DOMINICA FOREST REFERENCE LEVEL 2018 -2025

2022

CONTRIBUTORS

Ministry:	Ministry of Environment, Rural Modernization & Kalinago Upliftment
Division:	Forestry, Wildlife and Parks
National REDD+ Coordinator	Mr. Minchinton Burton
Lead Expert:	Bradley Guye, B.Sc
Technical Experts:	Ricardo Dominique Nigel Harve Felix Eugene Sheldon Simmon Cyrille John Francisco Maffei Nekelia Gregoire Machel Sulton
Collaborators:	Min. of Blue & Green Economy – Division of Agriculture
Support Group:	Coalition for Rainforest Nations (CfRN)

[1] Photo: https://immigrantinvest.com/en/insider/dominica-sustainable-development-goals-2021/

ACKNOWLEDGMENTS

We wish to first of all express deepest gratitude to the Coalition for Rainforest Nations, through the Reporting for Results-based REDD+(RRR+) Project, for providing the financial, technical and material support to enable Dominica to undertake this assignment. Special mention must be made of Lead GHG and REDD+ expert Mrs. Milena Nino and her wonderful team for their dedicated guidance and persistent commitment over the last two plus years in working with our team in this undertaking. We couldn't have asked for a better team of collaborators in this endeavor.

Appreciation also must be extended to the Government of the Commonwealth of Dominica, particularly our Honorable Minister, Permanent Secretary and the rest of the administrative and technical staff at the Ministry of Environment, Rural Modernization and Kalinago Upliftment for the overall support in advancing this important initiative.

To the various government ministries and departments who collaborated in this venture, especially staff within the Ministries of Agriculture, Physical Planning, and The Lands and Surveys Division, we are indeed very thankful.

Last, but by no means least, much recognition must be given to the hard work and dedication of the staff at the Forestry, Wildlife and Parks Division under the guidance of the Director of Forestry; especially to the Focal Point at the Division, Forest Officer (Ag.) Mr. Bradley Guye and the rest of the technical and field staff who participated in the realization of this memorable project.

[2] https://www.state.gov/countries-areas/dominica/

[3]

LIST OF ABBREVIATIONS AND ACRONYMS[4]

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

[4] Photo: https://thecommonwealth.org/our-member-countries/dominica

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
SIDS	Small Island Developing States
TNC	Third National Communication
TOA	Top of Atmosphere
UNFCCC	United Nations Framework Convention on Climate Change

TABLES OF CONTENTS

[5] Photo: https://thecommonwealth.org/our-member-countries/dominica

LIST OF TABLES

LIST OF FIGURES

CONTEXT[6]

In 1994, the Commonwealth of Dominica ratified the *United Nations Framework Convention on Climate Change* (UNFCCC)[7], hereinafter referred to as "the Convention", whose ultimate objective is to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system; and within a sufficient timeframe to facilitate natural adaptation of ecosystems, ensure food security and sustainable economic development.

At the 21st Conference of Parties (COP21)[8], a landmark agreement was reached to combat climate change and to accelerate and intensify actions and investments needed for a low carbon future. The Paris Agreement, which builds upon the Convention, has an overall objective to strengthen the global response to the threat of climate change by limiting global temperature rise this century to well below 2°C above pre-industrial levels and to pursue efforts to further limit the temperature increase to 1.5°C through ambitious mitigation actions. In addition, the Agreement establishes measures to increase the ability of nations to adapt to the adverse impacts of climate change and foster climate resilient development through consistent finance flows.

In 2015, in accordance with relevant paragraphs of Decisions 1/CP19[9] and 1/CP20[10] towards achieving the ultimate objective of Article 2 of the Convention, the Government of Dominica committed through its Intended Nationally Determined Contribution (INDC)[11], to a progressive reduction of total greenhouse gas emissions below 2014.

Consistent/in accordance with Decision 18/CMA.1[12] and its annex (the Katowice Climate Package), as well as Article 13 under the Agreement, Dominica provides information under the *Enhanced Transparency Framework*[13] (ETF), which details a set of Modalities, Procedures and Guidelines (MPGs) to build trust and confidence; and strengthen the global response to the threat of climate change. Regarding the forest sector, Dominica also intends to provide information as indicated in Article 5 of the Paris Agreement for REDD+ (Reducing Emissions

[6] Photo: https://discoverdominica.com/en/places/68/trafalgar-falls
[7] https://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveng.pdf
[8] https://unfccc.int/documents/184656
[9] https://unfccc.int/documents/8106
[10] https://unfccc.int/documents/8611
[11] https://www4.unfccc.int/sites/ndcstaging/Pages/LatestSubmissions.aspx
[12] https://unfccc.int/documents/193408
[13] https://unfccc.int/process-and-meetings/transparency-and-reporting/reporting-and-review-under-the-paris-agreement

from Deforestation and Forest Degradation) following the guidance developed since COP13 ensured transparency 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.

Small Island Developing states (SIDS) like Dominica, are on the frontlines of the climate crisis and are among the most vulnerable to its adverse impacts, but at the same time are at the forefront of climate actions. Dominica has taken national, sub-national and sectoral approaches towards its transition to a carbon-neutral, green, climate-smart and climate-resilient nation, with a cross-cutting emphasis on accessing climate change finance. Dominica has established a strong track record for the continual development, implementation and communication of policies and strategies to support climate change adaptation, mitigation, and resilience, with a focus on nature-based solutions.

The Government of Dominica considers it to be an important part of its mission to lead a process of collaboration with others with a view of preserving the nation's forests, rivers, and eco-tourism product, preserving the marine environment and the country's biodiversity; and popularizing even as preserve the nature island concept and brand. It is Government's intention to make an active and deliberate contribution to sustainable development of the natural and built-in environment, giving special attention to the larger environmental issues such as biodiversity, land degradation, climate change and the emission of GHG gases that cause global warming. We will give high priority to pursuing policies and programmes that are consistent with well-researched proposals and programmes developed by the international community and are consistent with our countries' needs and capacities.

The Government will contribute to ensure that in his or her personal behaviour, a consciousness and pride in our Nature Isle is manifested by every Dominican. It is Government's policy that the Nature Isle will take the lead in enshrining green principles as the guide to our national planning, and to inform initiatives in all sectors.

Pursuant the commitments set by the Government; **Dominica** has the honor to present to you the Forest Reference Level for the years 2018-2015 of the country at the national level to be evaluated during the period of 2022.

FRL KEY ELEMENTS[14]

Modalities for FRL according to 12/CP.17

- **Paragraph 7**. The FRL presented by Dominica 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.** Dominica developed a **single database for the National GHG Inventory and the FRL**. 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.

- **Paragraph 9**. In this submission, Dominica includes information and rationale on the development of the FRL and how the national circumstances were considered.

- **Paragraph 10**. In this submission, Dominica presents an improvement plan, which considers the gradual improvement of methods.

- **Paragraph 11**. Dominica's FRL is presented at the national level.

- **Annex, chapeau**. the information provided by Dominica 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[15]. 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 terms of activities covered, historical emissions and removals are considered for Forest land remaining Forest lands, and conversions to and from Forest land. In essence, this is equivalent to measuring and monitoring all activities in the FRL. However, due to specific country circumstances, only conservation, sustainable forest management and enhancement of carbon stocks are included.

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

---

[14] Photo: https://www.experience-dominica.com/post/the-kalinago-people

[15]https://docs.google.com/document/d/1R4EN581a3W0TBKJqJrshzSAnEBfiWyA5/edit?usp=sharing&ouid=102526969717149054724&rtpof=true&sd =true

REDD+ ACTIVITIES

As indicated in the Decision 1/CP.16, paragraph 71, Dominica has decided to develop a **national** forest reference level (FRL) in accordance with national circumstances and as a *benchmark* to assess the country's performance in implementing 3 of the 5 the activities referred to in decision 1/CP.16, paragraph 70: **conservation**, **enhancement of forest carbon stocks and sustainable management of forest.**

Definitions for the assessment of the FRL required defining key REDD+ terminologies within the Dominican national context. The definitions for forest and the three (3) REDD+ activities considered are:

Forest

Forest is defined as forest lands with a canopy cover equal or higher than 60%, with a minimum area extension of 1 ha and woody vegetation of minimum 3m height or higher, including temporary unstocked areas with the potential to reach the forest definition. There are seven forest types in the island: elfin forest, cloud forest, mountain rainforest, semi-evergreen forest, deciduous forest, dry scrub forest and littoral forests which vary depending on altitude and location. Characteristics of each forest type are described in section 7.1.

Conservation

Refers to the areas of forest lands remaining forest lands under the Protected Areas System. Conservation also includes, as stated in the National Land Use Policy and Plan, any areas identified as sensitive zones for natural resources management that are considered as "specially conserved areas". The priority of the system of protected areas is to effectively manage forests to conserve the natural biodiversity and function, and contributes to the sustainable socio-economic development, resilience and well-being of all citizens and users[17]. However, since hurricane Maria in 2017, these areas were significantly affected and now these are prioritized for natural regeneration.

Sustainable management of forest

Refers to the areas of forest lands remaining forest lands under management strategies, within the Protected Areas System, in particular in the two forest reserves (Central Forest Reserve and Northern Forest reserve). Since hurricane Maria in 2017, these areas are prioritized for restoration, rehabilitation,

[16] Photo: https://www.experience-dominica.com/post/the-kalinago-people
[17] Dominica Protected Areas System Plan Report.

and reforestation activities. Sustainable management of forest also refers to restoration, rehabilitation, and reforestation activities on farmlands and unallocated state lands[18].

Enhancement of forest carbon stock

Refers to lands converted to forest lands, and lands utilizing agroforestry practices that enhance forest carbon pools.

For the development of the FRL, Dominica selected a **Land Based Approach**, which means that the REDD+ activities were assessed all together, and therefore, no specific FRLs were developed by activity, aiming at environmental integrity. Therefore, REDD+ results will be evaluated as an integral outcome of national activities. Table 1 depicts the source category and associated REDD+ Activity using the IPCC suggested structure. Hence, this directly defines each REDD+ activity for Dominica.

Table 1. Depicting associated REDD+ activity and source category

Associated REDD+ Activity	Source Category
Conservation	Forest land Remaining Forest Land, disturbed, under management for natural regeneration.
Sustainable management of forest	Forest land remaining forest land, disturbed, under management for assisted regeneration.
Enhancement of C Stocks	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

Deforestation, explained as forest lands converted to other lands (croplands, grasslands, wetlands, settlements, and other lands) and **Forest degradation**, explained as Forest land remaining forest land affected by human disturbances (logging and fires) and natural disturbances (hurricanes) were accounted and are reported for the years 2000 to 2017. The reason for excluding deforestation and forest degradation as REDD+ activities, is because in 2017 Dominica lost about 90% of their forest cover in the forest lands[19], due to the hurricane Maria, and the remaining 10% was still affected leaving mostly the understory. Right now, Dominica efforts are focused on restoring the forest lands.

[18] These are state lands where no specific land used have been assigned.
[19] Post-Disaster Needs Assessment Hurricane Maria September 18, 2017.https://www.gfdrr.org/sites/default/files/publication/Dominica_mp_012418_web.pdf

CONSISTENCY WITH THE NATIONAL GHG INVENTORY[20]

In march 2020, Dominica submitted its Third National Communication which reports on the period from 2005 until the end of 2017, and includes an assessment of greenhouse gas (GHG) emissions during this time, together with an update concerning activities that have been undertaken to reduce Dominica's carbon footprint while building climate resilience, in part though measures to implement Dominica's Low Carbon Climate Resilient Development Strategy including though building the legal and institutional capacity to manage impacts from climate change.

For the forest and land use sector, applicable data for Dominica's forest was not available, with no recent census or forest inventory having been undertaken since 1987. This resulted in basing the GHG inventory on default values from to the FAO Global Forest Resource Assessment data (FAO STAT). The values from FAOSTAT 2000, could not be utilized to calculate the changes in area for the six IPCC land use categories because FAO's categories were different from that described in the IPCC guidelines. Given this information was the only complete land use data source information available for Dominica, Approach 1 was chosen as the best suited methodology for the analysis, because it does not require detailed information on land use changes. For the Emission Factors, Dominica fell into the category of having little or no country specific data available and thus Tier 1 was followed, using 2006 IPCC defaults values.

Based on these needs, during 2020-2021, the Forestry Division took the lead and developed a national FOLU-GHG Inventory including GHG emissions and removals for all Intergovernmental Panel on Climate Change categories and subcategories at national level, which includes land remaining in same category and conversions to other land uses, considering all lands as managed (2006, 2019 IPCC). It includes the pools above-ground biomass, below-ground biomass, dead wood, and soil organic Carbon. Harvested wood products were excluded due to lack of information.

The information on Activity Data used was obtained from land use and land-use change assessments, which were conducted on the basis of a sampling approach (2006 IPCC, V4, Ch3 approach 3), in which the land-use was determined for each year of the time series 2000 – 2017, derived using the FAO Collect Earth tool. The information on Emission Factors (EFs) was obtained from regional research, scientific literature, and default values of the 2006 IPCC Guidelines and 2019 Refinements to the 2006 IPCC Guidelines. The GHG Inventory was

[20] Photo: https://www.experience-dominica.com/post/the-uniqueness-of-dominica-s-natural-assets

developed using the Foundational Platform calculation tool developed by the Coalition for Rainforest Nations. This tool allows extracting the forest-related information from the GHG inventory to construct the Forest Reference Level and update the National Determined Contributions update report, using the same data, methods, assumptions, and projections, which ensures full consistency among the reports. This GHG Inventory will be included in the next report to the UNFCCC (1 Biennial Update Report or 1 Biennial Transparency Report). A copy of this FOLU-GHG Inventory is attached to this report[21]. This approach meets the requirements of Decision 12/CP.17, paragraph 8 and decision 4/CP.15, paragraph 7.

The information of this updated GHG Inventory (2021) has been already used for the estimations of the Updated National Determined Contributions report (2021).

[21]https://docs.google.com/document/d/1R4EN581a3W0TBKJqJrshzSAnEBfiWyA5/edit?usp=sharing&ouid=102526969717149054724&rtpof=true&sd=true

FOREST REFERENCE LEVEL OF DOMINICA


[22]

5.1Outline of Forest Reference Level (2018-2025)

The current national FRL proposed by Dominica is the net balance of greenhouse gas (GHG) emissions and removals in Forest lands remaining forest lands undergoing natural and assisted regeneration, as well as lands converted to Forest Lands after the hurricane Maria in 2017. 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[23]. All lands were considered as managed. It includes the pools above-ground biomass, below-ground biomass, dead organic matter, and soil organic carbon. Dominica acknowledges Decision 4 CP/15, paragraph 7. where "*developing country Parties in establishing forest reference emission levels and forest reference levels should do so transparently taking into account historic data*"; thus, an annual historical analysis from 2000 to 2017 of GHG emissions and removals for Forest land remaining Forest lands undisturbed, Forest land remaining Forest lands disturbed by human (fires and logging) and natural events (hurricanes), and conversions to and from Forest Lands is included; however, only as complementary information, because as mentioned previously, historical data does not represent the future expected conditions; therefore, Dominica is adjusting for national circumstances, as also indicated in the same decision (4 CP/15, p7).

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, in which the land-use condition, including natural and/or human disturbance, was determined for each year of the time series 2000 - 2018. Forest land was stratified by forest type (Montane Forest -Elfin, Cloud montane, Montane Rainforest-, Seasonal Forest -Semi-Evergreen, Semi-Deciduous-, Littoral Evergreen, Dry Scrub). Croplands are reported as annual and perennial crops. Grasslands and Settlements are reported as Woody and Non-Woody. Wetlands do not have further sub-classification and Other lands divided in Other Lands and Mining (see section 7.1).

The information on wood removals was derived from the Collect Earth assessment as cover loss instead of volume loss, as the tool does not allow that estimation. Losses due to Disturbances were also identified including Hurricanes, Fires, Logging and Shifting Cultivation.

[22] Photo: https://repeatingislands.com/2017/09/28/agriculture-sector-in-dominica-destroyed-by-hurricane-maria/
[23] This country specific tool is similar to the IPCC working sheets but adapted to capture country specific circumstances.

The methods selected allowed to fulfill the IPCC TACCC principles:

- Transparent, as data sources, definitions, methodologies, and assumptions are clearly described.
- Accurate, as it represents land-use categories and conversions between land-use categories, as needed to estimate carbon stock changes and GHG emissions and removals.
- Consistent, as it allows to represent land-use categories consistently over time, without being unduly affected by artificial discontinuities in time-series data.
- Complete, as all land within the country was included.
- Comparable, as it allowed a full time series analysis using same definitions, methodologies, and assumptions.

5.2 Carbon pools

GHG historical analysis (2000 – 2017) and FRL (2018 – 2025) include the carbon pools: **above-ground biomass**, **below-ground biomass**, **dead organic matter, and soil organic carbon.**

Above-ground biomass was obtained from the National Forest Inventory from Saint Lucia (2009), as both islands share the same forest types and there is no recent Forest inventory has taken place in Dominica. Below-ground biomass and dead organic matter were obtained from default values of the 2006 IPCC Guidelines, 2019 Refinement to the 2006 IPCC Guidelines. Soil organic carbon was obtained from the FAO Global Soil Organic Carbon Map -GSOCmap-, from FAO (2019).

5.3 Gases Included

Carbon dioxide (CO_2), **methane (CH_4)** and **nitrous oxide (N_2O)** emissions from biomass burning in forest land categories are included. 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)**.

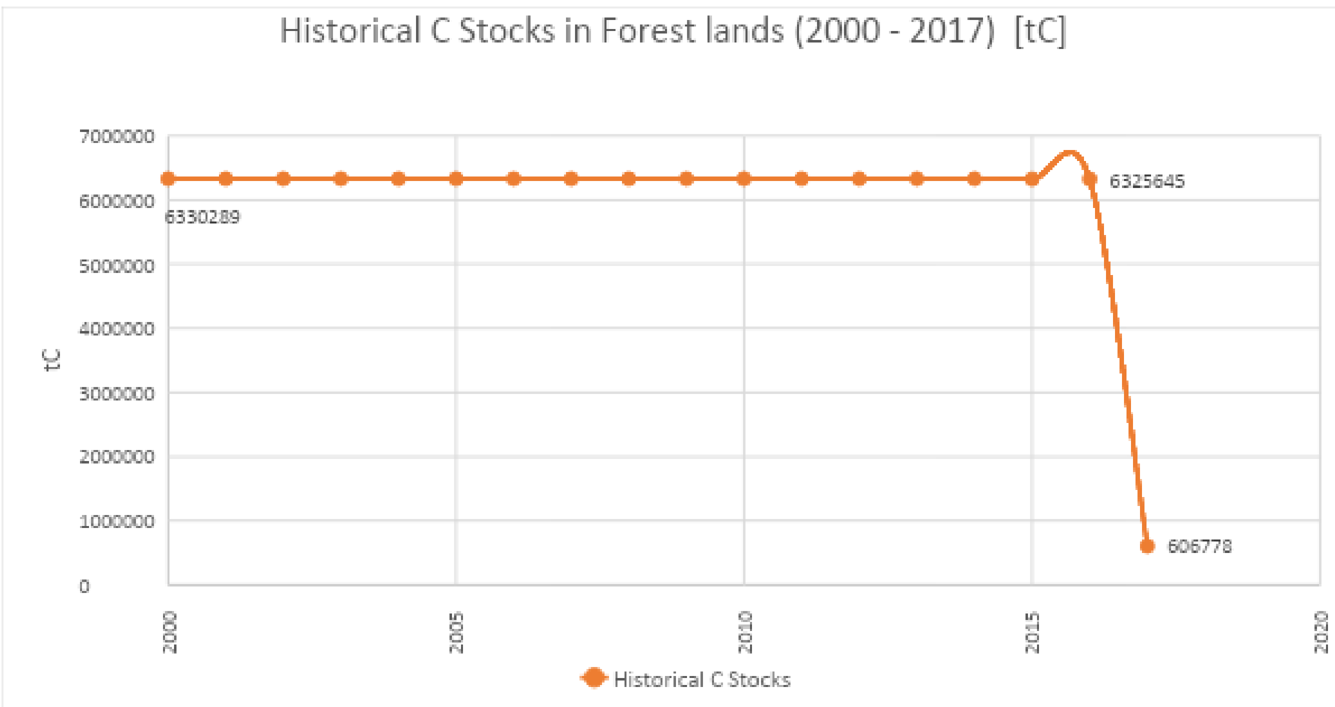
5.4 Scale

The scale of the inventory is National. The total land area is 750 square kilometers (km2) (75000 Ha). The country is divided into 10 parishes. A systematic sampling grid of 1605 plots located 750m distance apart was used to allow a national coverage analysis of the island.

5.5 Reference Period

The case of Dominica is kind of unique. After Hurricane Maria in 2017, the land use assessment indicated that depending on the location and forest type, about 85% to 95% of the forest was lost. Therefore, despite a historical annual analysis of GHG emissions and removals was developed, it cannot be used as benchmark. This means, that from an estimated 6.3 million tC of stock in the forest previous to the hurricane, it went down to approximated 600.000 tC of stock (figure 1). As a result, all previous conditions to 2017 do not apply; therefore, from 2018, forest lands present new conditions due to the loss of the majority of the forest cover. The country considers fundamental to build the reference level based on the post-hurricane conditions in 2018; particularly, considering the remaining forest cover area, which was about 15% to 25% compared to 2017 before the hurricane (figure 1).

Figure 1 Historical carbon stocks in forest lands (2000 - 2017)



5.6 Definition of the FRL

Historical GHG emissions and removals average 1,101,680 tCO2 e from 2001 to 2017. However, this average does not represent future expected Dominica emissions and removals dynamics, because previous to the hurricane, Dominica was a net sink with an average of -90,940.4 tCO2e removals (average 2001-2016). It is because of the hurricane Maria 2017, where emissions were approximated 20 million tCO2e, that Dominica resulted with more emissions than removals. In addition, as these emissions and removals were based on a forest that does not exist anymore as it was known, and the post-hurricane conditions are different, the historical average cannot be used to represent the expected future emissions or removals (table 2).

Table 2 Forest related net balance of GHG emissions and removals 2001-2017 [tCO2e]

Year	Net balance emissions and removals [tCO2e]	Net balance emissions and removals in F>F (undisturbed) [tCO2e]	Net balance emissions and removals in F>F (disturbed) [tCO2e]	Net balance emissions and removals in land converted to F [tCO2e]	Net balance emissions and removals in F converted to other land uses [tCO2e]
2001	-110,612	-110,612	0	0	0
2002	-110,612	-110,612	0	0	0
2003	-110,612	-110,612	0	0	0
2004	-110,612	-110,612	0	0	0
2005	-97,787	-110,079	0	0	12,291
2006	-80,606	-110,079	0	0	29,473
2007	-105,128	-110,079	0	0	4,951
2008	-105,128	-110,079	0	0	4,951
2009	-105,128	-110,079	0	0	4,951
2010	-105,128	-110,079	0	0	4,951
2011	-90,377	-109,723	0	0	19,346
2012	-49,053	-109,266	0	0	60,213
2013	-97,396	-109,266	0	-29,031	40,901
2014	-60,511	-108,911	0	-1,541	49,941
2015	-23,274	-107,718	17,744	-1,541	68,240
2016	-93,085	-107,439	-545	-29,014	43,913
2017	20,183,601	-279	20,107,923	203	75,754
Average	**1,101,680**	-103,266	1,183,831	-3,584	24,699

After the hurricane, some forest areas started to regenerate naturally; in other forest areas, restoration, rehabilitation, and reforestation projects have been necessary, for which the Government has drafted multiple projects to support and enhance the forest recovery. As a result, the selected baseline considers only the expected C removals due to post-disturbance forest regrowth as natural regeneration starting in 2018, along with the expected C removals of lands converted to forest lands, using the historical average, calculated as -648,028 tCO2 e /yr (table 3).

Table 3 Expected net removals in forest lands remaining forest lands and land converted to forest lands [tCO2e]

Year	Expected net removals in F>F and land converted to F [tCO2e / yr]
2018	-648,028
2019	-648,028
2020	-648,028
2021	-648,028
2022	-648,028
2023	-648,028
2024	-648,028
2025	-648,028
Sum	**-5,184,222**

Therefore, Dominica will use the post-hurricane C stock of 606,778 tC as benchmark for assessing the country's performance in implementing the activities referred to in decision 1/CP.16, paragraph 70 (figure 2).

