	0	4,020
	Forest land	F >F (Disturbance, Sub Type)	DOM	CO2	t CO2e	Equation 2.23	0	0	0	0	-9
	Forest land	F >F (Disturbance, Sub Type)	SOC	CO2	t CO2e	Equation 2.24	0	0	0	0	0
	Forest land	F >F (Disturbance, Sub Type)	Non-CO2 emissions due to biomass burning (CH4)	CH4	t CO2e	Equation 2.27	0	0	0	0	155
	Forest land	F >F (Disturbance, Sub Type)	Non-CO2 emissions due to biomass burning (N2O)	N2O	t CO2e	Equation 2.27	0	0	0	0	832

Reference	Category	Sub-category	Carbon Pool	Gas	Units	Equation	2016	2017	2018	209	2020
							-14424	**-177486**	**-107782**	**-33120**	**-96377**
Section 3	Forest land	C>F	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.15	-4,246	-69,528	-21,987	-18,546	-6,936
	Forest land	C>F	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.9	-4,246	-5,608	-5,836	-6,120	-6,051
	Forest land	C>F	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.11	0	0	0	0	885
	Forest land	C>F	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.16	0	-63,920	-16,151	-12,426	0
	Forest land	C>F	DOM	CO2	t CO2e	Equation 2.23	-945	-1247	-1299	-1362	-1346
	Forest land	C>F	SOC	CO2	t CO2e	Equation 2.24	-2186	-2956	-2961	-3296	-3296
	Forest land	C>F	Non-CO2 emissions due to biomass burning (CH4)	CH4	t CO2e	Equation 2.27	0	0	0	0	0
	Forest land	C>F	Non-CO2 emissions due to biomass burning (N2O)	N2O	t CO2e	Equation 2.27	0	0	0	0	0
	Forest land	G>F	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.15	-4,662	-57,034	-34,857	-6,370	-31,609
	Forest land	G>F	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.9	-4,662	-5,630	-6,370	-6,370	-6,937
	Forest land	G>F	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.11	0	0	0	0	0
	Forest land	G>F	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.16	0	-51,403	-28,487	0	-24,672
	Forest land	G>F	DOM	CO2	t CO2e	Equation 2.23	-1063	-1318	-1520	-1520	-1646
	Forest land	G>F	SOC	CO2	t CO2e	Equation 2.24	-973	-1343	-1677	-1677	-1852
	Forest land	G>F	Non-CO2 emissions due to biomass burning (CH4)	CH4	t CO2e	Equation 2.27	0	0	0	0	0
	Forest land	G>F	Non-CO2 emissions due to biomass burning (N2O)	N2O	t CO2e	Equation 2.27	0	0	0	0	0
	Forest land	F>W	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.15	0	-26,757	-28,487	0	-24,672
	Forest land	F>W	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.9	0	0	0	0	0
	Forest land	F>W	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.11	0	0	0	0	0
	Forest land	F>W	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.16	0	-26,757	-28,487	0	-24,672
	Forest land	F>W	DOM	CO2	t CO2e	Equation 2.23	0	0	0	0	0
	Forest land	F>W	SOC	CO2	t CO2e	Equation 2.24	0	0	0	0	0
	Forest land	F>W	Non-CO2 emissions due to biomass burning (CH4)	CH4	t CO2e	Equation 2.27	0	0	0	0	0
	Forest land	F>W	Non-CO2 emissions due to biomass burning (N2O)	N2O	t CO2e	Equation 2.27	0	0	0	0	0
	Forest land	S>F	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.15	-228	-17,183	-14,874	-228	-24,900
	Forest land	S>F	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.9	-228	-228	-228	-228	-228