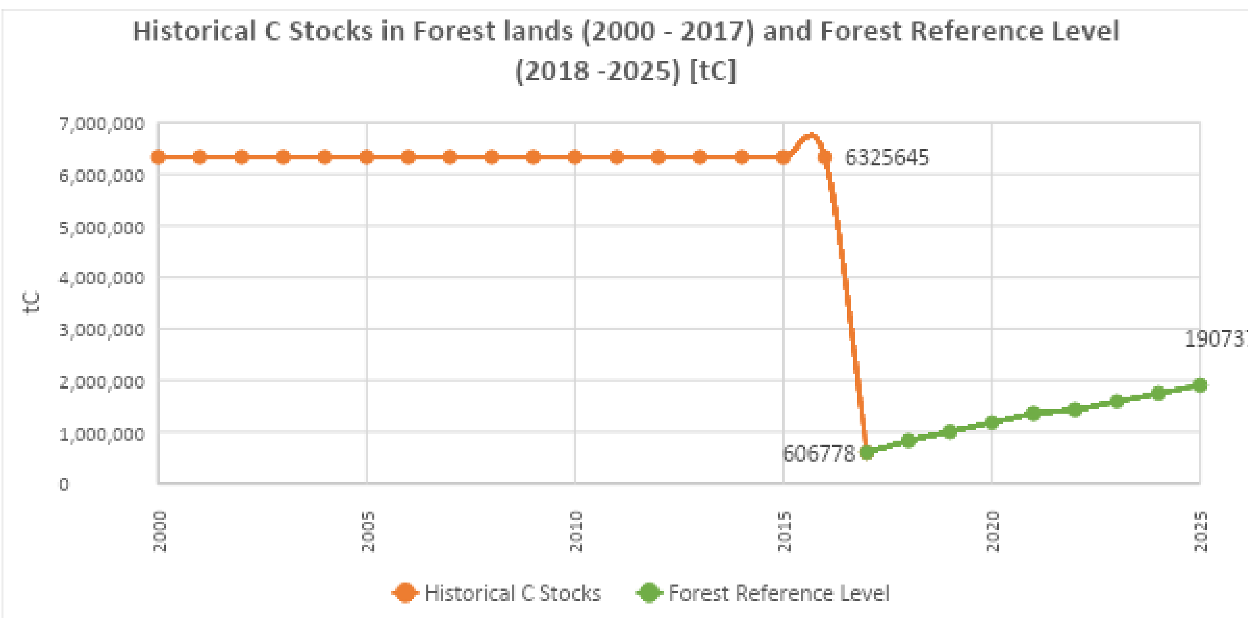


Figure 2 Historical C Stocks in Forest lands (2000 - 2017) and Forest Reference Level (2018 -2025) [tC]

FOREST SECTOR BACKGROUND[24]

6.1 Forest sector Background

Dominica is considered one of the wettest islands in the Caribbean with its inland receiving on average more than 10,000mm of rainfall annually. The islands rugged and steep terrain gives rise to plenty of perennial streams, rivers, lakes and waterfalls. These coupled with its high rainfall, results in extremely lush vegetation resulting in sixty-five percent of the island area covered by natural vegetation. This lushness together with the island's terrain, provides for areas of high biodiversity and relatively intact ecosystems giving Dominica its reputation as the "Nature Island of the Caribbean".

Dominica's island geography and complex geology have created unique habitats and high species diversity. More than 60% of the island is covered with lush forest and its fauna includes: 179 species of birds, 55 species of butterflies, 20 species of crabs, 11 species of crayfish and shrimp, 3 species of amphibians, 17 species of reptiles (4 snakes), 18 mammal species, 11 stick insect species, and around 45 species of inland fish. It is home to a number of global important species, housing a critically endangered toad and an endangered frog, bird, freshwater fish, and grass species. In addition, it comprises two island endemic bird species, 5 endemic reptiles, one endemic frog species and one endemic butterfly as well as a number of lesser Antilles and regional endemics.

Based on the last land use and land use change assessment (2020) done by the Forestry, wildlife and parks Division, Dominica in 2017 had 57.710 Ha of remaining Forest, mostly montane rainforest 28.271 Ha followed by semi-evergreen forest 10.28- Ha and Coastal Forest 12.150 Ha (table 4).

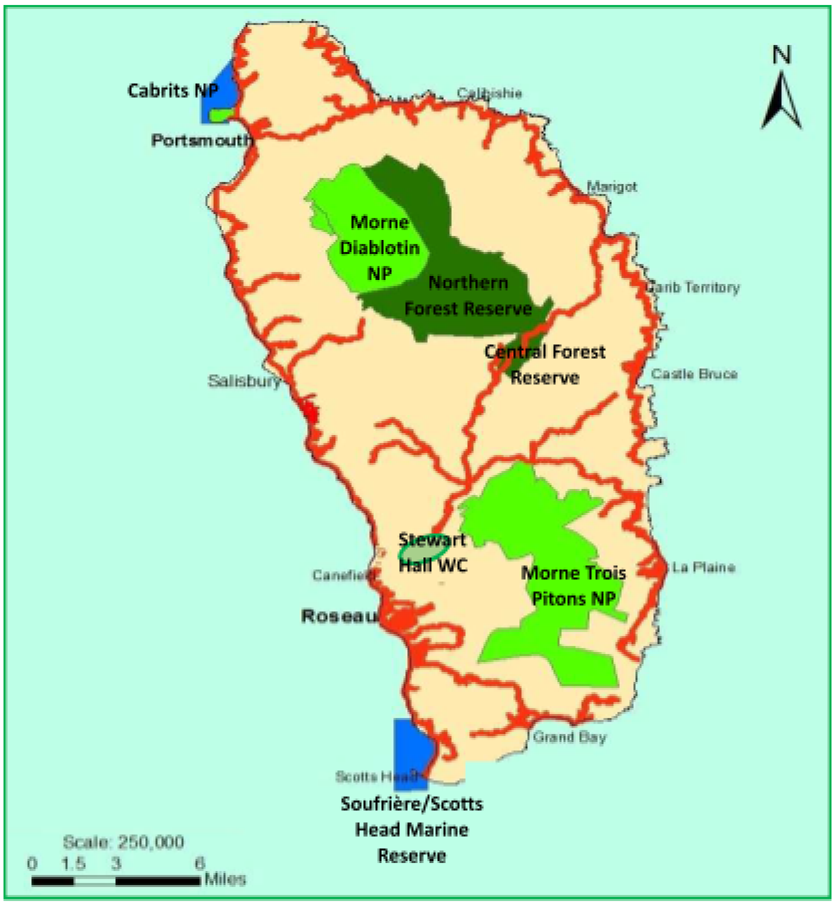
Table 4 Forest area change from 2000-2017 [Ha]

AREA CHANGE [HA]					
	2000	**2005**	**2010**	**2015**	**2017**
Elfin and Cloud forest	7,056	7,056	7,056	7,009	7,009
Montane Rainforest	28,411	28,411	28,364	28,271	28,271
Semi-evergreen Forest	10,514	10,514	10,514	10,374	10,280
Deciduous Forest	7,056	7,009	7,009	6,963	6,963

[24] Photo: https://www.lonelyplanet.com/articles/dominica-hiking-passport

Dry Scrub Forest	1,916	1,822	1,822	1,636	1,636
Litoral Forest	3,598	3,598	3,598	3,551	3,551
Total	58,551	58,411	58,364	57,804	57,710

In an effort to protect these important ecosystems and their biodiversity, Dominica has established seven protected areas over the years, with a further three areas proposed (figure 3).



The management of these protected areas are shared over a number of different Institutions (table 5).

Table Area of Protected Areas System [Km2]

Protected Area	Area km2	Year established	IUCN Category	Management Authority	Key feature(s)
Central Forest Reserve	4.1	1952	VI	Ministry of Environment, Rural Modernisation and Kalinago Upliftment (MoE) – Division of Forestry, Wildlife and Parks Division (DFWP)	• Oldest Forest reserve • Abundance of gommier
Morne Trois Pitons National Park	68.75	1975	II	MoE-DFWP -National Parks Unit (NPU)	• Dominica's first National Park and a World Heritage Site • Valley of Desolation • Boiling lake • Emerald pool • Boeri lake
Stewart Hall + all Water Catchment	3.18	1975 1995	VI	Dominica Water and Sewerage Company (DOWASCO)	• Water catchment areas providing water to island
Northern Forest Reserve Cabrits National Park	88.14 1.1 (terrestrial) 4.21 (Marine)	1977 1987	VI II	MoE-DFWP MoE-DFWP -National Parks Unit (NPU) Ministry of Blue and Green Economy, Agriculture and National Food security (MoAF)- Fisheries Division	• Watershed conservation area • Twin peaks of extinct volcanoes • Extensive swamp area • Important wetland
Soufrière/Scotts Head Marine Reserve	5.35	1998	V	MoAF- Fisheries Division SSHMR LAMA	• The largest and deepest near shore submarine volcanic crater in the Caribbean.
Morne Diablotin National Park	34.5	2000	II	MoE-DFWP -National Parks Unit (NPU)	• Morne Diablotin-highest mountain in Dominica • Picard Gorge
Total Terrestrial Area	**199.77**				
Total Marine Area	**96.56**				

The island is characterized by a very youthful and fragile forest landscape, which makes it very susceptible to the effects of land degradation. However, historically Dominica has a strong tradition of conserving its land resource base. In the post-World War II period, the banana industry developed, leading to the introduction of heavy machinery to build infrastructure (e.g. roads) together with increased housing needs related to the expanding economy. Thus, significant pressures were brought to bear on the fragile resource base with increasing levels of land degradation and desertification that is now being compounded by impacts from climate change [25].

The general pattern of land use in Dominica has been dictated by topographic limitations. The highest, most rugged elevations in the interior have remained inaccessible and therefore forest cover - which constituted Dominica's largest carbon sink. The narrow flat floodplains of the major rivers in the country have seen the most intensive land utilization, predominantly agriculture, with hillside cultivation extending into the mid-elevation areas along road access routes. Banana and temporary (vegetable and root) crops, coconut and citrus dominate commercial agricultural production in Dominica. Urbanization has been largely confined to the narrow coastal fringe, although newer settlements have been expanding into the interior along the rural road network.

[25] 3.4. Land Use, Protecting Carbon Sinks, and Enhancing the Resilience of Natural Ecosystems: https://unfccc.int/files/cooperation_support/nama/application/pdf/dominica_low_carbon_climate_resilient_strategy__%28finale%29.pdf

Historically, the majority of the land area in Dominica was parceled into large estates owned by the Crown (mainly unutilized lands in the interior) and private owners (major agricultural estates). As agricultural output from these large estates declined over time the land was subdivided and sold as smaller agricultural parcels and housing lots. By extension, the transition from larger-scale agriculture to small farms has also had implications for implementation of land conservation measures and efforts to enhance the resilience of natural ecosystems to address climate change concerns. As holdings become smaller, farmers tend to cultivate the full acreage within the holding in short-term crops to maximize financial returns.

Dominica’s agriculture sector has declined due to weather-related events and fluctuations in world market conditions, but it is still vitally important for rural livelihoods and an important contributor to employment. Tourism is growing, largely based on ecotourism and government support. The Government of the Commonwealth of Dominica (GoCD) is promoting Dominica as a “nature island” destination. Presently, Dominica lacks a timber industry, and the use of non-timber forest products (NTFPs) is not significant. However, the indirect contribution of forestry is very important. Forest resources, especially in its national parks and ecosites, are a key source of the island’s high biodiversity and play an important role in attracting tourists. There are close cross-sectoral connections with other sectors as well. Forests in Dominica also have important social dimensions: they have always been connected to the Kalinago (a unique population of pre-Columbian indigenous people) and are considered very important from a history/cultural perspective. Furthermore, an estimated 20 percent of jobs in Dominica are indirectly linked to forestry

Dominica’s economy reflects many of the traditional features of a small open economy. This includes a high level of dependence on external trade as a proportion of gross domestic product (GDP), dependence on single sector export products (agriculture) and tourism revenue, high levels of underemployment and unemployment, and dependence on foreign capital (both public and private sector) for investment into productive sectors and for infrastructural development.[26] The Dominican economy has been dependent on agriculture - primarily bananas - in years past, but increasingly has been driven by tourism as the government seeks to promote Dominica as an "ecotourism" destination mainly because Dominica is recognized to be *“The Nature Island of Caribbean*”.

Climate change has both on-site and off-site effects on land. On-site effects include the lowering of the productive capacity of the land, causing either reduced outputs (crop yields, livestock yields) and/or the need for increased inputs. Off-site effects include changes in water regime, such as decline in water quality and sedimentation of riverbeds and reservoirs, with increased sedimentation rates in rivers being expected in Dominica due to climate change. Moreover, Dominica is located in the hurricane belt and is highly susceptible to hurricanes. On average the island is impacted directly or indirectly approximately once every four years by hurricanes, with on average one hurricane every 15 years hitting it. Dominica has had two Category 5 hurricanes Hurricane David in 1979 and more recently Hurricane Maria in 2017, which was preceded by Tropical storm Erika in 2015. All brought devastation to the island, causing significant damage to the environment, with trees stripped of leaves, damaged, and even uprooted, destroyed housing and infrastructure, led to water shortages and disease and even in some instances death. Many coastal and marine and eco-tourism sites were damaged and

[26] Information from Dominica´s INDC.

high winds, flooding, and sea swells impacted businesses along coastal areas, along rivers, and in the forest reserve.

6.2 National legislation related to Forest sector

Legislation

The **National Parks and Protected Areas Act No. 16 of 1975** amended by Acts 54 of 1986, Act 12 of 1990, Act 8 of 2001 and Act 1 of 2015, is currently the overarching legislation providing for the declaration and management of terrestrial Protected Areas. The Act provides for the declaration of both national parks and PAs (excluding MPA's with the exception of Cabrits NP), leasing of land for PAs and the establishment of a System of National Parks. However only three of the current seven PA's, which are all considered national parks, were established under this legislation (MTPNP, MDNP and CNP) and whose administration, management and control falls under the remit of the MoE. The Act outlines the purposes for which PAs may be declared, and authorizes the MoE, by order, to set aside state lands for PAs in the form of national parks, historic sites, and recreational areas and to develop regulations. The Act also provides for the establishment of a National Parks Service, led by a Director of National Parks (DNP) and an advisory council whose role is to advise Minister on all matters related to the System of National Parks. However, while a National Parks Unit has been set up, there is currently no DNP or park advisory council. The Act authorizes the DNP to prepare management plans for its National Parks which will be open for public review, although to date no plans have been approved. The roles and powers of park wardens is also provided in under this Act. The Act does not however provide for matters related to a protected areas system such as system plan development. Since its enactment a number of Statutory Rules and Orders and regulations related to the PA system have been developed under the National Parks and Protected Areas Act.

- A User Fee Regulation **SRO No. 27 of 1997** amended, **SRO No. 22 of 2008, SRO No. 7 2013.** authorizes the National Park to generate revenue from user fee ticket sales, License fees from tour operators, vendors and tour guides. Permits for researchers, media personnel and impounding fees from animals in the Parks as well as Park fines for illegal activities in the Park.
- **The National Parks Regulations, No. 54 of 2003,** outlines the code of conduct in protected areas (hours of operation for visitors, prohibited activities, products permitted to be sold in the park, fees on impounding of animals, offences, fines etc.).
- Amended boundaries for parks established under the Act. **SRO 3 of 2000**, **SRO 24 of 2001** and **SRO 36** provide a description the Morne Diablotin National Park boundary and **SRO 54 of 1986** provides a description of the Cabrits National Park amended boundary.

In order to strengthen the management of all categories of PAs and not just National Parks, Dominica has drafted a new **Protected Areas Bill** to replace the existing National Parks and Protected Areas Act. This Bill provides the legislative framework for the establishment, development and effective management of protected areas which will supersede existing laws that contradict the Bill. It further repeals National Parks and Protected Areas Act regulations except those that are consistent with the Bill. This bill provides for the for the establishment of a protected areas system and the preparation and implementation of a plan for the system of protected areas as well as individual PA management plans. Under this bill a Protected Areas Authority, whose function will be to coordinate an integrated approach to the management of protected areas will be established to function as a management authority in respect of national parks and any other protected area for which it has management responsibility. The Bill also provides for the establishment of a Scientific Committee providing advice of a scientific nature to the Authority in the discharge of its functions under the Bill. This draft Bill is still under revision and has not yet been approved.

The **Forest Act, 1958** provides for forest management and the establishment of Forest Reserves on Crown Lands and protected forests on private lands. Currently this is the primary legislation for the Central and Northern Forest Reserves. The **Forest Ordinance Cap. 80, 1959** specifically, covers the designation of forest reserves and includes the designation of private lands as protected forest for water or soil conservation or other public purposes. It is under this Ordinance that the **Forest Rules SRO 17, 1972** were established which specifies prohibited activities in forest reserves and gives details on the issuing of licenses and permits for harvesting forest produce, and the declaration of Stewart Hall Water Catchment as protected forest, **Stewart Hall Water Catchment Rules SRO No. 11, 1975**.

The Forestry and Wildlife Act No. 12 of 1976, amendments **No. 35 of 1982** and **No. 12 of 1990** provides for the protection and management of wild fauna and the management of their forest habits and provides for the creation of wildlife reserves. Under this Act, a wildlife reserve could be declared within the boundaries of an existing PA and the address PA management through various prohibited activities such the introduction of alien species without a permit and hunting in national monuments. This Act however, is not currently linked to other legislation addressing species protection or to the national obligations under conventions such as CITES or CBD.

Relevant regulations further established under this Act are-:

Forestry and Wildlife (Fees) Regulations No. 19 of 2014, under section 53 of the Forestry and Wildlife Act, prescribes fees to be paid for seasonal hunting and fishing licenses as provided in Table 5.

Water Catchment Rules of 1995, under the Forestry and Wildlife Act, declare all water catchment areas as protected forests and managed by the Dominica Water and Sewerage Company Ltd. (DOWASCO). Water Catchment Rules include all regulations on prohibited acts, control of dwelling houses and other.

The **Physical Planning Act (2002)** mandates that persons or agencies must apply to develop land and construction practices and includes provisions for prohibitions on land use activities that causing environmental damage. It was established to ensure all development is carried out in an environmentally sustainable manner and requires the preparation of environmental impact assessments for development projects. This Act considers national parks and protected areas as a land for conservation purposes through the preparation of land use/development plans and is likely the most relevant for the establishment and management of any buffer zones surrounding PA's.

Tourism (Regulations and Standards) Act, 2001. This Act recognizes that the PAs form the base of the ecotourism product, and as such, ensures that all services offered at all national parks and marine management areas will focus primarily on tourists.

Other relevant legislation indirectly related to PA's and their management

- Land Acquisition Act, 1953.

- Crown Lands Ordinance and the Crown Lands Regulations, 1961
- Maritime Areas Act, 1981
- Beach Control Act, 1966, 1990
- Environmental Health Services Act, 1997
- Protection of New Varieties of Plants Act, 1999
- Pesticide Control Act, Pesticides Control (Prohibition) Regulations 2020

National Policies

National Resilience Development Strategy 2030- is the overarching framework which provides the road map and guidelines for taking the country to where it ought to be by 2030. Its vision is for Dominica to be the "First Climate Resilient Country in the World". One of the main objectives of the Strategy is to promote sustainable tourism development through the protection, conservation and development of the natural environment within its carrying capacity. It highlights several ways in which it will implement this which include collaborating with relevant agencies to promote the designation of specific areas, including conservation areas, for the development of tourism and coordinating the maintenance, development and management of the national parks, nature sites and trails. Thus, the Protected Areas System will play an important role in the country achieving its resilience development goals.

National Biodiversity Strategy and Action Plan (NBSAP) 2014-2022-As part of its UNCBD agreement the Government of the Commonwealth of Dominica along with the other signatories developed a NBSAP. The national biodiversity strategy sets out Dominica's vision for biodiversity and defines the broad policy and institutional measures that they will take to fulfil the objectives of the Convention. It also provides an action plan to achieve the strategy taking the 20 Aichi targets into account. This is the primary national policy as it relates to PA's. One of its four main objectives is "*To ensure that the basis for development is through the sustainable use of terrestrial and marine biological resources*" with a target for this objective being *"By 2020, at least 15% of terrestrial, inland water and 15% of coastal and marine areas especially areas of particular importance for biodiversity and ecosystem service, are conserved through comprehensive ecologically representative and well-connected systems of effectively managed protected areas and other means and integrated into the wider land and seascape"*

National Land Use Policy, 2014- provides direction for all land use decisions and describes how best to manage development to improve quality of life for Dominicans, through economic and social development, protecting human health and safety, and conserving the natural environment. The National Land Use Policy, enabled under the Physical Planning Act, 2002, represents the overarching policy that guides the development of the National Physical Development Plan. The National Land Use Policy is highly supportive of the protection of the national parks and recognizes the importance Protected Areas to Dominica's Nature Island brand. Protected Areas are incorporated under the national polies specifically by enhancing the vitality of forest reserves and national parks, **ensuring** National Parks are highly valued by citizens and tourists, and to protect and strengthen public access National Parks.

Physical Development Plan, 2016 -acts together with the National Land Use Policy guide planning for future land use and development in Dominica. Overall, its vision is for well managed settlements, agricultural lands, rivers, forests, coastal zones, and biodiversity. It recognizes the importance of National Parks and Forest Reserves to the natural environment, towards climate change mitigation and adaptation and to Dominica's identity. It prescribes the area adjacent to National Parks and Forest Reserves and marine zones as a transition zone and sets out considerations for development within these zones. It proposes the establishment of a third Marine reserve, Salisbury Marine Reserve and considers key species' nesting sites into its plan for land, development areas specifically turtles and parrots nesting sites.

The **National Tourism Policy –** defines the vision and direction of the Dominica's tourism sector. Its vision is for sustainable tourism which includes the national tourism policy is essential to define the vision for tourism and the direction protecting the natural resources and scenic, heritage and cultural features of the country. It states the importance of environment-based natural attractions, facilities, amenities, services and supporting infrastructure and maintaining and enhancing Dominica's pristine environment is one its guiding principles. It has objectives directly related to the system of Protected Areas, specifically to work in partnership with parks management to manage and plan for the sustainable use of the national parks, nature sites and the other protected areas while at the same time maintain the integrity of the resources as it offers quality experiences to visitors.

The Tourism Master Plan 2012-2022 -provides a framework for the development of the tourism sector in Dominica, identifying priority areas for tourism development, related tourism facilities and supporting infrastructure. The potential and opportunities across Dominica's Protected Areas System in growing the country's tourism sector are well recognized in this Master Plan. The plan identifies several areas and plans for tourism development across the country. Specific plans for tourism development within the system of Protected Areas have been highlighted in the previous section 2.1.3.

The **Forest Policy Statement for the Commonwealth of Dominica (2010) -** was developed in order to guide the sustainable management of Dominica's forest resources, while maintaining or improving the present area of forest cover. The Policy covers all of Dominica's forested areas, including Forest Reserves, National Parks, Unallocated State Lands, Carib Territory, and Privately Owned Land. The Policy addresses natural forests, plantations, as well as deforested, degraded forests and agro-forests.

International Commitments[27]

The multilateral environmental agreements (MEAs) directly or indirectly relevant to protected areas that have been signed by the Government of Dominica are-:

- UNESCO Convention concerning the Protection of the World Cultural and Natural Heritage, 1972, ratified 1994
- United Nations Convention on Biological Diversity (CBD), ratified 1994

[27] National Environmental Summary Commonwealth of Dominica 2010.

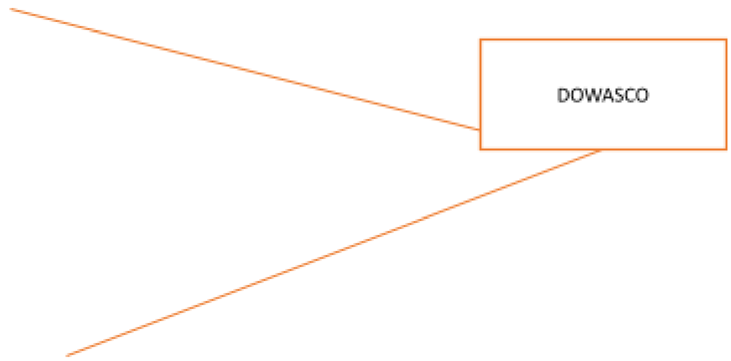
- Cartagena Protocol on Biosafety to the Convention on Biological Diversity, 2000, ratified 2004
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973, ratified 1995
- United Nations Framework Convention on Climate Change (UNFCC), 1992, ratified 1994;
- United Nations Convention to Combat Desertification (UNFCC),1994, ratified1997
- United Nations Convention on the Law of the Sea (UNCLOS),1982, ratified 1991
- International Convention for the Prevention of Pollution from Ships (MARPOL), 1973, ratified 1978
- Convention for the Protection and Development of the Marine Environment in the Wider Caribbean Region (Cartagena Convention), 1982, ratified 1990
- International Convention on Civil Liability for Oil Pollution Damage, acceded 2001

6.3 Institutional Overview

The management of Dominica's Protected Areas is shared across two Ministries, two local management authorities and a public utility, with no overarching or co-ordination mechanism, making the overall management of the Protected Areas System complex and fragmented (figure 4).

Under the National Protected Areas Act 1976, and the Forestry Act, 1958 the **Ministry of Environment, Rural Modernization and Kalinago Upliftment (MoE)** is responsible for establishing and managing national parks, protected land and forest reserves. It is the Forestry, Wildlife and Parks Division (DFWP) under this Ministry that is responsible for the management and/or administration of the three National Parks, (MTPNP, MDNP and Cabrits NP) and the Central and Northern Forest reserves. The SHWC is managed by the Dominica Water and Sewerage Company Ltd. (DOWASCO) under the Memorandum of understanding "*To undertake a Joint Management Approach for all the Lands Forming Part of the Stewart Hall Water Catchment Protected Forest*" signed with the MoE-DFWP in 2013. However, currently all water catchments fall under the responsibility of DOWASCO (SRO.11,1995).

Several smaller units fall under the DFWP with the largest National Park's Unit responsible for the three National Parks. The administration and management of the two forest reserves falls under the Conservation, Protection & Maintenance Unit. There is also the Forest Administration Unit and includes the Research and Monitoring Unit, the Environmental Monitoring and Research Unit and Clerical Staff. Lastly, the Forest Management Unit is responsible for all forest resource use as well as the establishment of forest plantation, reforestation programmes and agro-forestry.



6.4 Procedures and arrangements for the preparation of the FRL

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

Schedule of FRL 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. The process was completed by internal and external independent review.

Table 6 FRL tasks

Stages	Responsible
Identification and formation of the team	DFWP
Allocation of tasks	DFWP
Technical training	CfRN
Data collection	DFWP/ Ministry of Agriculture, Food and Fisheries / CFRN
QC/QA procedures	DFWP/ CFRN
Data analysis	DFWP/ CFRN
Compilation of the FREL	DFWP/ CFRN
QC/QA procedures	DFWP/ CFRN
Independent review	CfRN RRR+IP
Improvement plan	DFWP

DFWP: Forestry, Wildlife and Parks Division CfRN: Coalition for Rainforest Nations. CfRN RRR+ IP: Coalition for Rainforest Nations Independent Panel of Review.

Means of data acquisition and management

Data acquisition

Activity Data:

- On August 29th – 230th 2019, 12 Dominican national experts from the Forestry, Wildlife and Parks Division and Division of Agriculture (Ministry of Agriculture, Food and Fisheries) attended a training by CfRN aimed at increasing knowledge about standardized tools to be used for AFOLU 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+ 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, 3 national experts from the Forest DFWP, and 1 from Agriculture, attended a joint-training with St.Lucia, 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 Activity Data 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 is to be used in the preparation and submission of AFOLU-GHG Inventories to the UNFCCC via National Communications (NCs), Biennial Update Reports (BURs), Biennial Transparency Reports (BTRs); also, as a basis for a potential REDD+ Forest Reference Emission Levels/Forest Reference Levels (FREL/FRL).

List of data providers, roles, and responsibilities

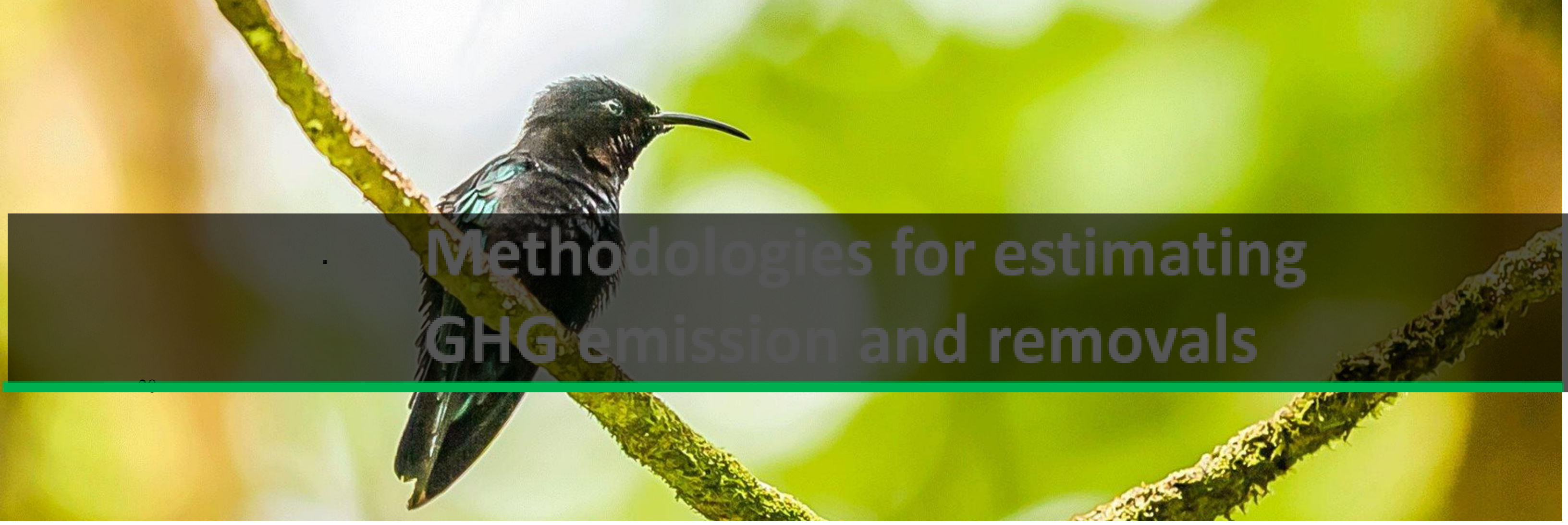
Table 7 List of data providers, roles and responsibilities

Institution	Division / Department	Name	E-mail	Role (Data Provider/Data Archiving/ QA/AC/Inventory Prep)
Ministry of Environment, Rural Modernisation and Kalinago Upliftment	Forestry, Wildlife and Parks Division	Minchinton Burton	directorforestry@dominica.gov.dm	Director Forestry, Wildlife and Parks Division - Coordinator
Ministry of Environment, Rural Modernisation and Kalinago Upliftment	Forestry, Wildlife and Parks Division	Bradley Guye	guyeb@dominica.gov.dm	Technical Lead, Activity Data Collection for LULUC 2000-2018, GHGi Preparation, Documentation, QC, Archives.
Ministry of Environment, Rural Modernisation and Kalinago Upliftment	Forestry, Wildlife and Parks Division	Machel Sulton	machelsulton@hotmail.com	Activity Data Collection for LULUC 2000-2018, GHGi Preparation, Documentation, QC, Archives.
Ministry of Environment, Rural Modernisation and Kalinago Upliftment	Forestry, Wildlife and Parks Division	Ricardo Dominique	ricardom13@gmail.com	Activity Data Collection for LULUC 2000-2018, GHGi Preparation, Documentation, QC, Archives.
Ministry of Blue and Green Economy	Agriculture	Nekelia Gregoire	gregoirenekelia@gmail.com	Activity Data Collection for LULUC 2000-2018.

Ministry of Environment, Rural Modernisation and Kalinago Upliftment	Forestry, Wildlife and Parks Division	Felix Eugene	felixeugene09@gmail.com	Technical Support
Ministry of Environment, Rural Modernisation and Kalinago Upliftment	Forestry, Wildlife and Parks Division	Sheldon Simmon	sheldonsimmon@gmail.com	Technical Support
Ministry of Environment, Rural Modernisation and Kalinago Upliftment	Forestry, Wildlife and Parks Division	Cyrille John	johnca63@hotmail.com	Technical Support
Ministry of Environment, Rural Modernisation and Kalinago Upliftment	Forestry, Wildlife and Parks Division	Francisco Maffei	maffeif@dominica.gov.dm	Technical Support
Ministry of Environment, Rural Modernisation and Kalinago Upliftment	Forestry, Wildlife and Parks Division	Richie Laville	richieville2@gmail.com	Technical Support
Ministry of Environment, Rural Modernisation and Kalinago Upliftment	Forestry, Wildlife and Parks Division	Nigel Harve	nigelharve@gmail.com	Technical Support

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.



Methodologies for estimating GHG emission and removals[28]

7.1 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, in which the land-use condition, including natural and/or human disturbance, was determined for each year of the time series 2000 - 2018. Forest land was stratified by forest type (Montane Forest -Elfin, Cloud montane, Montane Rainforest-, Seasonal Forest -Semi-Evergreen, Semi-Deciduous-, Littoral Evergreen, Dry Scrub). Croplands are reported as annual and perennial crops. Grasslands and Settlements are reported as Woody and Non-Woody. Wetlands do not have further sub-classification and Other lands divided in Other Lands and Mining.

The information on wood removals was derived from the Collect Earth assessment as cover loss instead of volume loss, as the tool does not allow that estimation. Losses due to Disturbances were also identified including Hurricanes, Fires, Logging and Shifting Cultivation, specifically on Forest lands.

7.1.1 Land Representation Approach

According to the 2006 IPCC guidelines, Dominica 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), using the Collect Earth tool.

In order to use the sampling approach, clear definitions of land uses were needed. Thus, a workshop took place on August 29-31, 2019. 12 national experts from forestry, agriculture and statistics participated. During this workshop the following land uses were agreed (figure 5).

[28] Photo: https://www.kempinski.com/en/dominica/cabrits-resort-kempinski-dominica/local-information/nature-playground/

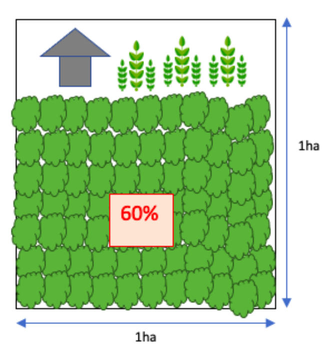
7.1.2 Land Use Classes

Dominica followed 2006/2019 IPCC guidelines structure for the FOLU sector, including the six main land uses proposed: Forest lands, Cropland, Grassland, Wetlands, Settlement, and other lands (Table 8).

Table 8 Land Use classes and sub-categories for Forest land

IPCC categories		sub-categories			Location
Level 1		Level 2	Level 3	Code	m.a.s.l
Forest land	F	Elfin and Cloud Forest	Elfin forest	FELF	>700
			Cloud montane	FCLOUD	500-900
		Montane Rainforest	Montane Rainforest	FRAIN	200-700
		Semi-Evergreen Forest	Semi-Evergreen Forest	FEVER	0-800
		Coastal Forest	Semi-Deciduous Forest	FDEC	0-500
			Dry Scrub	FDRYS	0-300
			Littoral Evergreen	FLIT	0-300
Croplands	C	Perennial crop		CPER	
		Annual crop		CANNUAL C	
Grassland	G	Grasslands		GGRASS	
Wetland	W	Wetlands		WWET	
Settlement	S	Urban areas		SSET	
		Woody settlements		SWOODS	
Other land	O	Other land		OOTHER	
		Mining		OMIN	

7.1.3 Land Use Classes Definitions



Level 1: Forest (F)

Forest is defined as forest lands with a canopy cover equal or higher than 60% (aprox 1.5 acres), with a minimum area extension of 1 ha and woody vegetation of minimum 3m height or higher, including temporary unstocked areas with the potential to reach the forest definition.

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.

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.

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.

Level 1: Settlements (S)

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

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.

7.1.4 Land sub-classes Definitions

Level 1: Forest lands (F)

Due to the lack of a recent National Forest Inventory, Dominica has used Saint Lucia's forest classification and definitions as described in Gravenson (2009) and complemented with country specific circumstances, as both Islands share the same conditions and forest types[29]. It is important to note that Dominica is already initiating a new national forest inventory, expected to be finalized by 2024. Once the information is available, descriptions and characteristics will be updated.

Level 2: Elfin and Cloud 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, 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 at an elevation of 700m or higher. 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 2: 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. Exposed ridges

[29] Graveson R. (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

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.

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: 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. 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 2: Coastal Forest

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. 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 and this forest class reaches an elevation up to 700m.

Level 3: 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.[30]

Level 3: Dry Scrub

This type of vegetation is found in a narrow zone between littoral rock and cliff vegetation and Deciduous Seasonal Forest or Littoral Evergreen Forest. It consists of shrubs, cacti and sometimes grassy spaces.

Level 1: Croplands (C)

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.

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 [31] were: tannia, dasheen, christophene, sweet potatoes, yam, cassava, tomato, peas, sweet pepper, cucumber, ginger, chives.

Level 1: Settlements (S)

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.

---

[30] For Dominica, the same classification as the National Forest demarcation and bio-physical resource inventory Project Caribbean – Saint Lucia. The classification of the vegetation of Saint Lucia (2010), was used

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

7.1.5 Disturbances:

In general forests in Dominica have suffered physical damage as a result of hurricanes over the past few decades. A number of factors reduce the natural resilience of Dominica's forests ecosystems and increase their vulnerability to climate change and climate variability. Many natural hazards periodically affect or threaten Dominica, among them hurricanes, earthquakes, volcanic eruptions, storm, surges, and landslides. These natural disasters can be attributed as one of the root causes of biodiversity loss in Dominica.

Hurricane David in 1979 caused significant impacts on the island's forest resources, causing damage to in excess of 50% of the trees in the southern half of the island. Hurricanes cause loss of habitat and food supplies for wildlife species and result in wildlife mortality. An indirect resultant effect Hurricane David was the conversion of wildlife habitat to agriculture. In accessible areas the toppled trees provide an opportunity to more easily clear land for farming, resulting in a further fragmentation of wildlife habitat[32].

Hurricane Dean in 2007 caused extensive defoliation resulting in loss of up to 35 percent of the forest cover over the eastern forest range (FAO, 2007)[33].

In August 2015, tropical Storm Erika triggered catastrophic floods and mudslides. Hundreds of homes were left uninhabitable and thousands of people were displaced; the entire town of Petite Savanne was evacuated and subsequently abandoned as a result of the storm. Flooding and landslides severely damaged transport infrastructure and substantially diminished the productive capacity of agriculture and tourism. The main airport was badly damaged.

In September 2017, Hurricane Maria made landfall in Dominica as a Category 5 hurricane with maximum sustained winds of 165 mph (265 km/h). These winds, the most extreme to ever impact the island, battered the roof of practically every home, with half the city flooded, cars stranded, and stretches of residential areas "flattened" it was indicated "total devastation". Its ferocious winds defoliated nearly all vegetation, splintering or uprooting thousands of trees and decimating the island's lush rainforests. The agricultural sector, a vital source of income for the country, was completely wiped out: with 100% of banana and tuber plantations was lost, as well as vast amounts of livestock and farm equipment (figure 6).

[32] Dominica Low-Carbon Climate-Resilient Development Strategy 2012-2020
[33] https://reliefweb.int/report/dominica/fao-agricultural-damage-assessment-mission-dominica-following-hurricane-dean

Figure 6 Trees stripped by Hurricane Maria in the interior of Dominica, October, 2017[34]

As a result of climate change, it is expected that the intensity of hurricanes will also increase, causing more severe damage, with potentially longer-term consequences for the integrity of the forest structure and canopy. Forest destruction from hurricanes recovers slowly with ecological implications such as landslides and soil loss and consequent socio-economic impacts such as impact on water quality and availability, and possible short to medium term tourism impacts.

7.1.6 Planning the land use assessment

After the experts decided on the land use categories that would be used to estimate the land use change over the years, clear classification criteria were needed to standardize the interpretation. Three main characteristics were selected.

a) Forest type by elevation.

As described in the previous section, forest types in Dominica are directly linked to elevation and location; therefore, the following figure was used to standardize the criteria of selection of a forest type (figure 7):

[34] Source: https://www.nybooks.com/daily/2017/12/28/dominica-after-the-storm/

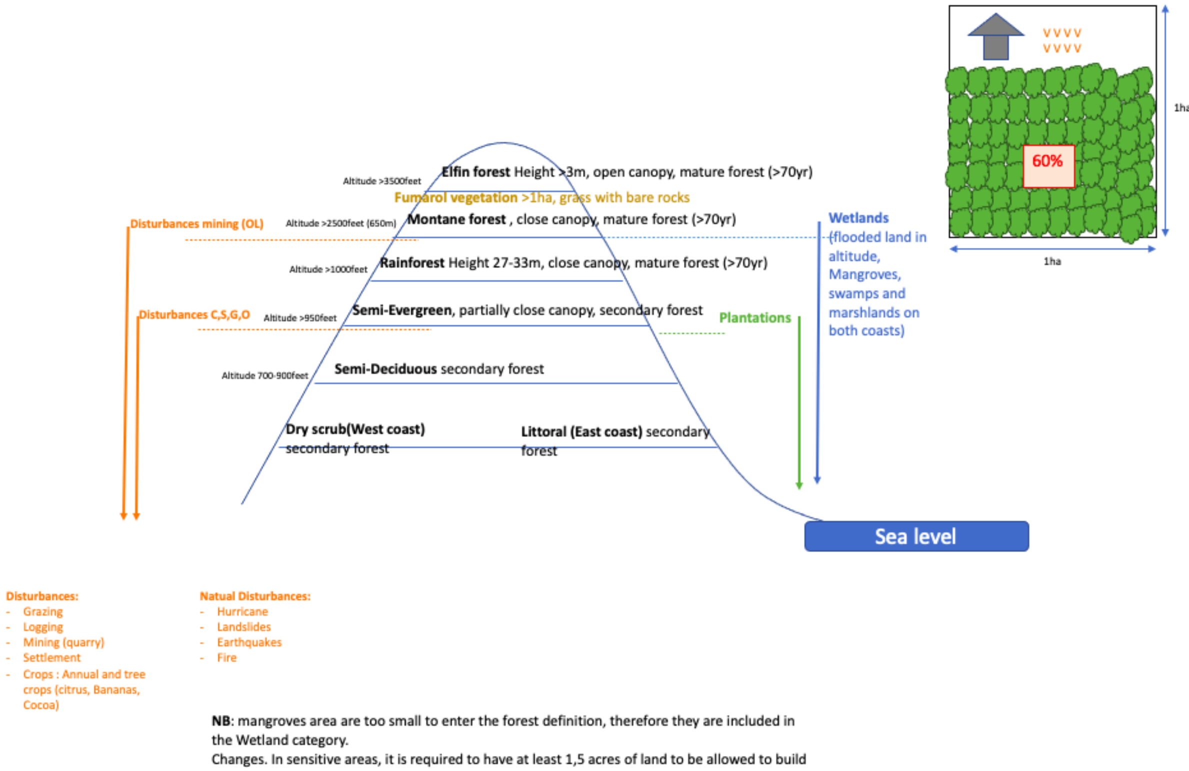


Figure 7 Land uses by elevation and location developed during preparation workshop

b) Possible and Impossible land use changes

The next step in the discussion was agreeing what type of land use changes can and cannot happen. This included understanding which forest types can be affected by, for example, which type of crops, or which ones are more subject to conversion to settlements or any other land use that is different from Forest lands. The main goal was to standardize what the disturbance factors are and where Forests are more subject to conversion to Croplands, Grasslands, Wetlands, Settlements and Other Lands. Moreover, which disturbances, both natural and anthropogenic, have affected the islands such as hurricanes, fires in croplands for slash and burn, fire in grasslands for clearing the land for pasture, natural wildfires, pests etc. The result of the discussion can be seen in figure 8:

Vertical: Land Use, Horizontal: Land Use Change		Forest Lands								Croplands		Grasslands	Wetlands	Settlements	Other Lands	Disturbances			
		Elfin	Montane Forest	Rainforest	Semi-evergreen	Semi-Deciduous	Dry Scrub	Littoral	Plantation	Tree Crops	Annual Crops	Grasslands	Wetlands	Settlements	Mining?	Hurricane/Storm	Fires	?	?
Forestlands	Elfin		x	x	x	x	x	x	x	x	x	x	x	x	x				
	Montane Forest	x		x	x	x	x	x	x	x	x	x	ok	x	ok				
	Rainforest	x	x		ok	ok	x	x	x	x	x	x	ok	x					
	Semi-evergreen	x	x	ok		ok	ok	x	ok	ok	ok	ok	ok	ok	ok				
	Semi-Deciduous	x	x	x	ok		ok	x	ok	ok	ok	ok	ok	ok	ok				
	Dry Scrub	x	x	x	x	x		x	ok	ok	ok	ok	ok	ok	ok				
	Littoral	x	x	x	x	x	x		ok	ok	ok	ok	ok	ok	ok				
	Plantation	x	x	x	ok	ok	ok	ok		ok	ok	ok	x	ok	x				
Croplans	Tree Crops	x	x	ok	ok	ok	ok	ok	ok		ok	ok	x	ok	ok				
	Annual Crops	x	x	ok	ok	ok	ok	ok	ok	ok		ok	x	ok	ok				
Grasslands	Grasslands(grazing)	x	x	x	ok	ok	ok	ok	ok	ok	ok								
	Fumarol Veg (?)																		
	Abandoned lands	x	x	ok	ok	ok	ok	ok	ok	ok	ok								
Wetlands	Wetlands	x	x	x	x	x	ok	ok	ok	ok	ok	ok							
Settlements	Settlements	x	x	x	ok	ok	ok	ok	x	x	x	ok	ok						
Other Lands	Mining?	x	x	x	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok					

Legend :
- x — Transition not possible in 1 year
- ok — Transition seen in 1 year
- in color the land remaining in the same category

Figure 8 Land use and land use change matrix indicating possible and impossible land use changes developed during preparation workshop

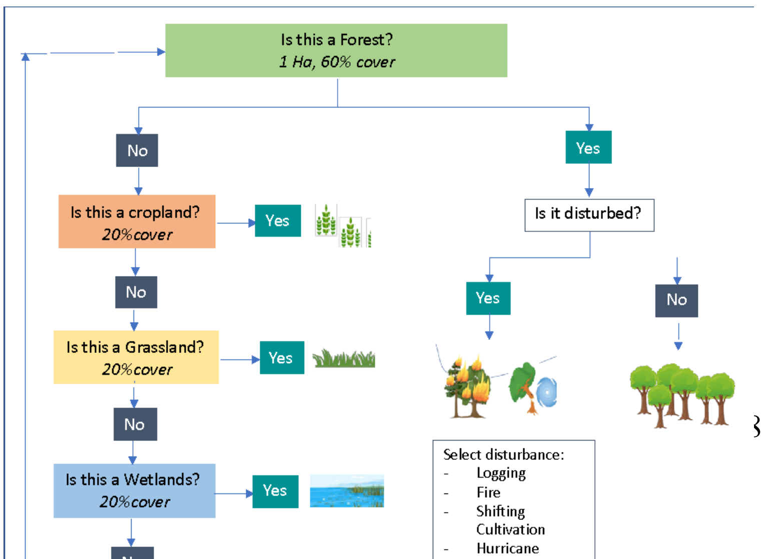
c) Hierarchy for land use classification

A hierarchy for the land use categories was established for the visual interpretation during the CE/OF Assessment. This will allow determining the land used depending on the percentage of land use cover (table 9).

Table 9 Hierarchy of land use classification for Dominica 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 (figure 9).

7.1.7 Project Design

Based on the information collected during the workshop, the plot size, sampling grid and survey were designed.

Plot Size: The size of the plot was decided to be 1Ha, to allow consistency with the Forest definition. This, along with the samples, 49 of them, facilitated counting the percentage of land use cover, as indicated in the hierarchy diagram (figure 10).

Distance among plots: Based on the experience and lessons learnt of Panama and Belize who have recently done their Collect Earth assessment, using grids of 3km by 3km and 1.5 km by 1.5 km (Panama) and Belize (1km by 1 km), Dominica planned to use a high sampling intensity, balancing country size, representatives of the samples, time and interpreters availability. As a result, a sampling of 750m by 750 m was selected (figure 11).

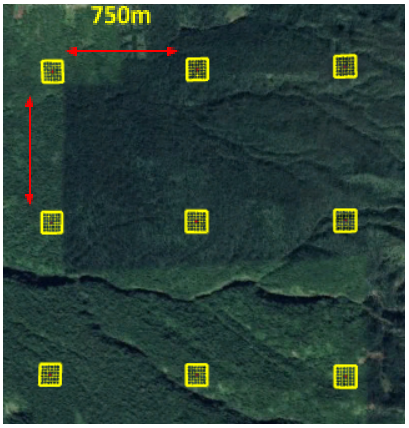


Figure 11. Plot size and distance among plots

National grid: Based on the previous analysis and criteria, a 750m by 750m national systematic grid consisted of 1605 sampling plots of 1Ha was selected. These sampling points were visually evaluated (figure 12).