	Forest land	S>F	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.11	0	0	0	0	0
	Forest land	S>F	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.16	0	-16,955	-14,645	0	-24,672
	Forest land	S>F	DOM	CO2	t CO2e	Equation 2.23	-51	-51	-51	-51	-51
	Forest land	S>F	SOC	CO2	t CO2e	Equation 2.24	-69	-69	-69	-69	-69
	Forest land	S>F	Non-CO2 emissions due to biomass burning (CH4)	CH4	t CO2e	Equation 2.27	0	0	0	0	0
	Forest land	S>F	Non-CO2 emissions due to biomass burning (N2O)	N2O	t CO2e	Equation 2.27	0	0	0	0	0
	Forest land	O>F	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.15	0	0	0	0	0
	Forest land	O>F	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.9	0	0	0	0	0
	Forest land	O>F	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.11	0	0	0	0	0
	Forest land	O>F	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.16	0	0	0	0	0
	Forest land	O>F	DOM	CO2	t CO2e	Equation 2.23	0	0	0	0	0
	Forest land	O>F	SOC	CO2	t CO2e	Equation 2.24	0	0	0	0	0
	Forest land	O>F	Non-CO2 emissions due to biomass burning (CH4)	CH4	t CO2e	Equation 2.27	0	0	0	0	0
	Forest land	O>F	Non-CO2 emissions due to biomass burning (N2O)	N2O	t CO2e	Equation 2.27	0	0	0	0	0

Reference	Category	Sub-category	Carbon Pool	Gas	Units	Equation	2016	2017	2018	2019	2020
							22807	**23157**	**14727**	**23545**	**9864**
Section 4	Cropland	F>C	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.15	-498	12,075	3,515	12,426	0
	Cropland	F>C	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.9	-498	-351	-147	0	0
	Cropland	F>C	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.11	0	0	0	0	0
	Cropland	F>C	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.16	0	12,426	3,662	12,426	0
	Cropland	F>C	DOM	CO2	t CO2e	Equation 2.23	0.0	1255.3	1343.4	1255.3	0.0
	Cropland	F>C	SOC	CO2	t CO2e	Equation 2.24	1296.8	1291.9	1334.0	1329.0	1329.0
	Cropland	F>C	Non-CO2 emissions due to biomass burning (CH4)	CH4	t CO2e	Equation 2.27	0	0	0	0	0
	Cropland	F>C	Non-CO2 emissions due to biomass burning (N2O)	N2O	t CO2e	Equation 2.27	0	0	0	0	0
	Grasslands	F>G	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.15	12,218	0	0	0	0
	Grasslands	F>G	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.9	0	0	0	0	0

	Grasslands	F>G	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.11	0	0	0	0	0
	Grasslands	F>G	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.16	12,218	0	0	0	0
	Grasslands	F>G	DOM	CO2	t CO2e	Equation 2.23	1255.3	0.0	0.0	0.0	0.0
	Grasslands	F>G	SOC	CO2	t CO2e	Equation 2.24	562.6	562.6	562.6	562.6	562.6
	Grasslands	F>G	Non-CO2 emissions due to biomass burning (CH4)	CH4	t CO2e	Equation 2.27	0	0	0	0	0
	Grasslands	F>G	Non-CO2 emissions due to biomass burning (N2O)	N2O	t CO2e	Equation 2.27	0	0	0	0	0
	Wetlands	F>W	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.15	0	0	0	0	0
	Wetlands	F>W	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.9	0	0	0	0	0
	Wetlands	F>W	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.11	0	0	0	0	0
	Wetlands	F>W	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.16	0	0	0	0	0
	Wetlands	F>W	DOM	CO2	t CO2e	Equation 2.23	0	0	0	0	0
	Wetlands	F>W	SOC	CO2	t CO2e	Equation 2.24	0	0	0	0	0
	Wetlands	F>W	Non-CO2 emissions due to biomass burning (CH4)	CH4	t CO2e	Equation 2.27	0	0	0	0	0
	Wetlands	F>W	Non-CO2 emissions due to biomass burning (N2O)	N2O	t CO2e	Equation 2.27	0	0	0	0	0
	Settlements	F>S	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.15	0	0	0	0	0
	Settlements	F>S	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.9	0	0	0	0	0
	Settlements	F>S	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.11	0	0	0	0	0
	Settlements	F>S	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.16	0	0	0	0	0
	Settlements	F>S	DOM	CO2	t CO2e	Equation 2.23	1029.5	1029.5	1029.5	1029.5	1029.5
	Settlements	F>S	SOC	CO2	t CO2e	Equation 2.24	5436.4	5436.4	5436.4	5436.4	5436.4
	Settlements	F>S	Non-CO2 emissions due to biomass burning (CH4)	CH4	t CO2e	Equation 2.27	0	0	0	0	0
	Settlements	F>S	Non-CO2 emissions due to biomass burning (N2O)	N2O	t CO2e	Equation 2.27	0	0	0	0	0
	Other lands	F>O	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.15	0	0	0	0	0
	Other lands	F>O	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.9	0	0	0	0	0
	Other lands	F>O	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.11	0	0	0	0	0
	Other lands	F>O	Biomass (AGB+BGB)	CO2	t CO2e	Equation 2.16	0	0	0	0	0
	Other lands	F>O	DOM	CO2	t CO2e	Equation 2.23	0	0	0	0	0
	Other lands	F>O	SOC	CO2	t CO2e	Equation 2.24	1506	1506	1506	1506	1506