Figure 12 Dominica's grid (collect earth)

Design of the Survey. For collecting the land use, land use changes, year of land use conversion, disturbance and year of disturbance, a country specific survey was designed that could capture all the information required. This survey included the six IPCCC land uses (Forest lands, Croplands, Grasslands, Wetlands, Settlements and other lands). It also included the sub-categories of land use as previously described (e.g Elfin forest, annual crop), and disturbances (hurricanes, logging, fires, shifting cultivation). This survey was displayed in each of the sampling plots and interpreters must fill it with the information of each plot on an annual basis. If no land use change or disturbance was recorded, the same information as the previous year was included. Figure 13 shows how the survey was seen when selecting a plot for assessment.

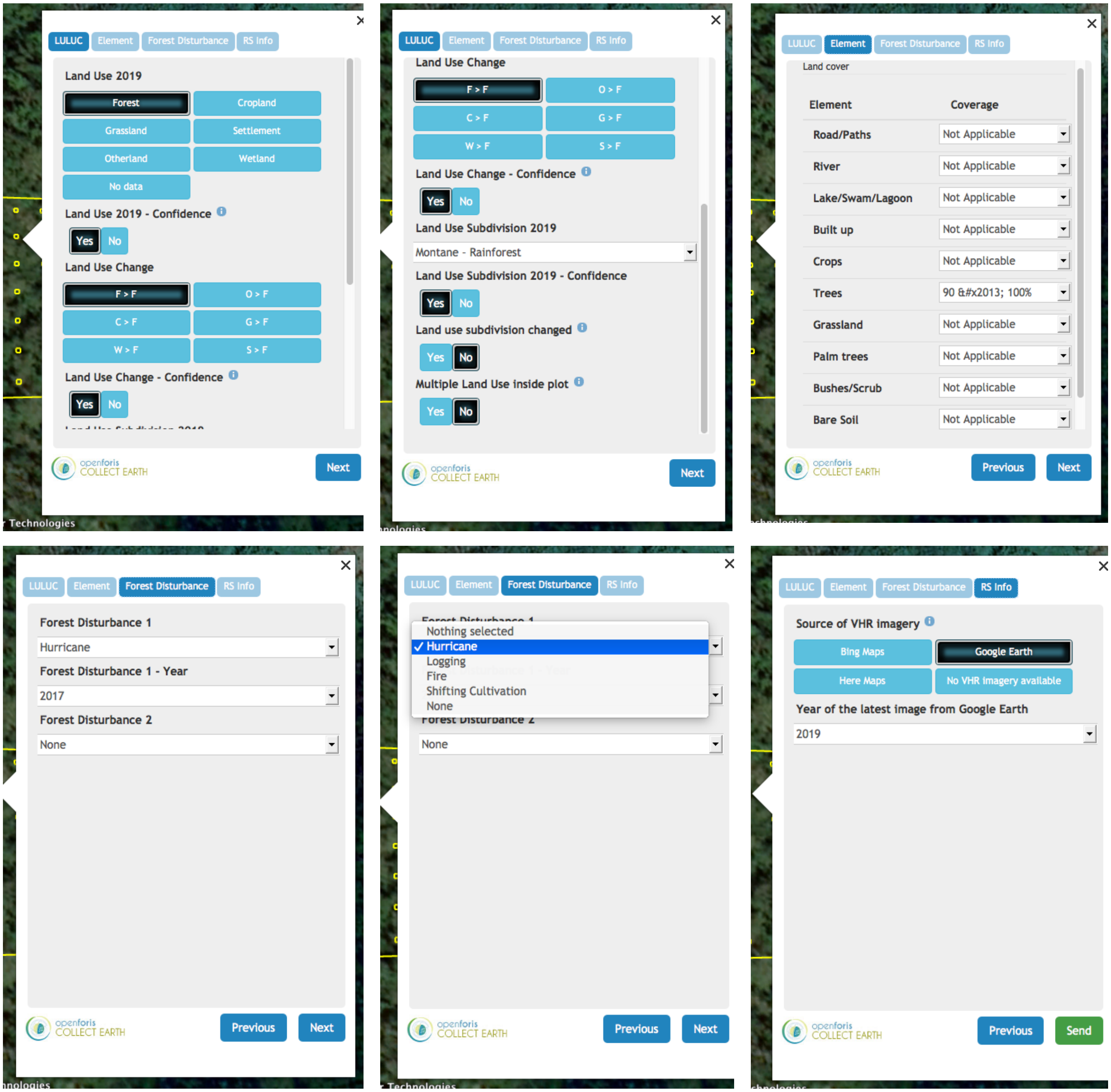


Figure 13. Collect earth survey

7.1.8 Open Foris Collect Earth Desktop

Training on how to use Collect Earth Desktop: On November 11th-12th 2019, 3 national experts from the Forest DFWP, and 1 from Agriculture, attended a join-training with St.Lucia, Belize and Panama, led by the Coalition for Rainforest Nations, on Collect Earth Desktop (figure 14). 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 suite 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.

Standardization of the interpretation

An important aspect regarding interpretation, is that all interpreters have the same criteria for selecting a land use or a disturbance. In addition of the previous criteria (elevation, location, possible and impossible transition matrix and hierarchy), different images were visualizing all together to ensure coherent classification among interpreters. Some examples of the plots used for training are included below (figures 15 to):

Level 1: FOREST LAND (F)

Level 2: Elfin and Cloud Forest

Level 3: Elfin forest

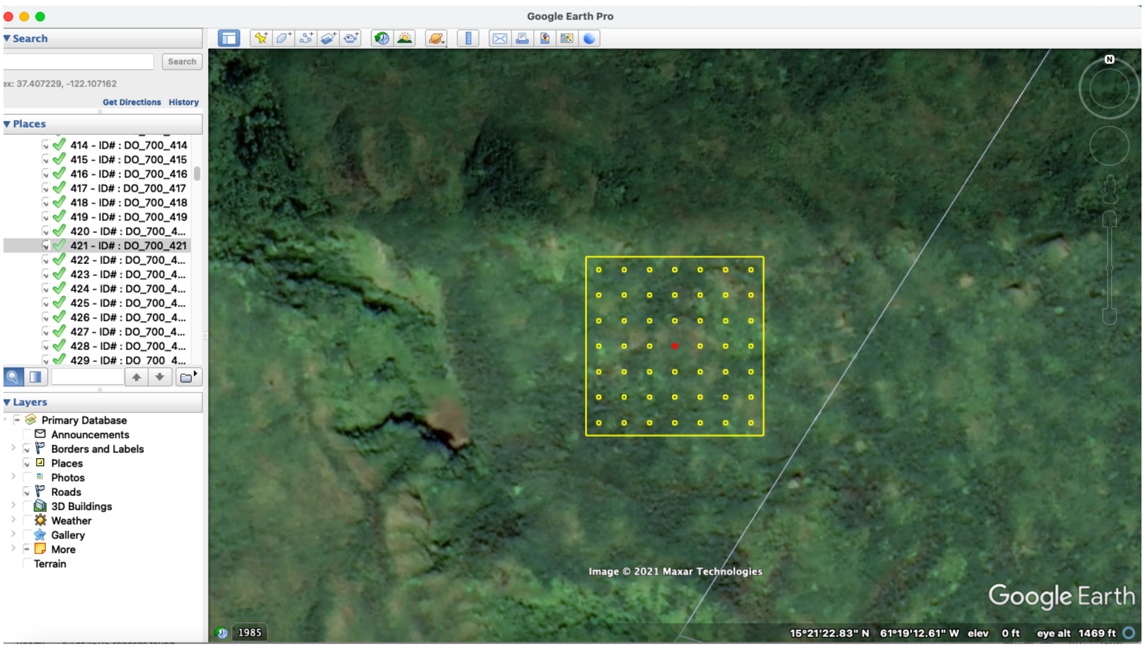


Figure 15 Visualization of Elfin forest in a high resolution image before disturbance

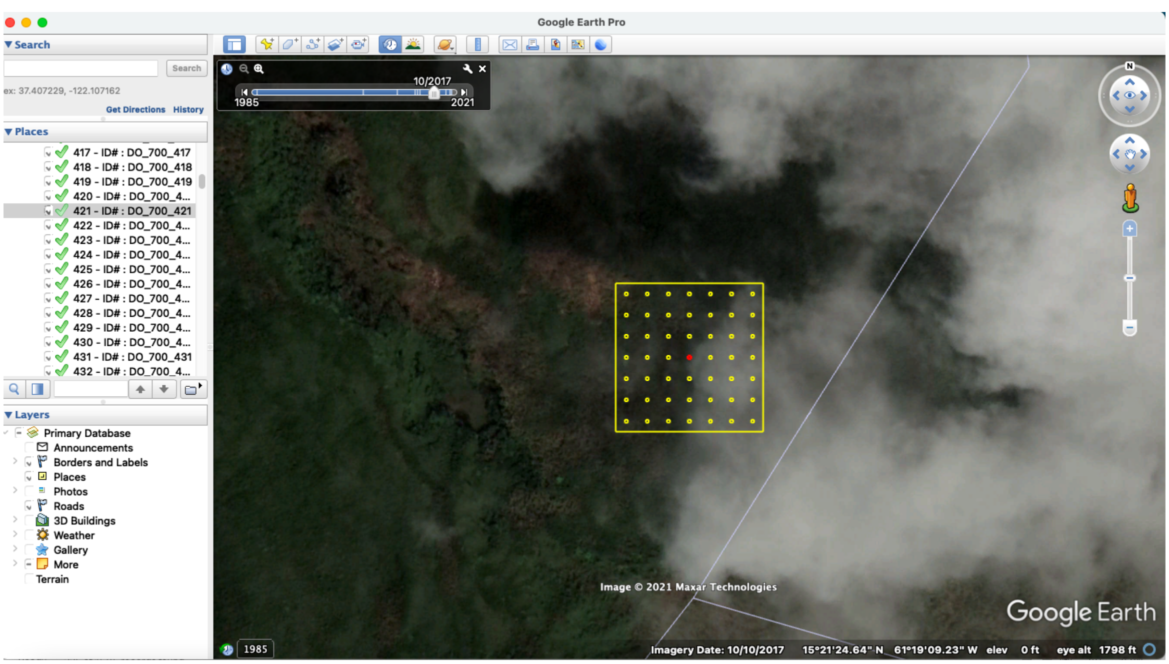


Figure 16 Visualization of Elfin forest (same plot) in a high resolution image after hurricane disturbance

Level 3: Cloud montane

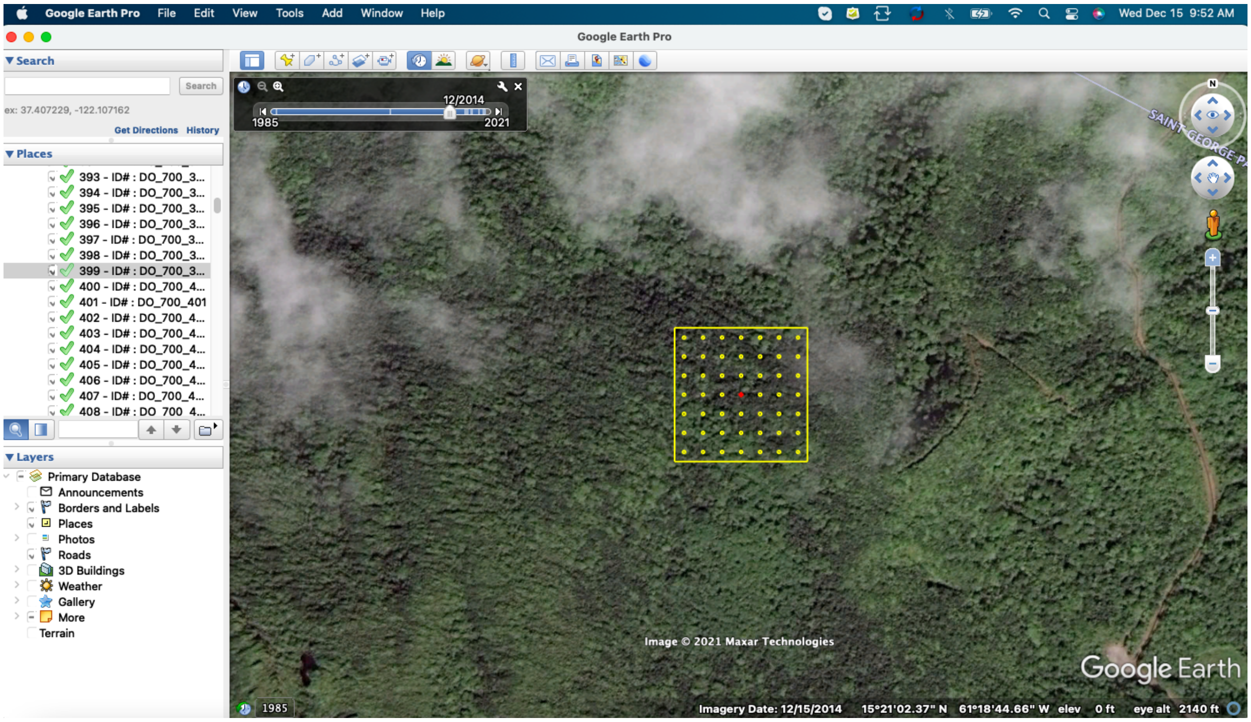


Figure 17 Visualization of Cloud montane forest in a high-resolution image before disturbance

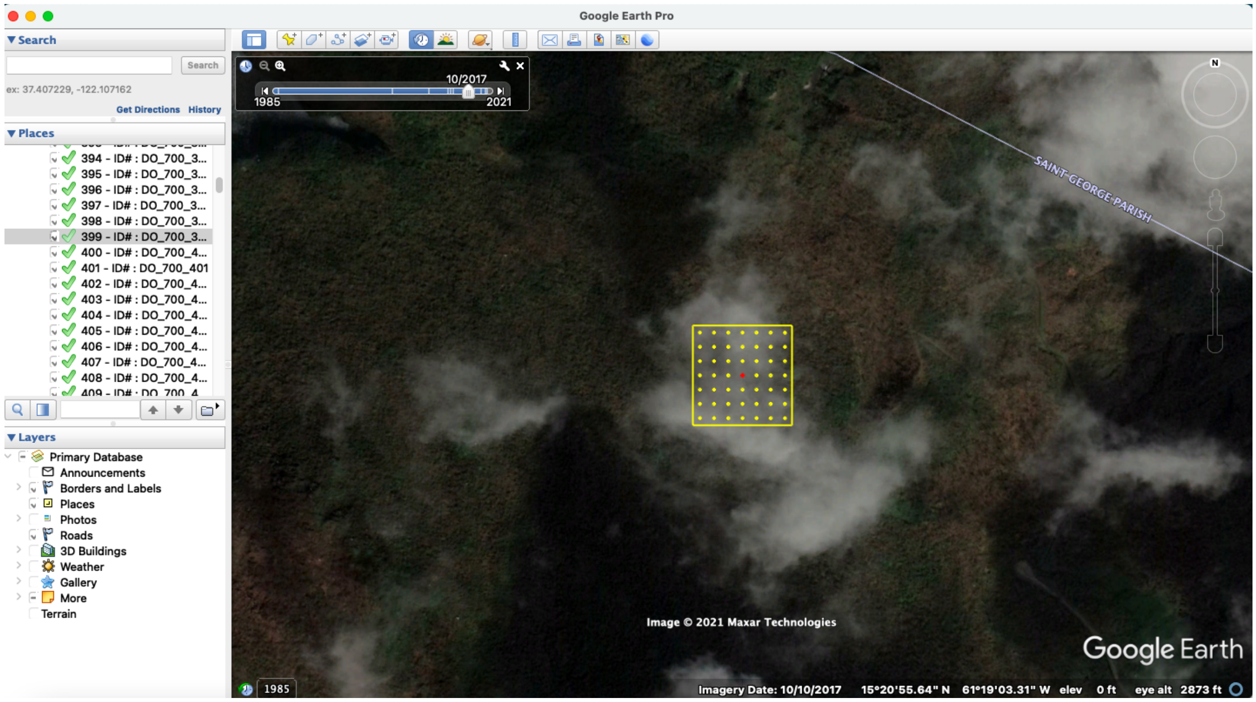


Figure 18 Visualization of Cloud montane forest (same plot) in a high-resolution image after hurricane disturbance

Level 2: Montane Rainforest

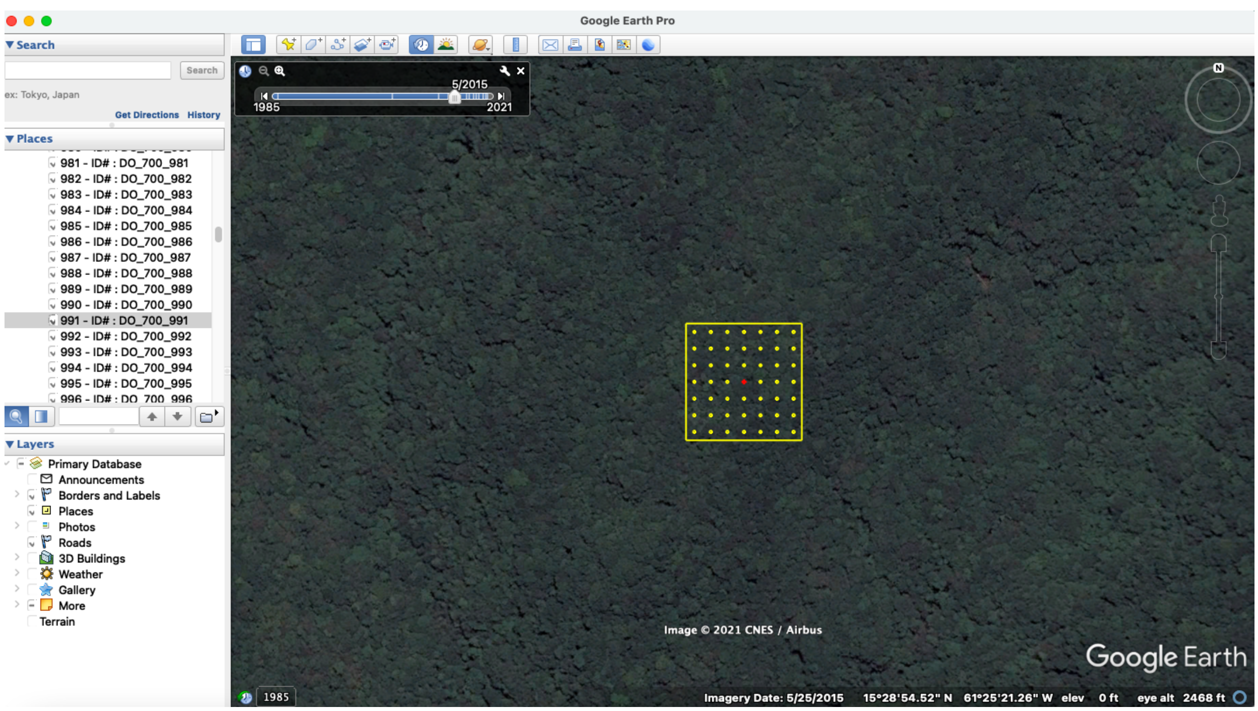


Figure 19 Visualization of Montane rainforest in a high-resolution image before disturbance

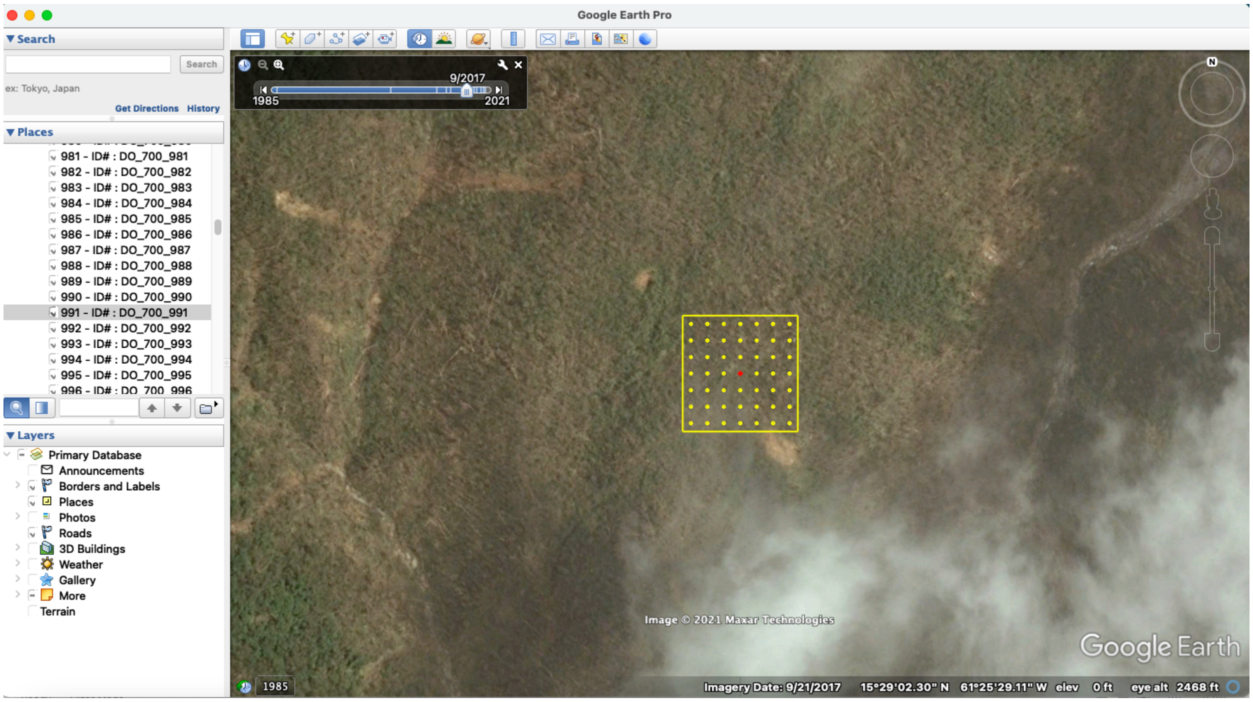


Figure 20 Visualization of Cloud montane forest (same plot) in a high-resolution image after hurricane disturbance

Level 2: Semi-Evergreen Forest

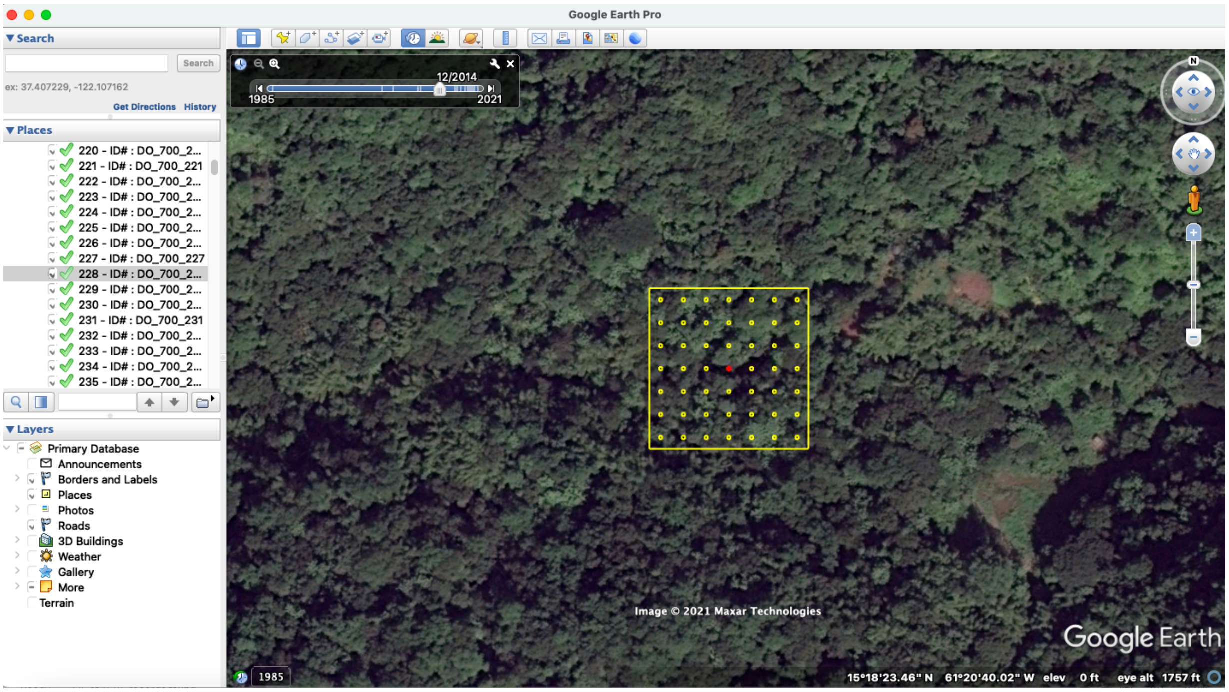


Figure 21 Figure 18 Visualization of Semi-evergreen forest in a high-resolution image before disturbance

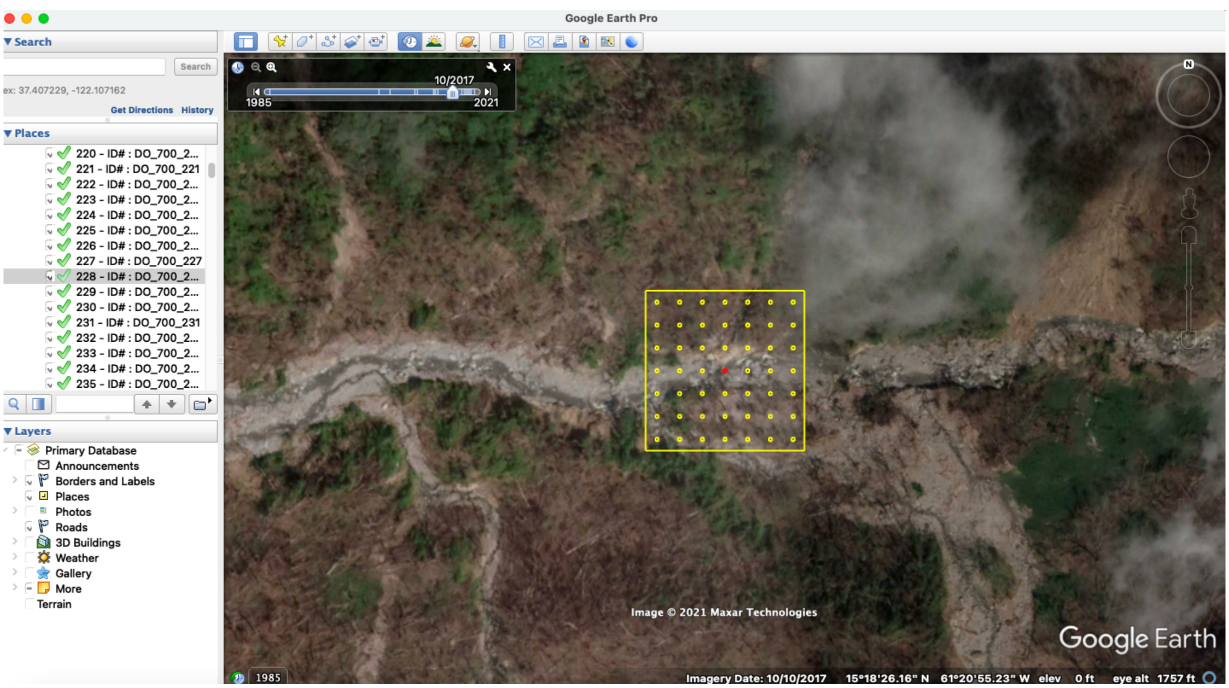


Figure 22 Visualization of Semi-evergreen forest in a high-resolution image after hurricane disturbance

Level 2: Coastal Forest

Level 3: Semi-Deciduous Forest

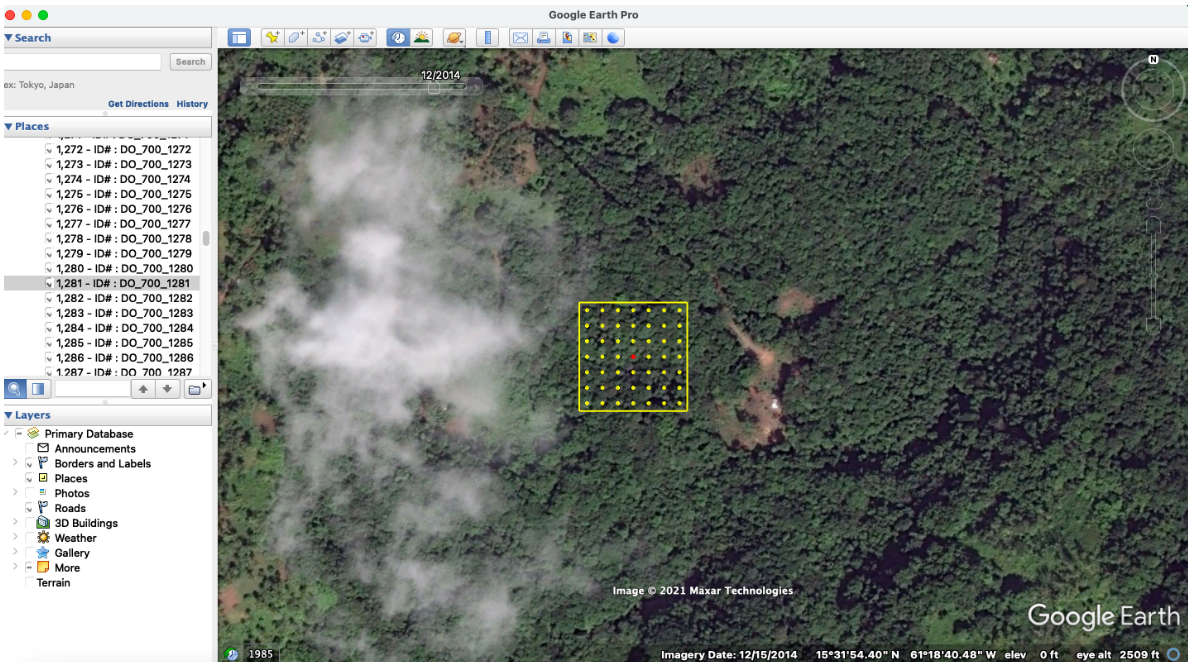


Figure 23 Visualization of Semi-deciduous forest in a high-resolution image before disturbance

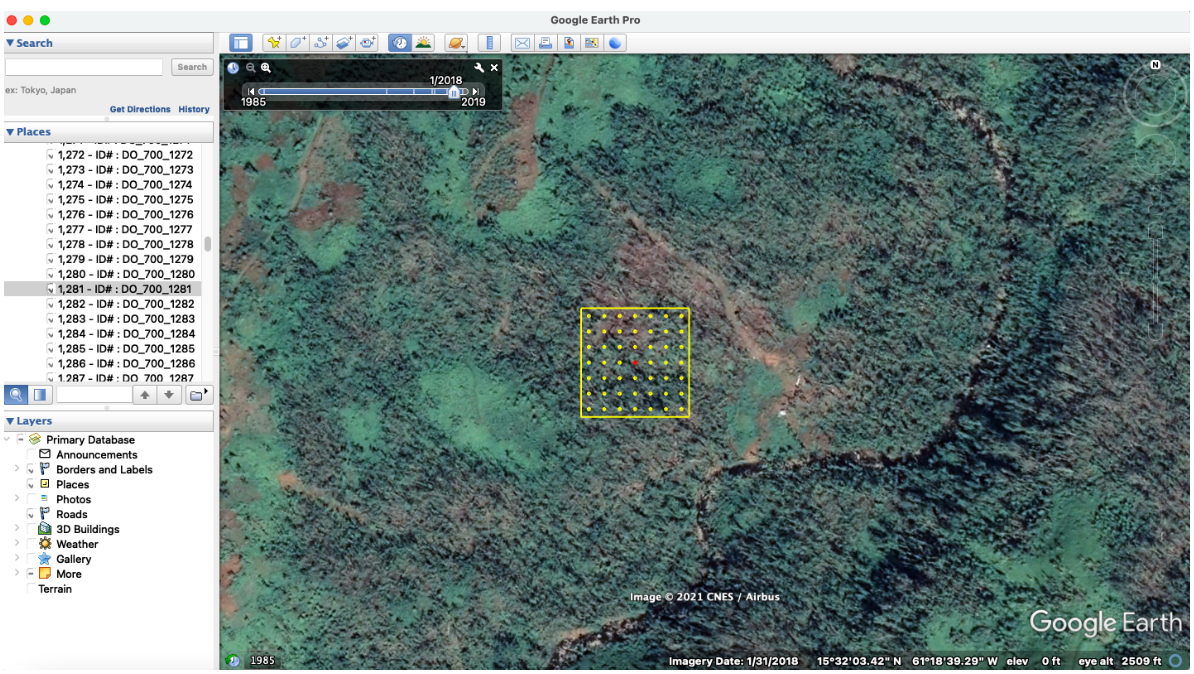


Figure 24 Visualization of Semi-deciduous forest (same plot) in a high-resolution image after hurricane disturbance

Level 3: Littoral Evergreen

Figure 25 Visualization of Littoral evergreen forest in a high-resolution image before disturbance

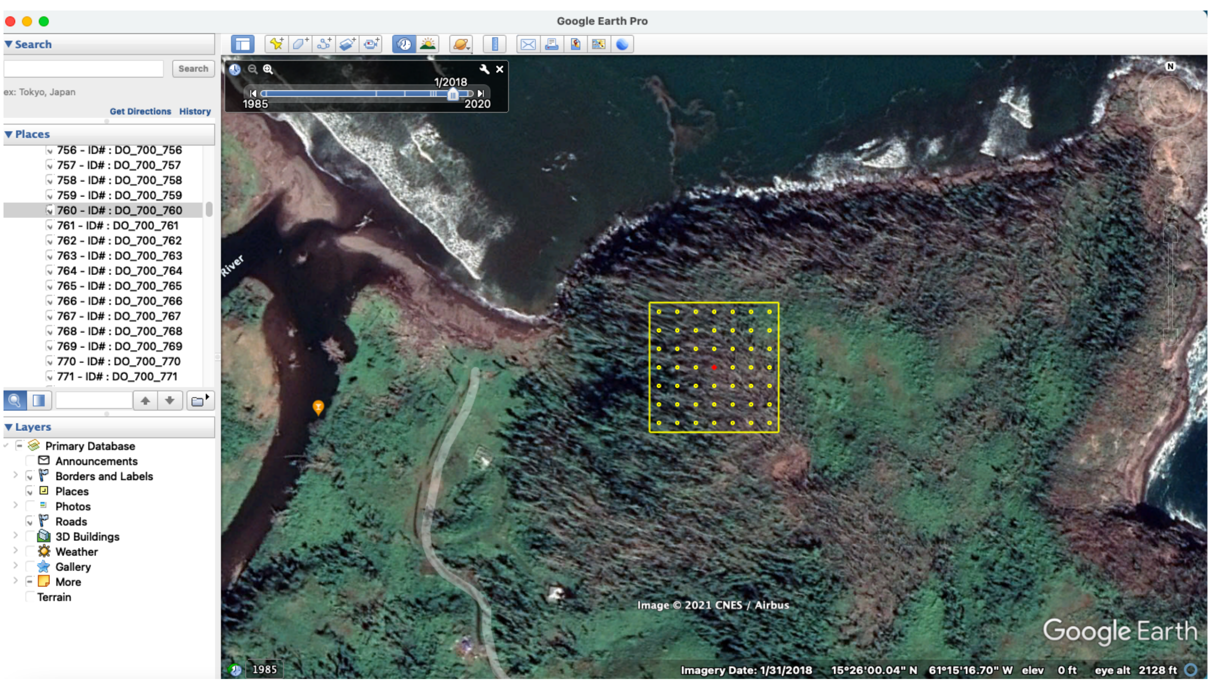


Figure 26 Visualization of Littoral evergreen forest in a high-resolution image after hurricane disturbance

Level 3: Dry Scrub

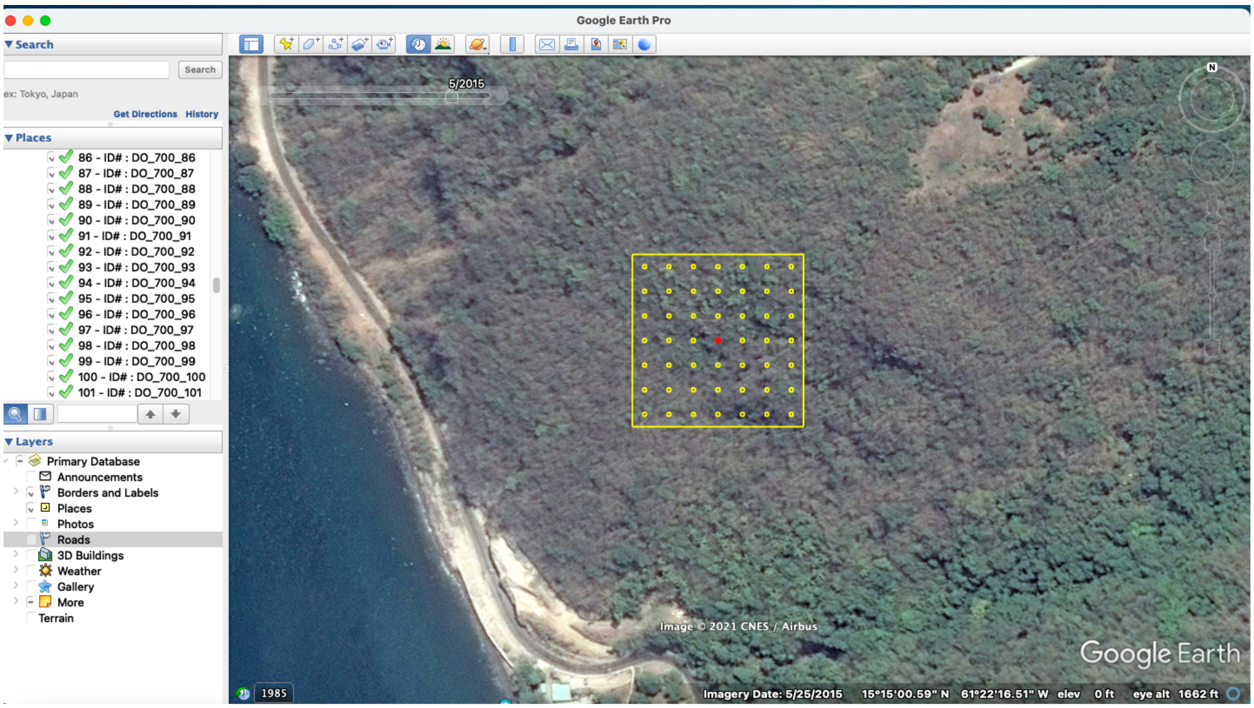


Figure 27 Visualization of Dry Scrub forest in a high-resolution image after before disturbance

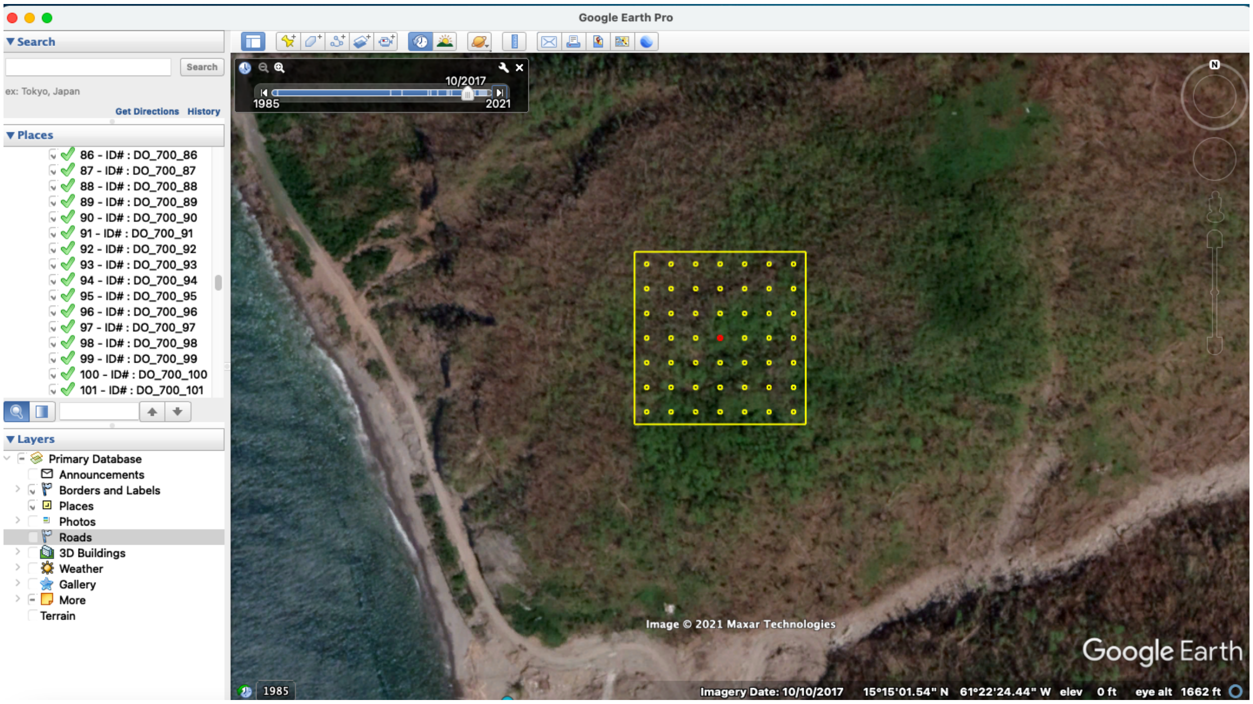


Figure 28 Visualization of Dry Scrub forest (same plot) in a high-resolution image after hurricane disturbance

Level 1: CROPLANDS (C)

Level 2: Perennial Crop

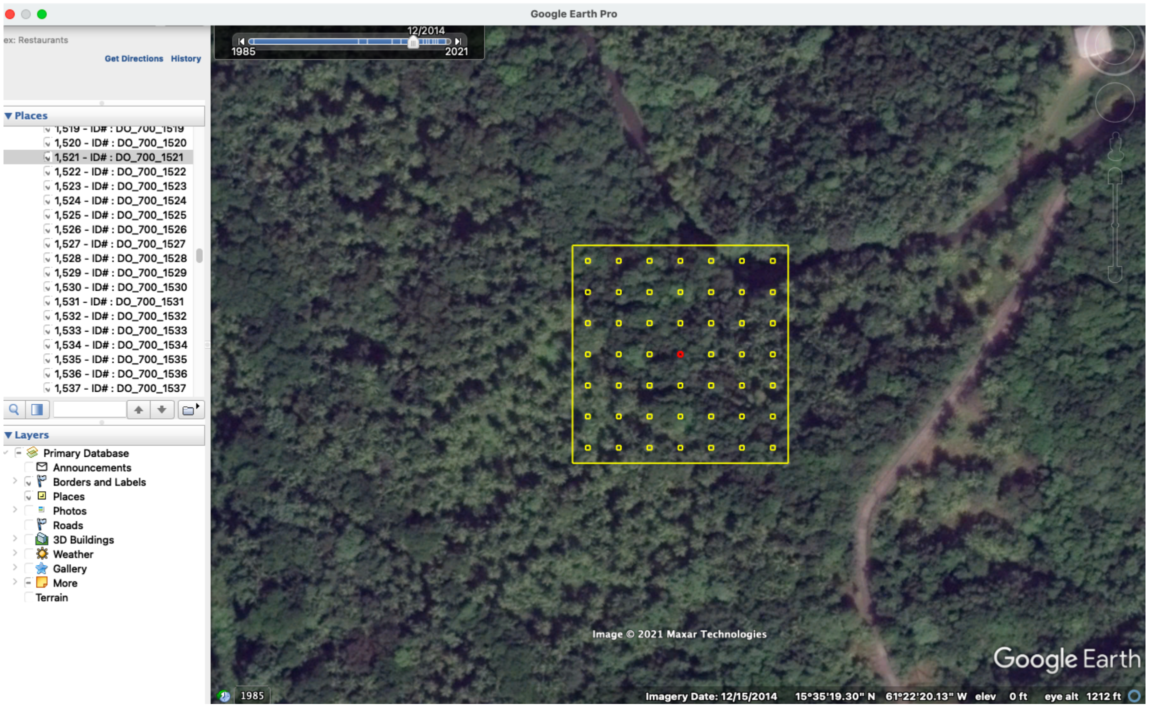


Figure 29 Visualization of perennial crop in a high-resolution image

Level 2: Annual Crop

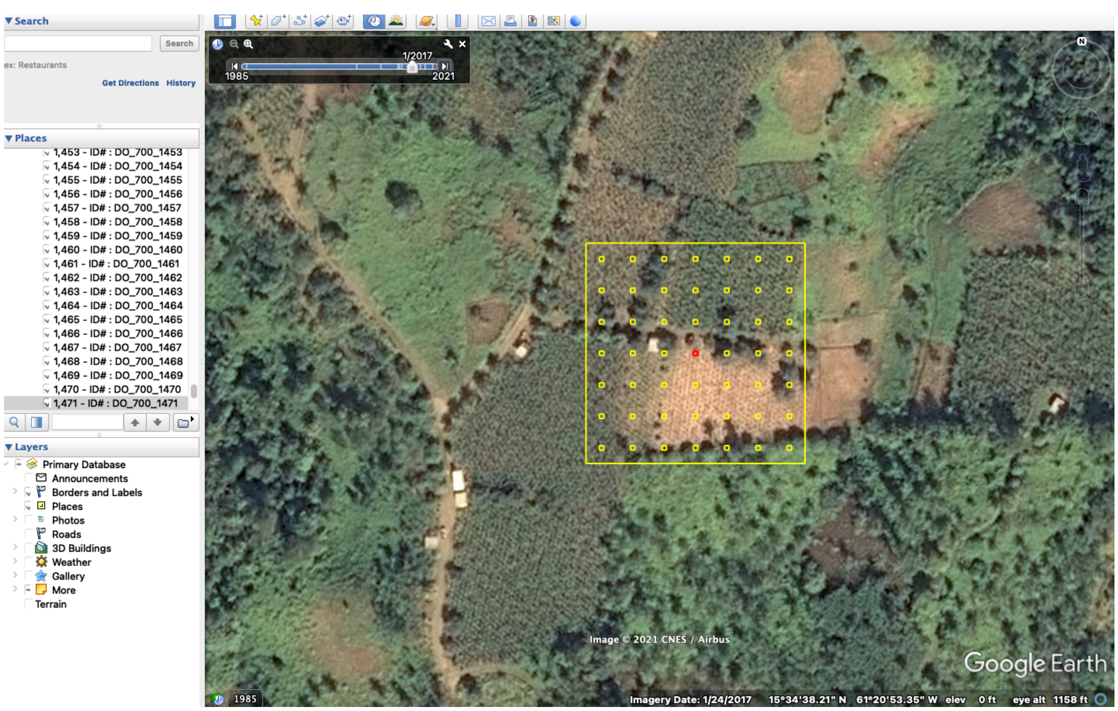


Figure 30 Visualization of annual crop in a high-resolution image

LEVEL 1: GRASSLANDS (G)

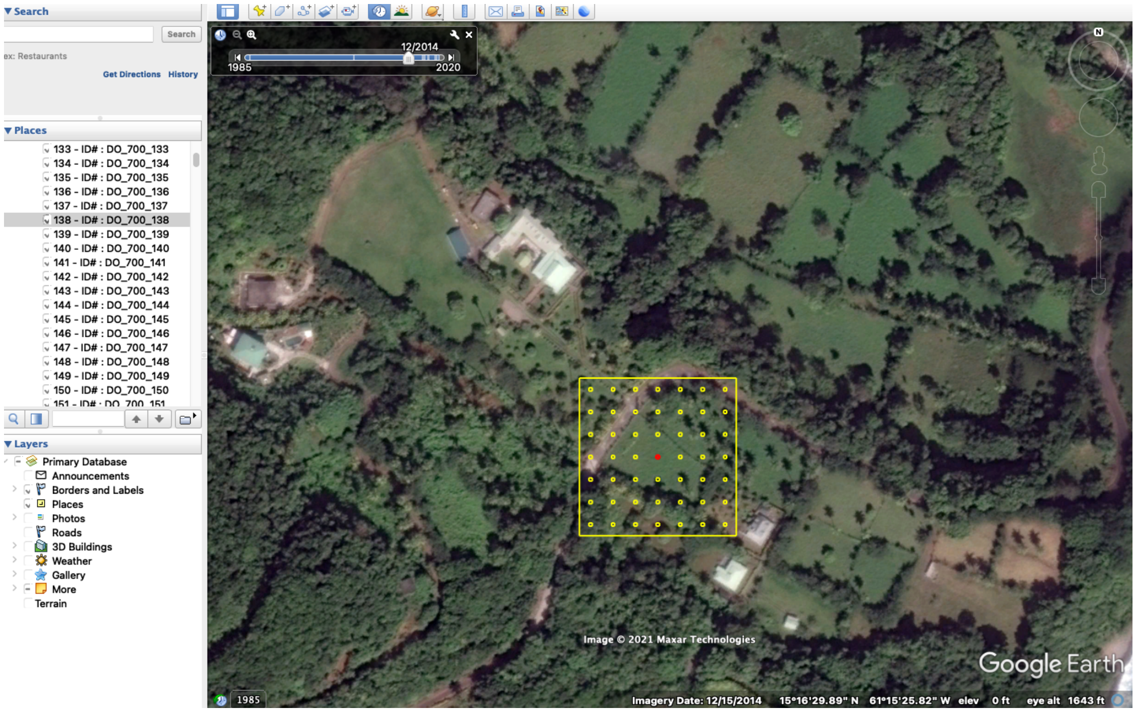


Figure 31 Visualization of grasslands in a high-resolution image

LEVEL 1: SETTLEMENTS (S)