	Other lands	F>O	Non-CO2 emissions due to biomass burning (CH4)	CH4	t CO2e	Equation 2.27	0	0	0	0	0
	Other lands	F>O	Non-CO2 emissions due to biomass burning (N2O)	N2 O	t CO2e	Equation 2.27	0	0	0	0	0

Therefore, net average of GHG emissions and removals in t CO_2e per year are:

Table 38. Historical emissions and removals in tCO2e

	Year	Gg CO_2 eq
HISTORICAL EMISSIONS AND REMOVALS	2016	-168,394
	2017	-337,030
	2018	-277,275
	2019	-199,802
	2020	-273,277

These emissions and removals result in an average of, which will be the estimated value projected for the Forest Reference Emissions Level:

Table 39. Forest Reference Emissions Level GgCO2e

	Year	Gg CO_2 eq
FRL/FREL	2021	**-251,156**
	2022	**-251,156**
	2023	**-251,156**
	2024	**-251,156**
	2025	**-251,156**

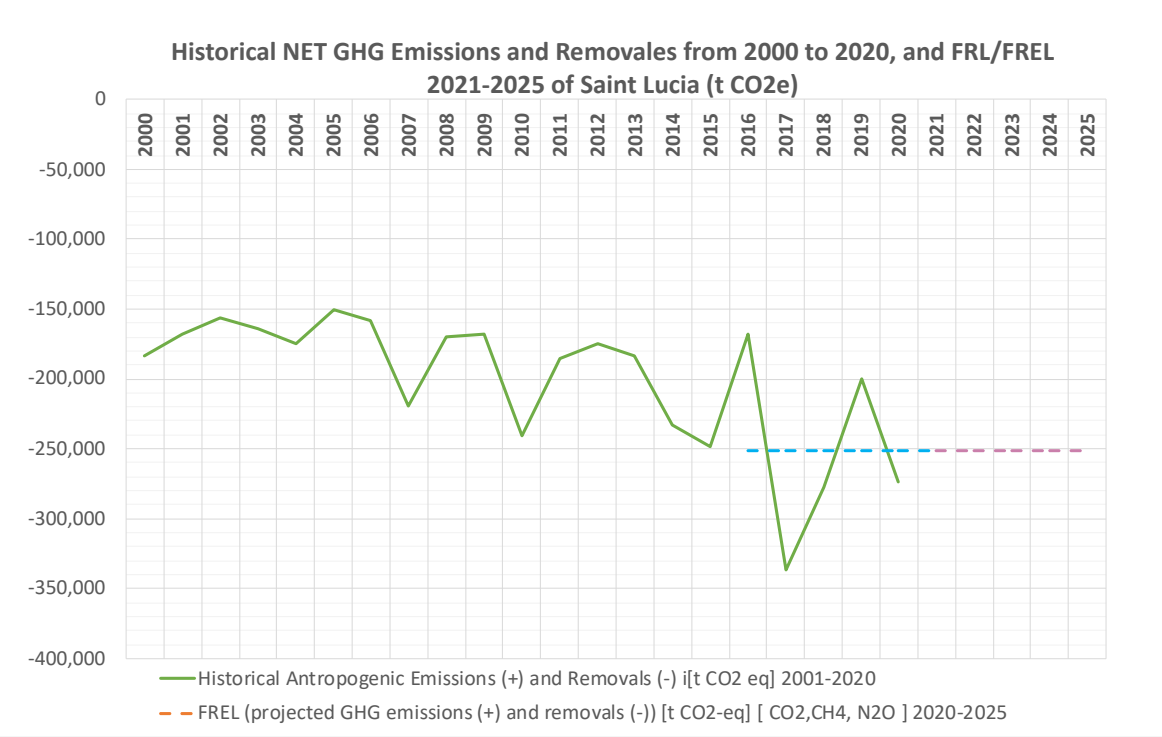


Figure 34. Historical NET GHG Emissions and Removals from 2000 to 2020, and FRL/FREL(2021-2015) of Saint Lucia (t CO2e)

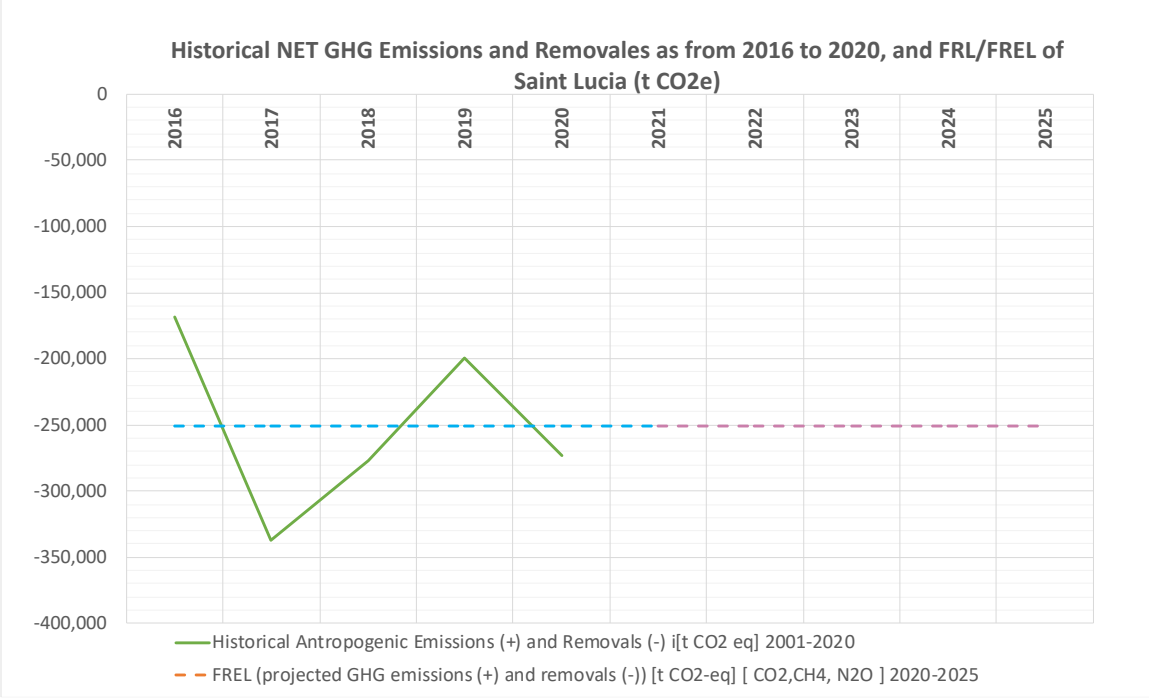


Figure 35 Historical NET GHG Emissions and Removals from 2000 to 2020, and FRL/FREL(2021-2015) of Saint Lucia (t CO2e)

7. UNCERTAINTY ANALYSIS

As indicated in the 2006 IPCC guidelines, uncertainty estimates are an essential element of a complete inventory of greenhouse gas emissions and removals. This why St. Lucia has determined the uncertainties of the emission factors, activity data and estimates of emissions and removals from the different categories used to estimate the FRL/FREL; also, identifying significant sources of uncertainty to help prioritize data collection and efforts to improve the GHG inventory and REDD+ reporting.

For the Uncertainty Assessment of the of the whole time series (2000-2017), Saint Lucia applied Approach 1 (Propagation of Error), as described in detail in the 2006 IPCC Guidelines (Volume 1, Chapter 3, section 3.2.3.1).