Level 2: Urban areas

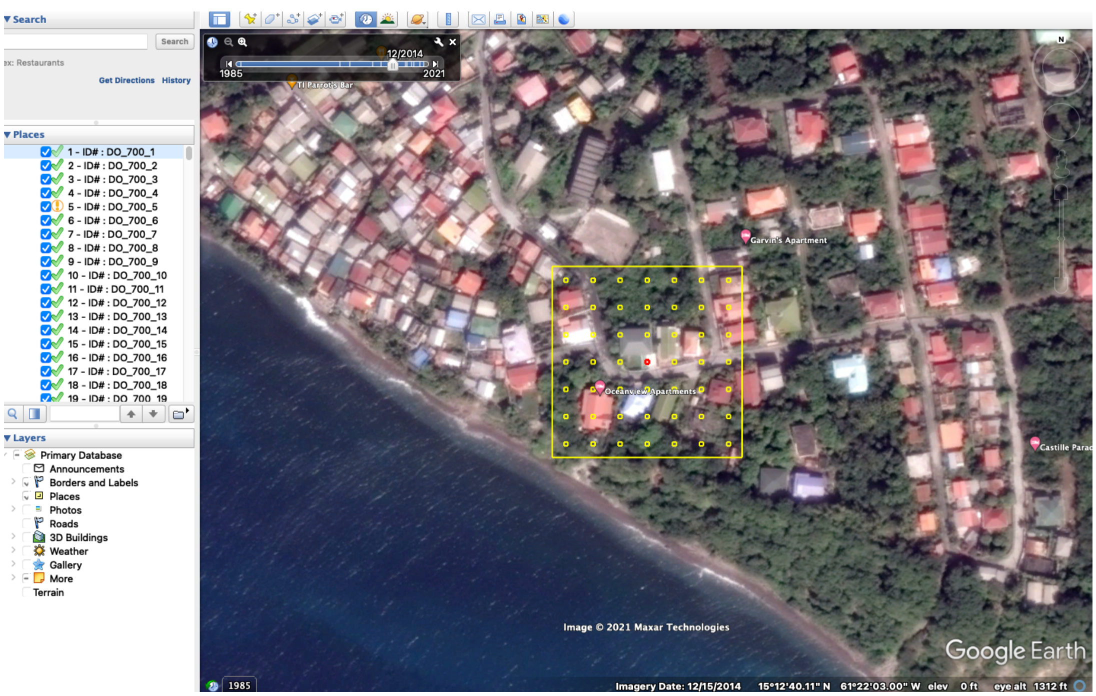


Figure 32 Visualization of settlements in a high-resolution image

Level 2: Woody Settlements

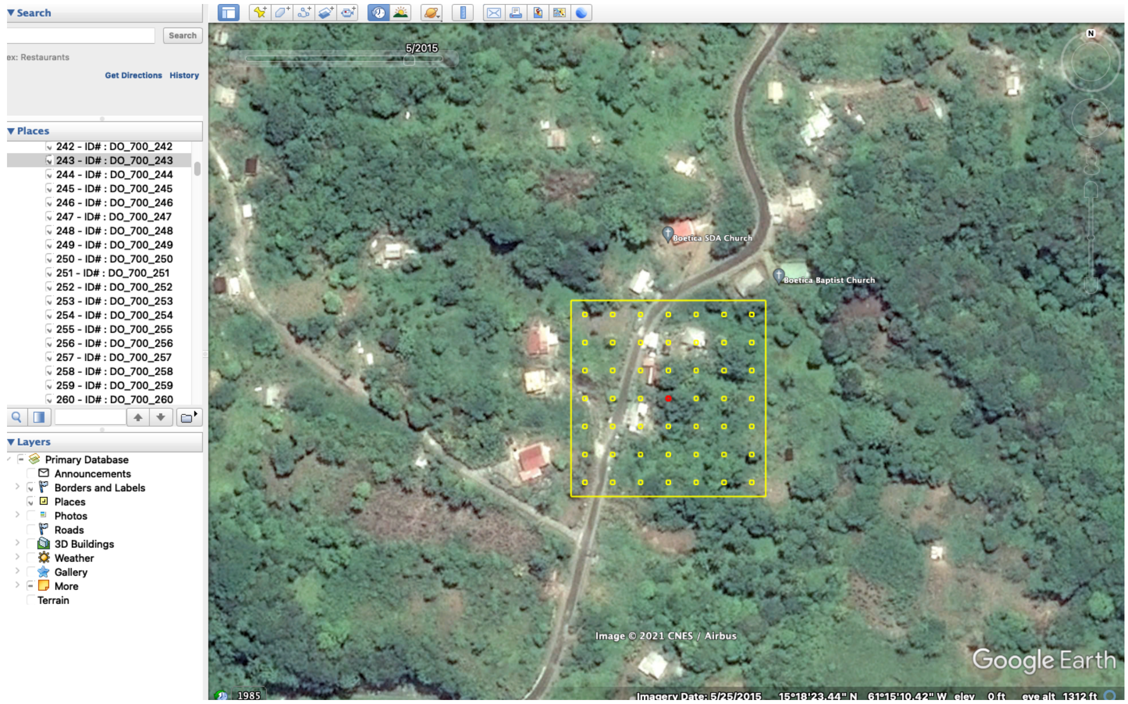


Figure 33 Visualization of woody settlements in a high-resolution image

LEVEL 1: OTHER LANDS (O)

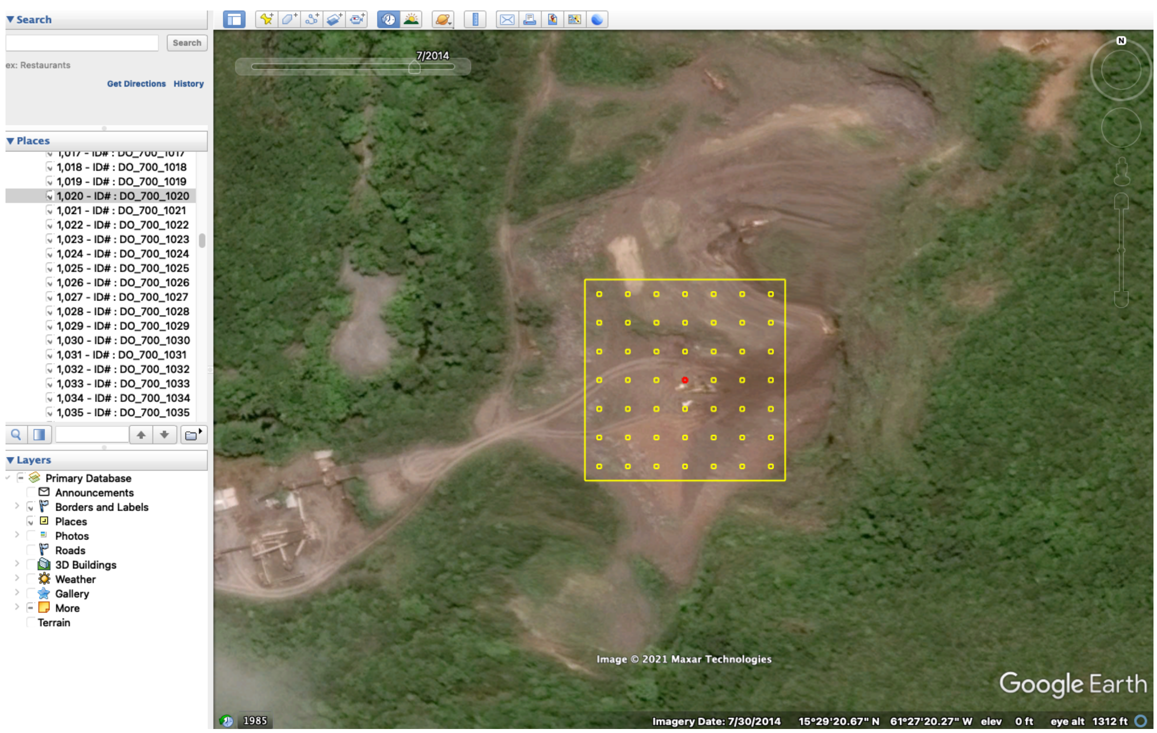


Figure 34 Visualization of other lands (mining) in a high-resolution image

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

The 1605 plots were divided into 4 groups. Each interpreter analyzed its assigned plots following the steps indicated in the diagram below (figure 34), which provides an overview of the key steps for assessing land use with Collect Earth and its supporting software:

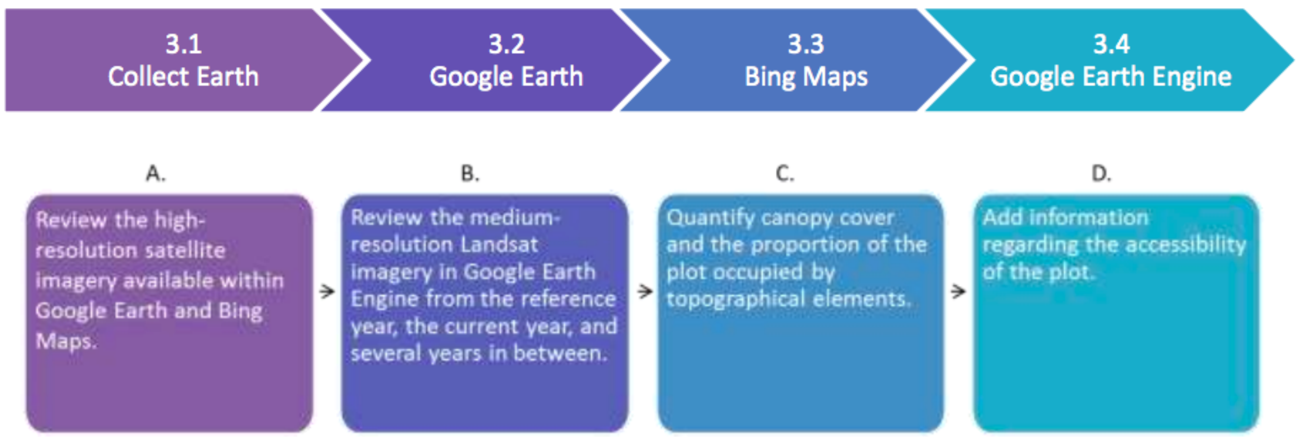


Figure 35. Support images used in CE

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. This 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.

Historically Imagery

For the annual analysis, interpreters used the historical tool, which allows seeing images from different years, which could be visualizing either high-resolution images (figure 35), or images from Landsat 7, Landsat 8, and Sentinel 2 (figure 36).

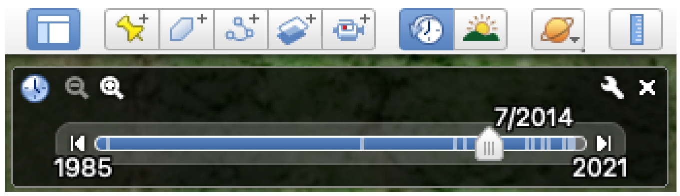


Figure 36. Historical imagery

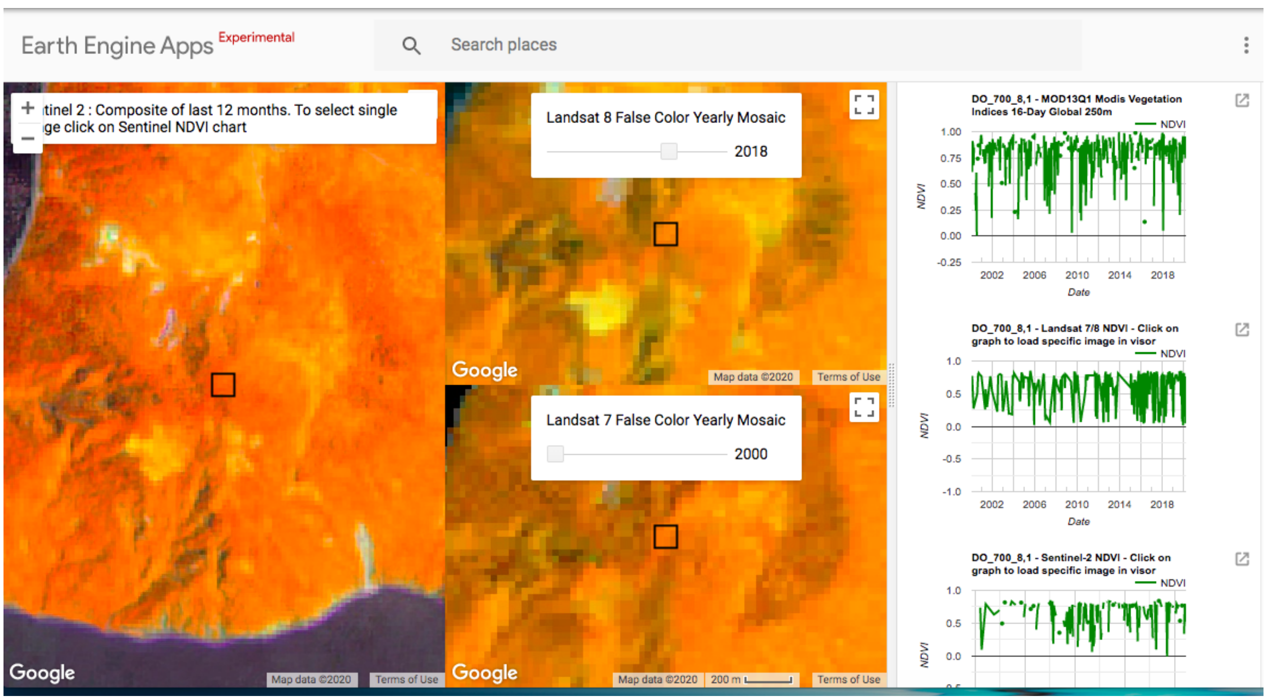


Figure 37. Examples of the use of Google Earth Engine

7.1.10 Collect Earth database with results of the interpretation

After the assessment was finished, a CVS database from the Collect Earth assessment with all information recorded for each of the 1605 plots from 2000 to 2017 was extracted. Each of the plots includes the time series indicating the land use (figure 37), whether the plot remained in the same land use category or if there was a land use conversion, and year of conversion, and if there was a disturbance and year of the event.

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

7.1.11 Quality Control of the Activity Data

Several rounds of Quality Control took place while developing the Collect Earth Assessment. Plots misidentified were corrected by the National Interpreters (4) and two experts leads from Panama and Belize. The Matrix of impossible transitions of Land Use and Disturbances developed before the assessment was used to identify the errors during the assessment. Elevation ranges previously agreed as well as influence of location in forest types was also used to identify errors (for example, a coastal forest in >1000 m.a.s.l). Posterior to the assessment that took place in Saint Lucia, the technical lead did a full reassessment of all plots, and it was compared to the information previously collected. Different plots was revised and corrected if necessary.[35]

7.1.12 Data processing _ Area estimation

For data analysis of the 1605 plots, a coding system was created to aggregate plots with the same land use or land use change (figure 38).

[35] As part of the uncertainty analysis, a percentage of error interpretation will be given.

Figure 39 Grouping plots with the same land use dynamic.

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 (figure 39).

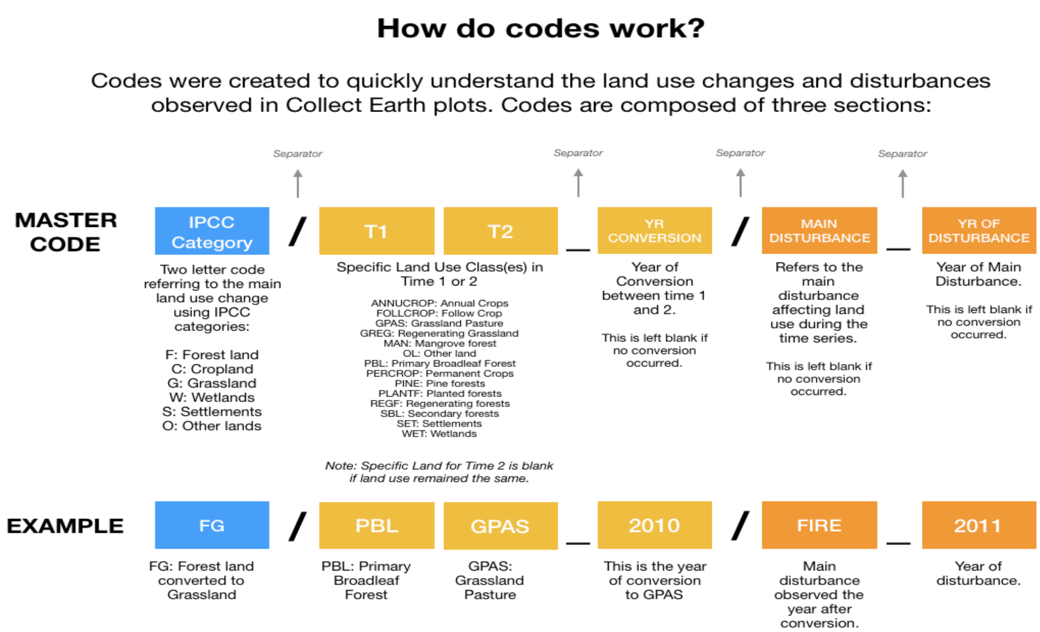


Figure 40 Coding system of land use dynamics

Once the code was applied to each of the 1605 assessed plots, information was summarized on the form of a pivot table (table 10). Then, area that each trajectory was calculated by multiplying the number of plots of each trajectory by the expansion factor, which was calculated diving the total surface of the country (75000 Ha) by the total number of plots of the grid (1605 plots), equal to 43.76 Ha, meaning that each 1Ha plot represents an area of 43.76 ha, area that is distributed surrounding the plot.

Table 10 pivot table summarizing all land use dynamics and area estimation.

STEP 2 - AREA ESTIMATION (Plot count * Exp. Factor)		
	1605	75000
Row Labels	Count of Transition Coding	Area [Ha]
CC/CANNUAL/_	130	6074.8
CC/CPER/_	84	3925.2
CF/CANNUAL>FRAIN_2013/Hurricane_2017	1	46.7
CG/CANNUAL>GGRASS_2014/_	1	46.7
CG/CPER>GGRASS_2014/_	1	46.7
CG/CPER>GGRASS_2018/_	1	46.7
CG/CPER>GWGRASS_2017/_	1	46.7
CS/CANNUAL>SSET_2016/_	1	46.7
CS/CPER>SSET_2014/_	1	46.7
FC/FCLOUD>CANNUAL_2011/_	1	46.7
FC/FDEC>CANNUAL_2005/_	1	46.7
FC/FDSCRUB>CANNUAL_2011/_	1	46.7
FC/FEVER>CANNUAL_2017/_	1	46.7
FC/FEVER>CANNUAL_2018/_	1	46.7
FC/FRAIN>CANNUAL_2013/_	1	46.7
FF/FCLOUD/Hurricane_2017	108	5046.7
FF/FDEC/Hurricane_2015	1	46.7
FF/FDEC/Hurricane_2017	148	6915.9
FF/FDSCRUB/Hurricane_2017	35	1635.5
FF/FELF/Hurricane_2017	42	1962.6
FF/FEVER/Hurricane_2017	218	10186.9
FF/FEVER/Shifting Cultivation_2015	1	46.7
FF/FLIT/Hurricane_2017	76	3551.4
FF/FRAIN/Hurricane_2017	603	28177.6
FG/FDEC>GWGRASS_2012/_	1	46.7
FG/FDSCRUB>GWGRASS_2005/_	1	46.7
FG/FEVER>GWGRASS_2015/_	2	93.5
FG/FEVER>GWGRASS_2016/_	1	46.7
FG/FLIT>GGRASS_2015/_	1	46.7
FG/FRAIN>GGRASS_2014/_	1	46.7
FO/FDSCRUB>OMIN_2014/_	1	46.7
FO/FRAIN>OOTHER_2017/_	1	46.7
FS/FDSCRUB>SSET_2011/_	1	46.7

FS/FDSCRUB>SWSET_2005/_	1	46.7
FS/FDSCRUB>SWSET_2014/_	1	46.7
FS/FEVER>SWSET_2012/_	1	46.7
FS/FRAIN>SWSET_2006/_	1	46.7
FS/FRAIN>SWSET_2012/_	1	46.7
GF/GWGRASS>FRAIN_2016/Hurricane_2017	1	46.7
GG/GGRASS/_	26	1215.0
GG/GWGRASS/_	29	1355.1
OO/OMIN/_	2	93.5
OO/OOTHER/_	7	327.1
SS/SSET/_	27	1261.7
SS/SWSET/_	34	1588.8
WW/WWET/_	5	233.6
Sum	1605.0	75000.0

For facilitating the understanding of the data, the information of the pivot table was reorganized in land use and land use change matrices and disturbance matrices (figure 30).

Figure 41. Land use change matrices (area in ha)

LAND USE CHANGES

Period	Land Use and Land Use Change (LULUC) Vertical: Final Use Horizontal: Initial Use	Elfin and Cloud forest	Montane Rainforest	Semi-evergreen Forest	Deciduous Forest	Dry Scrub Forest	Litoral Forest	Croplands, Annual Crops	Croplands, Perennial Crops	Grasslands (Pastures)	0	Wetland	Settlement	Woody Settlement	Other Lands	Mining	TOTAL
2016-2017	Elfin and Cloud forest	7,009															
	Montane Rainforest		28,271												47		
	Semi-evergreen Forest			10,280				47									
	Deciduous Forest				6,963												
	Dry Scrub Forest					1,636											
	Litoral Forest						3,551										
	Croplands, Annual Crops							6262									
	Croplands, Perennial Crops								3972		47						
	Grasslands (Pastures)									1,402							
	Shrublands										1,589						
	Wetland											234					
	Settlement												1,449				
	Woody Settlement													1,776			
	Other Lands														327		
	Mining															140	140
	TOTAL	7,009	28,271	10,280	6,963	1,636	3,551	6,308	3,972	1,402	1,636	234	1,449	1,776	374	140	75,000
									10,280	1,402	1,636	234		3,224		514	0
2015-2016	Elfin and Cloud forest	7,009															
	Montane Rainforest		28,271														
	Semi-evergreen Forest			10,327							47						
	Deciduous Forest				6,963												
	Dry Scrub Forest					1,636											
	Litoral Forest						3,551										
	Croplands, Annual Crops							6262					47				
	Croplands, Perennial Crops								4019								
	Grasslands (Pastures)									1,402							
	Shrublands		47								1,542						
	Wetland											234					
	Settlement												1,402				
	Woody Settlement													1,776			
	Other Lands														327		
	Mining															140	140
	TOTAL	7,009	28,318	10,327	6,963	1,636	3,551	6,262	4,019	1,402	1,589	234	1,449	1,776	327	140	75,000
									10,280	1,402	1,589	234		3,224		467	0

2014-2015

	Elfin and Cloud forest	Montane Rainforest	Semi-evergreen Forest	Deciduous Forest	Dry Scrub Forest	Litoral Forest	Croplands, Annual Crops	Croplands, Perennial Crops	Grasslands (Pastures)	0	Wetland	Settlement	Woody Settlement	Other Lands	Mining	TOTAL
Elfin and Cloud forest	7,009															
Montane Rainforest		28,271														
Semi-evergreen Forest			10,374							93						
Deciduous Forest				6,963												
Dry Scrub Forest					1,636											
Litoral Forest						3,551			47							
Croplands, Annual Crops							6308									
Croplands, Perennial Crops								4019								
Grasslands (Pastures)									1,355							
Shrublands										1,495						
Wetland											234					
Settlement												1,402				
Woody Settlement													1,776			
Other Lands														327		
Mining															140	140
TOTAL	7,009	28,271	10,374	6,963	1,636	3,551	6,308	4,019	1,402	1,589	234	1,402	1,776	327	140	75,000
								10,327	1,402	1,589	234		3,178		467	0

2013-2014

	Elfin and Cloud forest	Montane Rainforest	Semi-evergreen Forest	Deciduous Forest	Dry Scrub Forest	Litoral Forest	Croplands, Annual Crops	Croplands, Perennial Crops	Grasslands (Pastures)	0	Wetland	Settlement	Woody Settlement	Other Lands	Mining	TOTAL
Elfin and Cloud forest	7,009															
Montane Rainforest		28,271							47							
Semi-evergreen Forest			10,467													
Deciduous Forest				6,963												
Dry Scrub Forest					1,636								47		47	
Litoral Forest						3,598										
Croplands, Annual Crops							6308		47							
Croplands, Perennial Crops								4019	47			47				
Grasslands (Pastures)									1,215							
Shrublands										1,495						
Wetland											234					
Settlement												1,355				
Woody Settlement													1,729			
Other Lands														327		
Mining															93	280
TOTAL	7,009	28,271	10,467	6,963	1,636	3,598	6,308	4,019	1,355	1,495	234	1,402	1,776	327	140	75,000
								10,327	1,355	1,495	234		3,178		467	0

2012-2013

	Elfin and Cloud forest	Montane Rainforest	Semi-evergreen Forest	Deciduous Forest	Dry Scrub Forest	Litoral Forest	Croplands, Annual Crops	Croplands, Perennial Crops	Grasslands (Pastures)	0	Wetland	Settlement	Woody Settlement	Other Lands	Mining	TOTAL
Elfin and Cloud forest	7,009															
Montane Rainforest		28,271					47									
Semi-evergreen Forest			10,467													
Deciduous Forest				6,963												
Dry Scrub Forest					1,729											
Litoral Forest						3,598										
Croplands, Annual Crops		47					6308									
Croplands, Perennial Crops								4112								
Grasslands (Pastures)									1,215							
Shrublands										1,495						
Wetland											234					
Settlement												1,355				
Woody Settlement													1,729			
Other Lands														327		
Mining															93	93
TOTAL	7,009	28,318	10,467	6,963	1,729	3,598	6,355	4,112	1,215	1,495	234	1,355	1,729	327	93	75,000
								10,467	1,215	1,495	234		3,084		421	0

LAND USE CHANGES

2011-2012

Land Use and Land Use Change (LULUC) Vertical: Final Use Horizontal: Initial Use	Elfin and Cloud forest	Montane Rainforest	Semi-evergreen Forest	Deciduous Forest	Dry Scrub Forest	Litoral Forest	Croplands, Annual Crops	Croplands, Perennial Crops	Grasslands (Pastures)	0	Wetland	Settlement	Woody Settlement	Other Lands	Mining	TOTAL
Elfin and Cloud forest	7,009															
Montane Rainforest		28,318											47			
Semi-evergreen Forest			10,467										47			
Deciduous Forest				6,963						47						
Dry Scrub Forest					1,729											
Litoral Forest						3,598										
Croplands, Annual Crops							6355									
Croplands, Perennial Crops								4112								
Grasslands (Pastures)									1,215							
Shrublands										1,449						
Wetland											234					
Settlement												1,355				
Woody Settlement													1,636			
Other Lands														327		
Mining															93	140
TOTAL	7,009	28,318	10,467	6,963	1,729	3,598	6,355	4,112	1,215	1,495	234	1,355	1,729	327	93	75,000
								10,467	1,215	1,495	234		3,084		421	0

2010-2011

	Elfin and Cloud forest	Montane Rainforest	Semi-evergreen Forest	Deciduous Forest	Dry Scrub Forest	Litoral Forest	Croplands, Annual Crops	Croplands, Perennial Crops	Grasslands (Pastures)	0	Wetland	Settlement	Woody Settlement	Other Lands	Mining	TOTAL
Elfin and Cloud forest	7,009						47									
Montane Rainforest		28,364														
Semi-evergreen Forest			10,514													
Deciduous Forest				7,009												
Dry Scrub Forest					1,729		47					47				
Litoral Forest						3,598										
Croplands, Annual Crops							6262									
Croplands, Perennial Crops								4112								
Grasslands (Pastures)									1,215							
Shrublands										1,449						
Wetland											234					
Settlement												1,308				
Woody Settlement													1,636			
Other Lands														327		
Mining															93	140
TOTAL	7,009	28,364	10,514	7,009	1,729	3,598	6,355	4,112	1,215	1,449	234	1,355	1,636	327	93	75,000
								10,467	1,215	1,449	234		2,991		421	0

2009-2010

Elfin and Cloud forest	7,056															
Montane Rainforest		28,364														
Semi-evergreen Forest			10,514													
Deciduous Forest				7,009												
Dry Scrub Forest					1,822											
Litoral Forest						3,598										
Croplands, Annual Crops							6262									
Croplands, Perennial Crops								4112								
Grasslands (Pastures)									1,215							
Shrublands										1,449						
Wetland											234					
Settlement												1,308				
Woody Settlement													1,636			
Other Lands														327		
Mining															93	0
TOTAL	7,056	28,364	10,514	7,009	1,822	3,598	6,262	4,112	1,215	1,449	234	1,308	1,636	327	93	75,000
								10,374	1,215	1,449	234		2,944		421	0

2008-2009

Elfin and Cloud forest	7,056															
Montane Rainforest		28,364														
Semi-evergreen Forest			10,514													
Deciduous Forest				7,009												
Dry Scrub Forest					1,822											
Litoral Forest						3,598										
Croplands, Annual Crops							6262									
Croplands, Perennial Crops								4112								
Grasslands (Pastures)									1,215							
Shrublands										1,449						
Wetland											234					
Settlement												1,308				
Woody Settlement													1,636			
Other Lands														327		
Mining															93	0
TOTAL	7,056	28,364	10,514	7,009	1,822	3,598	6,262	4,112	1,215	1,449	234	1,308	1,636	327	93	75,000
								10,374	1,215	1,449	234		2,944		421	0

2007-2008

Elfin and Cloud forest	7,056															
Montane Rainforest		28,364														
Semi-evergreen Forest			10,514													
Deciduous Forest				7,009												
Dry Scrub Forest					1,822											
Litoral Forest						3,598										
Croplands, Annual Crops							6262									
Croplands, Perennial Crops								4112								
Grasslands (Pastures)									1,215							
Shrublands										1,449						
Wetland											234					
Settlement												1,308				
Woody Settlement													1,636			
Other Lands														327		
Mining															93	0
TOTAL	7,056	28,364	10,514	7,009	1,822	3,598	6,262	4,112	1,215	1,449	234	1,308	1,636	327	93	75,000
								10,374	1,215	1,449	234		2,944		421	0

LAND USE CHANGES

2006-2007

Land Use and Land Use Change (LULUC) Vertical: Final Use Horizontal: Initial Use	Elfin and Cloud forest	Montane Rainforest	Semi-evergreen Forest	Deciduous Forest	Dry Scrub Forest	Litoral Forest	Croplands, Annual Crops	Croplands, Perennial Crops	Grasslands (Pastures)	0	Wetland	Settlement	Woody Settlement	Other Lands	Mining	TOTAL
Elfin and Cloud forest	7,056															
Montane Rainforest		28,364														
Semi-evergreen Forest			10,514													
Deciduous Forest				7,009												
Dry Scrub Forest					1,822											
Litoral Forest						3,598										
Croplands, Annual Crops							6262									
Croplands, Perennial Crops								4112								
Grasslands (Pastures)									1,215							
Shrublands										1,449						
Wetland											234					
Settlement												1,308				
Woody Settlement													1,636			
Other Lands														327		
Mining															93	0
TOTAL	7,056	28,364	10,514	7,009	1,822	3,598	6,262	4,112	1,215	1,449	234	1,308	1,636	327	93	75,000
								10,374	1,215	1,449	234		2,944		421	0

2005-2006

Elfin and Cloud forest	7,056															
Montane Rainforest		28,364										47				
Semi-evergreen Forest			10,514													
Deciduous Forest				7,009												
Dry Scrub Forest					1,822											
Litoral Forest						3,598										
Croplands, Annual Crops							6262									
Croplands, Perennial Crops								4112								
Grasslands (Pastures)									1,215							
Shrublands										1,449						
Wetland											234					
Settlement												1,262				
Woody Settlement													1,636			
Other Lands														327		
Mining															93	47
TOTAL	7,056	28,364	10,514	7,009	1,822	3,598	6,262	4,112	1,215	1,449	234	1,308	1,636	327	93	75,000
								10,374	1,215	1,449	234		2,944		421	0

2004-2005

Elfin and Cloud forest	7,056															
Montane Rainforest		28,411														
Semi-evergreen Forest			10,514													
Deciduous Forest				7,009			47									
Dry Scrub Forest					1,822					47			47			
Litoral Forest						3,598										
Croplands, Annual Crops							6215									
Croplands, Perennial Crops								4112								
Grasslands (Pastures)									1,215							
Shrublands										1,402						
Wetland											234					
Settlement												1,262				
Woody Settlement													1,589			
Other Lands														327		
Mining															93	140
TOTAL	7,056	28,411	10,514	7,009	1,822	3,598	6,262	4,112	1,215	1,449	234	1,262	1,636	327	93	75,000
								10,374	1,215	1,449	234		2,897		421	0

2003-2004

Elfin and Cloud forest	7,056															
Montane Rainforest		28,411														
Semi-evergreen Forest			10,514													
Deciduous Forest				7,056												
Dry Scrub Forest					1,916											
Litoral Forest						3,598										
Croplands, Annual Crops							6215									
Croplands, Perennial Crops								4112								
Grasslands (Pastures)									1,215							
Shrublands										1,402						
Wetland											234					
Settlement												1,262				
Woody Settlement													1,589			
Other Lands														327		
Mining															93	0
TOTAL	7,056	28,411	10,514	7,056	1,916	3,598	6,215	4,112	1,215	1,402	234	1,262	1,589	327	93	75,000
								10,327	1,215	1,402	234		2,850		421	0

2002-2003

Elfin and Cloud forest	7,056															
Montane Rainforest		28,411														
Semi-evergreen Forest			10,514													
Deciduous Forest				7,056												
Dry Scrub Forest					1,916											
Litoral Forest						3,598										
Croplands, Annual Crops							6215									
Croplands, Perennial Crops								4112								
Grasslands (Pastures)									1,215							
Shrublands										1,402						
Wetland											234					
Settlement												1,262				
Woody Settlement													1,589			
Other Lands														327		
Mining															93	0
TOTAL	7,056	28,411	10,514	7,056	1,916	3,598	6,215	4,112	1,215	1,402	234	1,262	1,589	327	93	75,000
								10,327	1,215	1,402	234		2,850		421	0

LAND USE CHANGES

Land Use and Land Use Change (LULUC) Vertical: Final Use Horizontal: Initial Use	Elfin and Cloud forest	Montane Rainforest	Semi-evergreen Forest	Deciduous Forest	Dry Scrub Forest	Littoral Forest	Croplands, Annual Crops	Croplands, Perennial Crops	Grasslands (Pastures)	0	Wetland	Settlement	Woody Settlement	Other Lands	Mining	TOTAL

2001-2002

Elfin and Cloud forest	7,056															
Montane Rainforest		28,411														
Semi-evergreen Forest			10,514													
Deciduous Forest				7,056												
Dry Scrub Forest					1,916											
Litoral Forest						3,598										
Croplands, Annual Crops							6215									
Croplands, Perennial Crops								4112								
Grasslands (Pastures)									1,215							
Shrublands										1,402						
Wetland											234					
Settlement												1,262				
Woody Settlement													1,589			
Other Lands														327		
Mining															93	0
TOTAL	7,056	28,411	10,514	7,056	1,916	3,598	6,215	4,112	1,215	1,402	234	1,262	1,589	327	93	75,000
								10,327	1,215	1,402	234		2,850		421	0

2000-2001

Elfin and Cloud forest	7,056															
Montane Rainforest		28,411														
Semi-evergreen Forest			10,514													
Deciduous Forest				7,056												
Dry Scrub Forest					1,916											
Litoral Forest						3,598										
Croplands, Annual Crops							6215									
Croplands, Perennial Crops								4112								
Grasslands (Pastures)									1,215							
Shrublands										1,402						
Wetland											234					
Settlement												1,262				
Woody Settlement													1,589			
Other Lands														327		
Mining															93	0
TOTAL	7,056	28,411	10,514	7,056	1,916	3,598	6,215	4,112	1,215	1,402	234	1,262	1,589	327	93	75,000
								10,327	1,215	1,402	234		2,850		421	0

2000

Elfin and Cloud forest	7,056															
Montane Rainforest		28,411														
Semi-evergreen Forest			10,514													
Deciduous Forest				7,056												
Dry Scrub Forest					1,916											
Litoral Forest						3,598										
Croplands, Annual Crops							6215									
Croplands, Perennial Crops								4112								
Grasslands (Pastures)									1,215							
Shrublands										1,402						
Wetland											234					
Settlement												1,262				
Woody Settlement													1,589			
Other Lands														327		
Mining															93	
TOTAL	7,056	28,411	10,514	7,056	1,916	3,598	6,215	4,112	1,215	1,402	234	1,262	1,589	327	93	75,000
											234	1,262	1,589	327	93	

7.2 Emission Factors

The information on Emission Factors (EFs) was obtained from default values of the 2006 IPCC Guidelines, 2019 Refinement to the 2006 IPCC Guidelines, and from the National Forest Inventory from Saint Lucia (2009), as both islands share the same forest types, and no recent Forest inventory has taken place in Dominica.

National Forest Inventory [Saint Lucia] (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 (table 11). 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).[36] 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.

[36] 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

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 11 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.
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 Table 11 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.

For major forest classes analysis Stehle's (1945) 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 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 12).

Table 12 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

7.3 IPCC Methodologies applied

Following paragraphs 10[37] and 21[38] of annex to decision 17/CP.8, 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, Dominica 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). It includes the analysis for Land remaining in a land-use category and lands converted to a new land-use category. The Dominica'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.

The equations were applied to each of the land use dynamics included in the pivot table (figure 41)

[37] **Paragraph 10, annex to 17/CP.8,** states that the IPCC Guidelines offer a default methodology which includes default emission factors and in some cases default activity data. As these default factors, data and assumptions may not always be appropriate for specific national circumstances, non-Annex I Parties are encouraged to use their country-specific and regional emission factors and activity data for key sources or, where these do not exist, to propose plans to develop them in a scientifically sound and consistent manner, provided that they are more accurate than the default data and documented transparently.

[38] **According to paragraph 21, annex to 17/CP.8**, Non-Annex I Parties are encouraged to provide information on methodologies used in the estimation of anthropogenic emissions by sources and removals by sinks of GHG not controlled by the Montreal Protocol, including a brief explanation of the sources of emission factors and activity data. If non-Annex I Parties estimate anthropogenic emissions and removals from country- specific sources and/or sinks which are not part of the IPCC Guidelines, they should explicitly describe the source and/or sink categories, methodologies, emission factors and activity data used in their estimation of emissions, as appropriate.

Figure 42 Diagram explaining how IPCC equations for the Gain and Loss method were applied to the land use dynamics.

7.3.1 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)

$$\Delta CLUi = \Delta CAB + \Delta CBB + \Delta CDW + \Delta CLi + \Delta CHWP$$

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 13. Carbon 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.

7.3.2 Change in biomass carbon stocks (above-ground biomass and below-ground biomass) in forest lands remaining in the same category

Annual change in carbon stocks in biomass in forest land remaining in the same category (gain-loss method) (Equation 2.7, Ch2, V4)

$$\Delta C = \Delta CG + \Delta CL$$

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 forest land remaining in the same land-use category (Equation 2.9, Ch2, V4)

$$\Delta CG = \sum_{i,j}(Ai, j \bullet GTOTAL\ i, j \bullet CFi, j)$$

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

GTOTAL= 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 14. Sources of activity data for 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 2000-2017
C	Croplands	Forestry Division	Collect earth assessment - Annual time series 2000-2017
G	Grasslands	Forestry Division	Collect earth assessment - Annual time series 2000-2017
W	Wetlands	Forestry Division	Collect earth assessment - Annual time series 2000-2017
S	Settlements	Forestry Division	Collect earth assessment - Annual time series 2000-2017
O	Other lands	Forestry Division	Collect earth assessment - Annual time series 2000-2017

Table 15. Carbon fraction values

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
C	Annual Crops	0	X		Assumption	
	Perennial Crops	0.5	X		IPCC 2006, V4, Ch5, p.5.11 (Step 4)	
G	Grasslands	0.47	X		IPCC 2006, V4, Ch6, page 6.29. Step 5 - herbaceous	
	Woody Grasslands	0.5	X		IPCC 2006, V4, Ch6, page 6.29. Step 5 - woody biomass	
W	Wetlands	0	X		Assumption	
S	Non-Woody Settlements	0	X		Assumption	
	Woody Settlements	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 not country-specific research has been carried out. Agreed on May 21st 2020 with Forest Division Team.

Table 16. Values of ratio of below to above ground biomass

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
C	**Annual Crops**		0	X		Assumption	
	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 (Dry)**		2.8	X		IPCC 2006, V4, Ch6, Table 6.4	
	Grassland (Moist)		1.6	X		IPCC 2006, V4, Ch6, Table 6.4	
	Woody Grassland		2.8	X		IPCC 2006, V4, Ch6, Table 6.4	
W	**Wetlands**		0			Assumption	
S	**Non-Woody Settlements**		0			Assumption	
	Woody Settlements		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**		0			Assumption	

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

$$GTOTAL = \sum_{i,j}\{GW \bullet (1 + R)\}$$

Where:

GTOTAL = average annual biomass growth above and below-ground, tonnes d. m. ha_{-1} yr_{-1}

GW = 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 17. Values for Net biomass growth 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			Assumption	Expert Judgement, Forestry Division. Gw is 0 as it is considered stable forest.
		Disturbed (Hurricane, fire, logging, Shift.Cult)	4.40	X	SD:1.6	2019 IPCC RF, Vol 4, Ch4, Table 4.9	
	Montane Forest	Undisturbed	0.00	X		Assumption	Expert Judgement, Forestry Division. Gw is 0 as it is considered stable forest.
		Disturbed (Hurricane, fire, logging, Shift.Cult)	5.90	X	SD: 2.3	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

	Croplands	Annual	0	X		Assumption	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 t.d.m ha-1 yr-1. For Tropical moist (Value 2.6 C ha-1 yr-1, this value is divided for the CF=0.5, to obtain de t.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 d.m ha-1 yr-1.. For Tropical dry (Value 1.8 C ha-1 yr-1, this value is divided for the CF=0.5, to obtain de t.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.
		Moist	6.2	X		IPCC 2006, V4, Ch6, Table 6.4	
		Woody	1.5	X			Estimated as the AGB divided by 10 years, which was the time indicated by the Dominica team to have woody components in grasslands.
	Wetlands		0	X		Assumption	Assumed to be 0 for Wetlands remaining Wetlands following Tier 1 approach and lands converted to Wetlands
	Settlements	Settlements	0	X		Assumption	Assumed to be 0 for Settlements remaining Settlements following Tier 1 approach and lands converted to Settlements
		Woody Settlement	1.27	X			Assumed to be 0 for Woody Settlements remaining Woody Settlements following Tier 1 approach and for lands converted to Woody Settlements, Gw is equal to 70% is the same value as settlements, 10% is same value a Perennial Crops, 10% is same value as Semi-Evergreen Forest, 10% is same value as Deciduous 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 June 4th, 2020 Forestry Division team. 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 18. Values for time to reaching max stock

Forestland	Time to reach max stock [years]
Elfin and Cloud forest (FCLOUD)	4.4
Montane Forest (FRAIN)	47.4
Semi-evergreen Forest (FEVER)	43.8
Deciduous - Coastal Forest (FDEC, FLIT, FDRYS)	10.6
Croplands	
Perennial (CPER) (Moist)	8.1
Perennial (CPER) (Dry)	5.0
Grassland	
Grassland (GGRASS)(Dry)	1
Grassland (GGRASS)(Moist)	1
Grassland Woody (GWGRASS)	10
Settlement	
Woody Settlement (SWOOD)	22.6

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

$$\Delta CL = \Delta Lwood - removals + \Delta Lfuelwood + \Delta Ldisturbance$$

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}

Lwood-removals = annual carbon loss due to wood removals, tonnes C yr_{-1} (See Equation 2.12)

Lfuelwood = annual biomass carbon loss due to fuelwood removals, tonnes C yr_{-1} (See Equation 2.13)

Ldisturbance = 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)

$$Lwood - removals = \{ H \bullet BCEFR \bullet (1 + R) \bullet CF \}$$

Where:

Lwood-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.)$_{-1}$

BCEFR = 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 19. Annual wood removals values

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

Clarification Notes

Detailed national statistics on wood removals is not available as yet. However, losses due to wood removals were estimated as an area of cover loss, through the Collect Earth assessment, and allocated as “Logging Disturbance”, where a fraction (fd) was determined and then used in eq. 2.14

Table 20. $BCEF_R$ values

$BCEF_R$: 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)

$$Lfuelwood = [\{ FGtrees \bullet BCEFR \bullet (1 + R) \} + FGpart \bullet D] \bullet CF$$

Where:

Lfuelwood = annual carbon loss due to fuelwood removals, tonnes C yr_{-1}

FGtrees = annual volume of fuelwood removal of whole trees, m_3 yr_{-1}

FGpart = 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}

BCEFR = biomass conversion and expansion factor for conversion of removals in merchantable volume to biomass removals (including bark), tonnes biomass removal (m_3 of removals)$_{-1}$

Table 21. FGtree and FGpart values

FGtrees = annual volume of fuelwood removal of whole trees				
LU	**Sub-Category**	**Source**	**years**	**Notes**
F	NE	NE		
FGpart = annual volume of fuelwood removal as tree parts				
LU	**Sub-Category**	**Sources**		**Notes**
F	NE	NE		

Clarification Notes

Detailed national statistics on fuelwood removals is not available as yet

Table 22. Wood density values

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), 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)[39] and Chave *et* al. (2007)[40] (See Annex III. Wood Density by FCV in the Excel GHG calculation tool).

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

$$Ldisturbance = Adisturbance \bullet BW \bullet (1 + R) \bullet CF \bullet fd$$

Where:

Ldisturbances = annual other losses of carbon, tonnes C yr_{-1}

Adisturbance = area affected by disturbances, ha yr_{-1}

BW = 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

Adisturbance: area affected by disturbances, ha yr_{-1}

Figure 43. Land use matrices for disturbances

[39] 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.
[40] 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.

DISTURBANCES

2016-2017

Land Use and Land Use Change (LULUC) Vertical: Inicial Use Horizontal: Final Use	*Affected by Fire*	*Affected by by Hurricane*	*Affected by Logging*	*Affected by Shifting Cultivation*	**TOTAL**
Elfin and Cloud forest		7009			7,009
Montane Rainforest		28271			28,271
Semi-evergreen Forest		10187			10,187
Deciduous Forest		6916			6,916
Dry Scrub Forest		1636			1,636
Litoral Forest		3551			3,551
Croplands, Annual Crops					0
Croplands, Perennial Crops					0
Grasslands (Pastures)					0
					0
Wetland					0
Settlement					0
Woody Settlement					0
Other Lands					0
Mining					0
TOTAL					57,570

2015-2016

Land Use and Land Use Change (LULUC)	*Affected by Fire*	*Affected by by Hurricane*	*Affected by Logging*	*Affected by Shifting Cultivation*	**TOTAL**
Elfin and Cloud forest					0
Montane Rainforest					0
Semi-evergreen Forest					0
Deciduous Forest		47		47	93
Dry Scrub Forest					0
Litoral Forest					0
Croplands, Annual Crops					0
Croplands, Perennial Crops					0
Grasslands (Pastures)					0
					0
Wetland					0
Settlement					0
Woody Settlement					0
Other Lands					0
Mining					0
TOTAL					93

Table 23. Average above ground biomass t.d.m ha-1

BW = average above-ground biomass of land areas affected by disturbances							
LU	**Category**	**Value**	**Regional value (tier 2)**	**Default Value (tier 1)**	**Error o range reported**	**Source**	**Comments and assumptions**
F	**Elfin and Cloud forest**	19.2	X			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	279.6	X			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	227.6	X			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	41.5	X			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
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 t.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 t.d.m). This value is used only for conversions from Dry Forest (ex. FDEC,FDRYS, FLIT) to Croplands
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
	Woody Grassland	15					Values allocated by expert judgement. The value was selected using as reference the AGB for FEVER and FDEC/FSCRY and Perennial Croplands
W	**Wetlands**	0		X			Assumed to be 0
S	**Non-Woody Settlements**	0		X			Assumed to be 0
	Woody Settlements	28.7		X		Estimates as: =(0*0.7)+(0.1*227.6)+(0.1*41.5)+(0.1*18)	70% is the same value as settlements, 10% is same value a Perennial Crops, 10% is same value as Semi-Evergreen Forest, 10% is same value as Deciduous 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)[41] pantropical biomass allometric equation was selected to estimate biomass in Saint Lucia, and the same approach was considered applicable to Dominica. Tree AGB (kg) was regressed against the product ρ *D^2 * H. The best-fit pantropical model identified was:

$$AGB_{est}: 0.0673 * (\rho * D^2 * H)^{0.976}$$
$$(\sigma = 357; AIC = 3130; df = 4002)$$

where D is in cm, H is in m, and ρ is in g cm/3. 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 24. 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	0.85	x	Forestry Division, Collect Earth Assessment and Expert Judgement
	Affected by Fire	NO	x	Forestry Division, Collect Earth Assessment and Expert Judgement
	Affected by Logging	NO	x	Forestry Division, Collect Earth Assessment and Expert Judgement
	Affected by Shifting Cultivation	NO	x	Forestry Division, Collect Earth Assessment and Expert Judgement
Montane Forest	Affected by hurricane	0.90	x	Forestry Division, Collect Earth Assessment and Expert Judgement
	Affected by Fire	NO	x	Forestry Division, Collect Earth Assessment and Expert Judgement

[41] 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.