Using this approach to estimate uncertainty required estimates of the uncertainty for each input, as well as the equation through which all inputs are combined to estimate an output. The simplest equations include statistically independent (uncorrelated) inputs, and this is the assumption made throughout this analysis. For uncorrelated uncertainties, the Guidelines provide two equations: one when the quantities (emission factors, activity data and other estimation parameters) are to be combined by multiplication, reproduced below in equation 3.1 (IPCC 2006 GLs, V. 1, Ch3); and another where the uncertain quantities are to be combined by addition or subtraction, reproduced in equation 3.2 (IPCC 2006 GLs, V. 1, Ch3).

EQUATION 3.1
COMBINING UNCERTAINTIES – APPROACH 1 – MULTIPLICATION

$$U_{total} = \sqrt{U_1^2 + U_2^2 + \ldots + U_n^2}$$

Where,

U_{total} = is the percentage uncertainty in the product of the quantities
U_i = denotes the percentage uncertainties with each of the quantities

EQUATION 3.2
COMBINING UNCERTAINTIES – APPROACH 1 – ADDITION AND SUBTRACTION

$$U_{total} = \frac{\sqrt{(U_1 \bullet x_1)^2 + (U_2 \bullet x_2)^2 + \ldots + (U_n \bullet x_n)^2}}{|x_1 + x_2 + \ldots + x_n|}$$

Where,

U_{total} = is the percentage uncertainty in the sum of the quantities (expressed as a percentage)
U_i = is the percentage uncertainty associated with source/sink i
x_i = is the emission/removal estimate for source/sink i

Note:The team of national experts is working on the development of the uncertainty analysis. Currently there is progress with respect to the emission factors used but still missing some values. The country's team of experts is also evaluating a method that is consistent with the land representation method that Saint. Lucia has chosen. Once this is defined, the error propagation method will be implemented, which will be included in the modified version.

8. QUALITY ASSURANCE/ QUALITY CONTROL

Activity Data:

Several rounds of Quality Control took place while developing the LULUC Assessment. Plots misidentified were corrected by the National Interpreters (6) and two experts leads from Panama and Belize. A Matrix of impossible transitions of Land Use and Disturbances was developed before the assessment, as tool for identification of errors during. This matrix was developed during a workshop on August 25th – 28th 2019, where 17 Saint Lucian national experts from the Departments of Forestry, Planning, Sustainable Development, Veterinary, Economic Development, Agriculture Engineering, Customs and Excise, and Water Resource Management Agency agreed on main Land Uses, Possible and impossible Land Use changes in the country and possible disturbances based on the land use. The final database was then reviewed several times by the technical experts of the Coalition for Rainforest Nations, where misidentified plots were corrected by the National Interpreters.

In addition, during the QC, some plots were flagged, and the Forestry team went to field for ground truthing. 77 plots were assessed. From this list, 33 remained in the same land use category, and 44 were corrected *(See Excel > Annex VI. Ground Truthing)*.

Table 40. Number of plots assessed.

Row Labels	Count of alu_2018_subdivision_label
Dry Scrub	37
Littoral Evergreen Forest	16
Montane – Cloud Forest	4
Montane – Rainforest	10
Seasonal Deciduous	1
Seasonal Semi Evergreen	4
Urban Areas	1
Woody Settlement	4
Grand Total	**77**

[26] Photo: https://caribbeanwarehouse.co.uk/blog/2021/08/best-excursions-for-nature-lovers-st-lucia/

FRL/FREL:

Quality Control took place by 5 members of the Forestry Division and technical experts of the Coalition for Rainforest Nations. The emissions and removals estimations done in Excel sheet were checked using spot checks of formulas. Key points assessed were the implementation of the IPCC Principles (Transparency, Accuracy, Consistency, Comparability, Completeness), compliance of UNFCCC Decisions (Annex III of Decision 12/CP.17) and correct implementation of IPCC Guidelines.

9. IMPROVEMENTS IDENTIFIED

The priority improvements for the Forest sector are as follows:

- New NFI and collection of field information aimed at estimating carbon in its five reservoirs.
- Emissions factors in forestland could be improved by local data about biomass losses and growth rates in disturbed and undisturbed areas.
- Collection of local forest wood density values.
- Biomass burning activity data and emission factors collection could be improved by using local field data
- Data on HWPs could be collected in the future, to estimate emissions and removals in this pool.

[27] Photo: https://www.celebritycruises.com/blog/st-lucia-food

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