	Affected by Logging	NO	x	Forestry Division, Collect Earth Assessment and Expert Judgement
	Affected by Shifting Cultivation	NO	x	Forestry Division, Collect Earth Assessment and Expert Judgement
Semi-evergreen Forest	Affected by hurricane	0.90	x	Forestry Division, Collect Earth Assessment and Expert Judgement
	Affected by Fire	NO	x	Forestry Division, Collect Earth Assessment and Expert Judgement
	Affected by Logging	NO	x	Forestry Division, Collect Earth Assessment and Expert Judgement
	Affected by Shifting Cultivation	0.60	x	Forestry Division, Collect Earth Assessment and Expert Judgement
Deciduous - Coastal Forest	Affected by hurricane	0.85	x	Forestry Division, Collect Earth Assessment and Expert Judgement
	Affected by Fire	NO	x	Forestry Division, Collect Earth Assessment and Expert Judgement
	Affected by Logging	NO	x	Forestry Division, Collect Earth Assessment and Expert Judgement
	Affected by Shifting Cultivation	NO	x	Forestry Division, Collect Earth Assessment and Expert Judgement
	Affected by Fire	NO	x	Forestry Division, Collect Earth Assessment and Expert Judgement
	Affected by Logging	NO	x	Forestry Division, Collect Earth Assessment and Expert Judgement
	Affected by Shifting Cultivation	NO	x	Forestry Division, Collect Earth Assessment and Expert Judgement

Clarification Notes

Fd values were selected based on expert judgment of the interpreters who did the Collect Earth, estimated as an average of the lost seen in the images, caused the by the indicated disturbance

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

The Tier 1 assumption for both dead wood and litter pools for all forest land sub-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.

7.3.4 Change in soil organic carbon stock in forest land remaining in the same category

The assumption in Tier 1 is that the SOC carbon stocks in all Forest land Remaining Forest land are insignificant or are not changing and therefore no emission/removal factors and activity data are needed.

7.3.5 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)

$$\Delta CB = \Delta CG + \Delta CCONVERSION - \Delta CL$$

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 25. Sources of area of land converted to a land-use category

A: area of land converted to a land-use category			
LU	**Sub-Category**	**Source**	**Notes**
Non-F>F	Non-Forest Lands > Forest Lands	Forest Division	Collect earth assessment - Annual time series 2000-2017
F>C	Forest lands > Croplands	Forest Division	Collect earth assessment - Annual time series 2000-2017
F>G	Forest lands > Grasslands	Forest Division	Collect earth assessment - Annual time series 2000-2017
F>W	Forest lands > Wetlands	Forest Division	Collect earth assessment - Annual time series 2000-2017
F>S	Forest lands > Settlements	Forest Division	Collect earth assessment - Annual time series 2000-2017
F>O	Forest lands > Other lands	Forest Division	Collect earth assessment - Annual time series 2000-2017

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 using the same approach as in forest lands remaining forest lands.

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

$$\Delta CCONVERSION = \sum_{i}\{(BAFTER - BBEFORE) \bullet \Delta ATO\_OTHERS\} \bullet C$$

Where:

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

$BAFTER_i$ = biomass stocks on land type i immediately after the conversion, tonnes d.m. ha_{-1}

$BBEFORE_i$ = biomass stocks on land type i before the conversion, tonnes d.m. ha_{-1}

ΔATO_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

<u>**Note:**</u> 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 forest lands remaining in the same category.

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

<u>Note:</u> 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 forest lands remaining in a category.

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

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

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

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 26. Dead wood/litter stock values

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
DOM	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
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	
DOM	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	
DOM	Grassland	0	X		IPCC 2006, V4, Ch6, page 5.31. Tier 1	
Litter	Wetlands	NO				
DOM	Wetlands	NO				
Litter	Settlement	NO				
	Woody Settlement	NO				
DOM	Settlement	NO				
	Woody Settlement	NO				

Litter	Other Lands	NO				
DOM	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.

7.3.7 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)

$$\Delta CMineral = \frac{(SOCo - SOC_{o-t})}{D}$$

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

Where,

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

SOC0 = 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.

SOCREF = 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.

Soil information was obtained from the Global Soil Organic Carbon Map -GSOCmap-, from FAO (2019) (figure 44). The web address of the portal is http://54.229.242.119/GSOCmap/. The country was selected, and information was downloaded through the “crop & Download” function. The result of the process is a TIFF file. The TIFF image processing was done in QGIS Desktop version 3.1.6. The TIFF had to undergo a correction for adequate georeferencing, which was done by selecting 4 sampling points and the coordinates were reassigned.

As a result, a CVS file is generated containing the SOC ref values for each sampling point. Information was saved as CSV file (this sheet). Then, information is organized by land use and sub-category and an average value is estimated. The final SOC ref value is reported In EF-Values

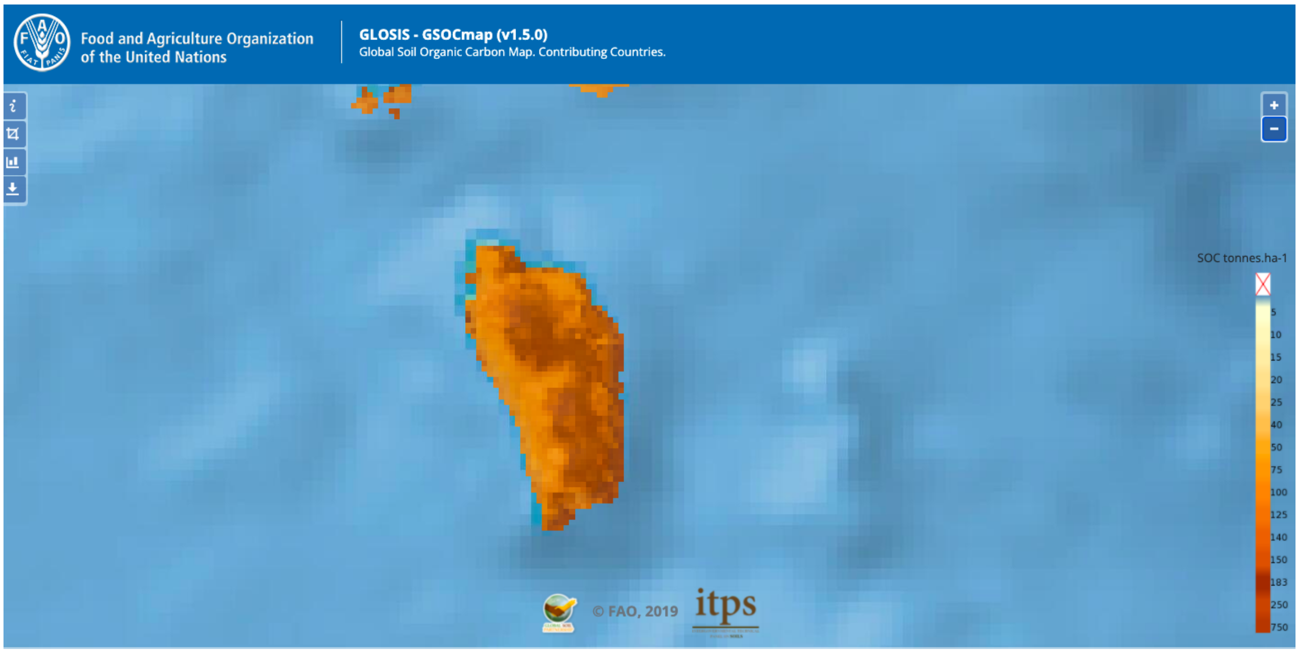


Figure 44 Dominica - Global Soil Organic Carbon Map -GSOCmap-, from FAO (2019).

Dominica has information on land uses obtained through Collect earth assessment described in the activity data section. Thus, the objective is to link the SOC information for each of the plots (figure 45)., which will then allow allocating the SOC ref value by land use and sub-categories of land use (Table 27). The TIFF image was processed using the Samples Raster Values tool for the process of linking the Collect Earth plots with the SOC shapefile.

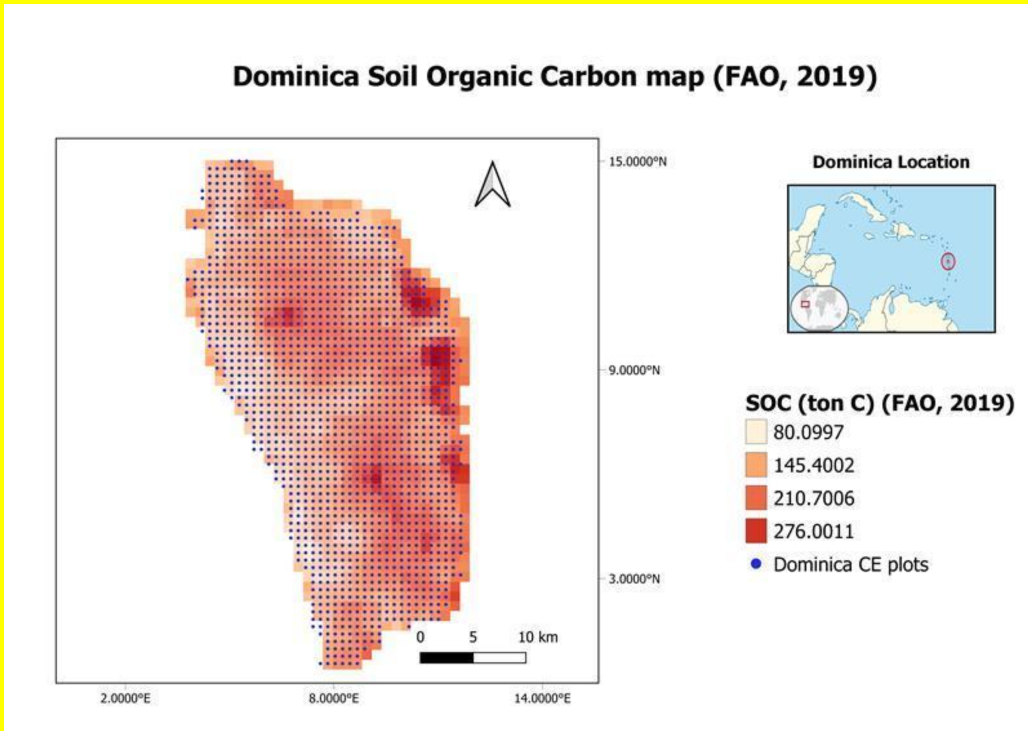


Figure 45 Overlapping FAO SOC map vs Collect Earth sampling grid

Table 27 Soil organic carbon by land use sub-category [tC ha]

Sub-category of land use	Number of plots	Average t C ha	Maximum t C ha	Minimum t C ha	StdDev t C ha
CANNUAL	131	155.4	307.0	93.5	46.6
CPER	87	148.8	292.5	97.4	37.9
FCLOUD	109	187.7	286.0	117.4	28.7
FELF	42	216.8	310.0	150.3	33.8
FCLOD and FELF	151	195.8	310.0	117.4	32.8
FDEC	149	152.6	334.3	88.3	44.4
FDSCRUB	35	125.1	167.6	80.1	20.3
FLIT	77	168.4	295.8	113.6	39.9
FDEC, FDSCRUB,FLIT	261	153.6	334.3	80.1	42.6
FEVER	225	156.9	317.8	98.3	38.2
FRAIN	608	164.8	341.3	101.5	33.2
GGRASS	26	158.7	275.4	103.4	35.1
GWGRASS	30	112.2	167.6	93.5	15.0
OMIN	2	101.8	103.1	100.6	1.8
OOTHER	7	180.2	310.0	121.4	62.4
SSET	25	134.9	259.7	87.6	50.0
SWSET	34	144.8	259.3	80.1	49.8

WWET	4	181.0	250.7	115.4	60.9
Grand Total	1591	161.2	341.3	80.1	40.3

Table 28. 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 (FDSCRUB)	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 Note

For lands converted to Forest lands, D=20, until Forest lands is considered stable (F>F), then changed to SOC=0.
For Forest lands converted to other lands, D=20, until indicating a transitional change of SOC to the new SOC values depending on the conversion.

7.3.8 Non-CO2 Emissions

Estimation of Greenhouse Gas Emissions from s (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 (CH4, N2O).
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 29. MB, Cf, GefCH4, GefN2O values

		MB	Cf	Gef CH4	Gef N2O
LU	Sub-Category	Mass of fuel available for combustion	Combustion factor	Emission factor- CH4	Emission factor- N2O
		tonnes ha^{-1}	Dimensionless	g kg-1 dry matter burnt	g kg-1 dry matter burnt
F	Deciduous-Coastal Forest	36.2	1	6,8	0,2

A summary of the level of the methods used for activity data and emission factors is included in table 30

Table 30.Methods and EF used for the FRL

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

Results of GHG emissions and Removals 2000-2017

Historical GHG emissions of CO2, CH4 and N2O for the period 2001–2017 associated with deforestation and forest degradation and net removals of CO2 associated with conservation of forest carbon stocks and enhancement of forest carbon stocks were calculated as part of the analysis. However, due to country specific circumstances, the national FRL proposed by Dominica is the expected C removals due to post-disturbance (Hurricane Maria 2017) forest regrowth as natural regeneration starting in 2018, along with the expected C removals of lands converted to forest lands calculated as -648,028 tCO2 (figure 46).

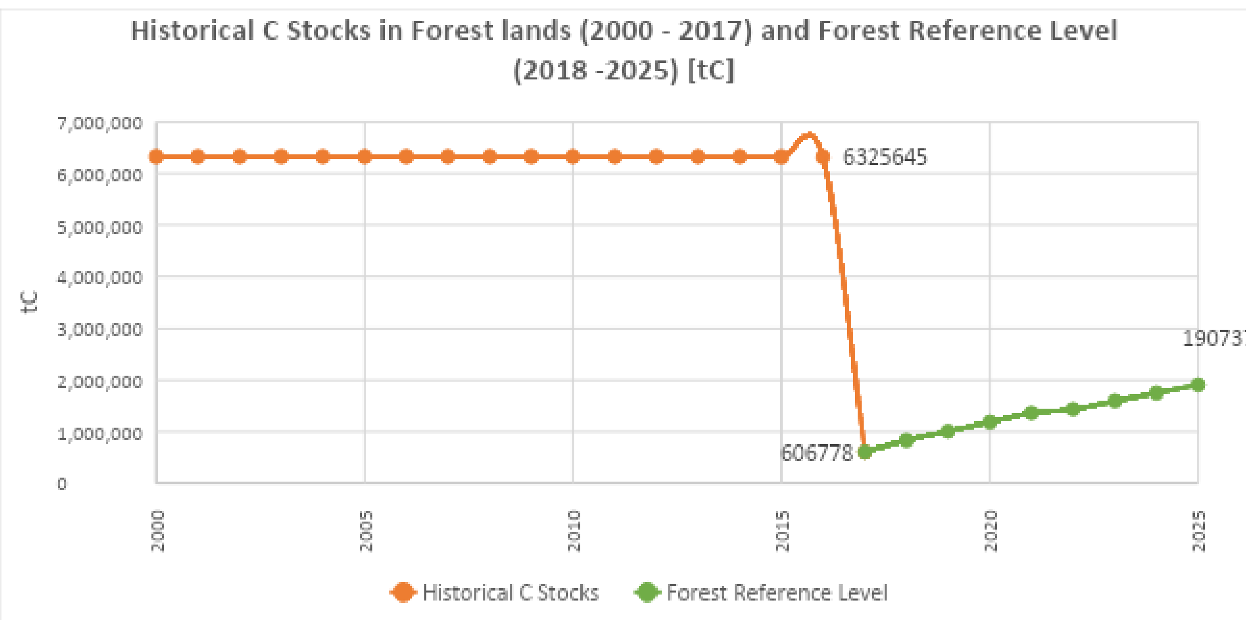


Figure 46 Historical C Stocks in Forest lands (2000 - 2017) and Forest Reference Level (2018 -2025) [tC]

The proposed FRL was constructed using the gain–loss method from the 2006 IPCC Guidelines. All lands were considered as managed. The EFs were obtained from Saint Lucia's NFI carried out in 2009, as they share same

[42]Photo:https://www.semanticscholar.org/paper/Perceptions-of-nature-in-the-Caribbean-island-of-Yarde/cf1497bde9823974f51b8ccf73cbe93eb8cf8787

forest conditions, and the FAO GSOCmap, and complemented by IPCC default values from the 2006 IPCC Guidelines, and the 2019 Refinement to the 2006 IPCC Guidelines. Dominica used global warming potential values from the IPCC Second Assessment Report based on the effects of GHGs over a 100-year time-horizon to convert CH4 and N2O emissions into CO2 eq emissions. 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.

For the estimations of annual GHG emissions and removals, Dominica applied the land representation approach 3, using the sampling method combined with a plot-by-plot annual analysis using 1605 plots of 1ha distributed in a systematic grid 750 m × 750 m that were analyzed annually from 2000 to 2017 to determine land use, land use changes, year of land use change, disturbance and year of disturbance using the Collect Earth software, which contains a combination of high and medium spatial resolution imagery (i.e. 15 m resolution Landsat imagery, 2.5 m resolution SPOT imagery and high-resolution imagery from several other sources) accessible through the Google Earth, Bing Maps and Google Earth Engine platforms. Dominica used the Collect Earth tool to synchronize the view of each sampling point on the three platforms and incorporate the land-use condition for each year of the time series 2001–2017. Forest land was stratified by forest type (Elfin Forest, Cloud Forest, Montane rainforest, Semi-evergreen forest, Deciduous Forest; Littoral Forest and Dry Scrub). Cropland was classified as either annual or perennial cropland, settlements were classified as woody and non-woody. Other land was divided into other land and mining. Grasslands and Wetlands did not have a further subclassification.

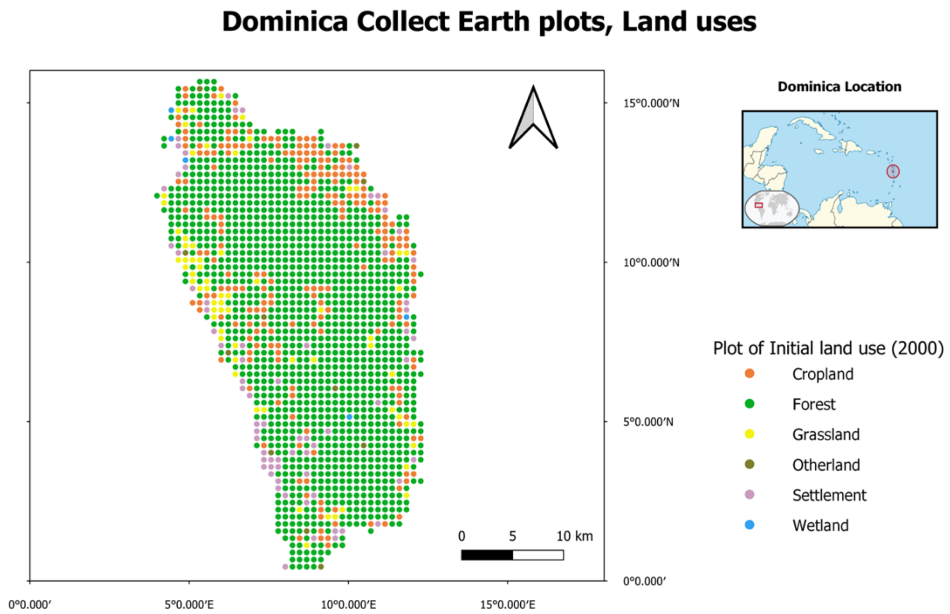


Figure 47 Dominica initial land use in 2000, represented in the sampling plots

The sampling approach combined with a annual plot by plot analysis allowed capturing multiple land use changes for a plot; however, these were not registered; therefore, only the initial Land Use (figure 47) and the Final land use was captured, and only when that second land use reached the definition. Specifically, in conversion to forest, only when the forest reached the definition that conversion would be registered; otherwise, it remained in the initial land use. Also, the survey allowed to capture multiple disturbances; however, only the primary one was accounted.

The land use and land use change analysis indicated that total area of forest lands in 2000 was 58.551 Ha compared to 57.710 Ha in 2017 (figure 48), resulting in a forest loss of 888 Ha in 17 years of about 52Ha per year, locating Dominica in a high forest cover low, deforestation country. However, all forest were severely affected in 2017 by Hurricane Maria, which was a hurricane category 5, removing most of the canopy cover and in some cases uprooting trees, causing also floods and landslides.

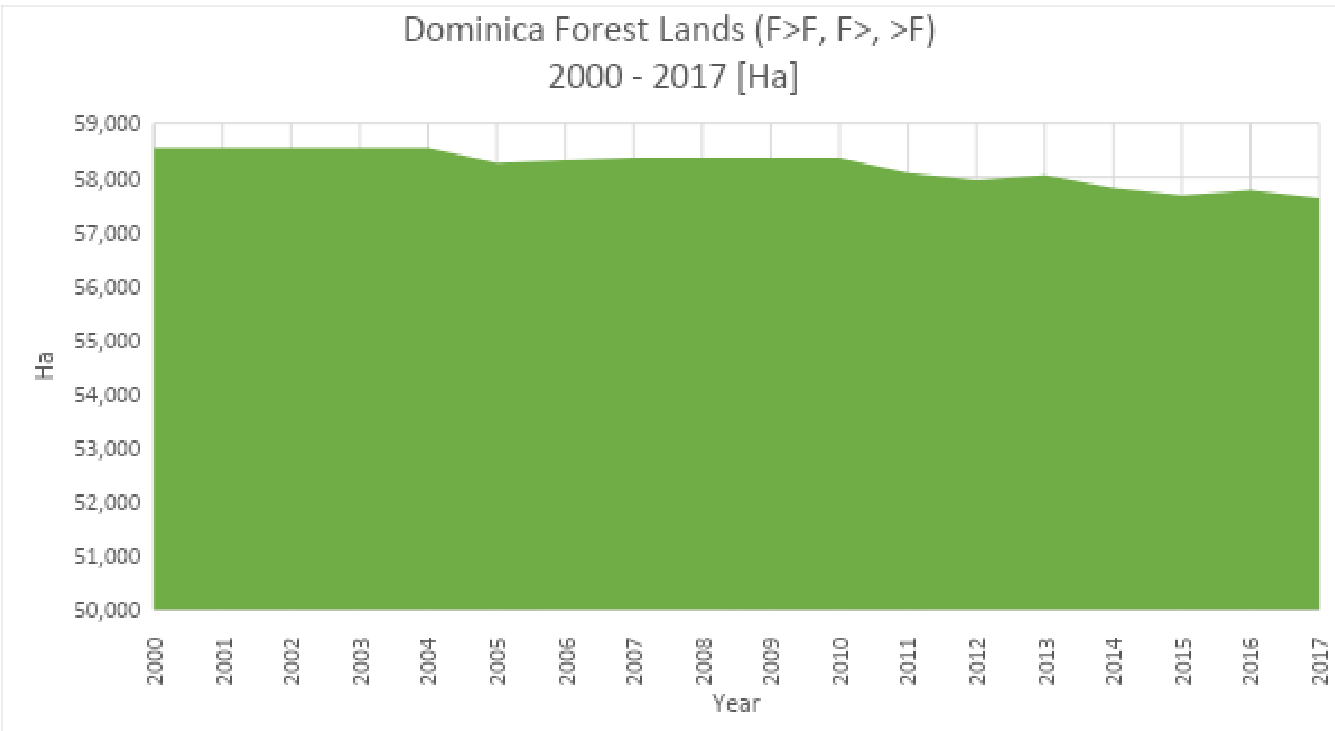


Figure 48 Net balance of forest lands in Dominica (Forest lands remaining and Forest lands converted to and from other land uses) [Ha]

In the period 2000-2017, 280 Ha of forest were converted to croplands, 327 Ha converted to Grasslands, 280 Ha converted to Settlements and 94 Ha converted to Other lands (figure 49).

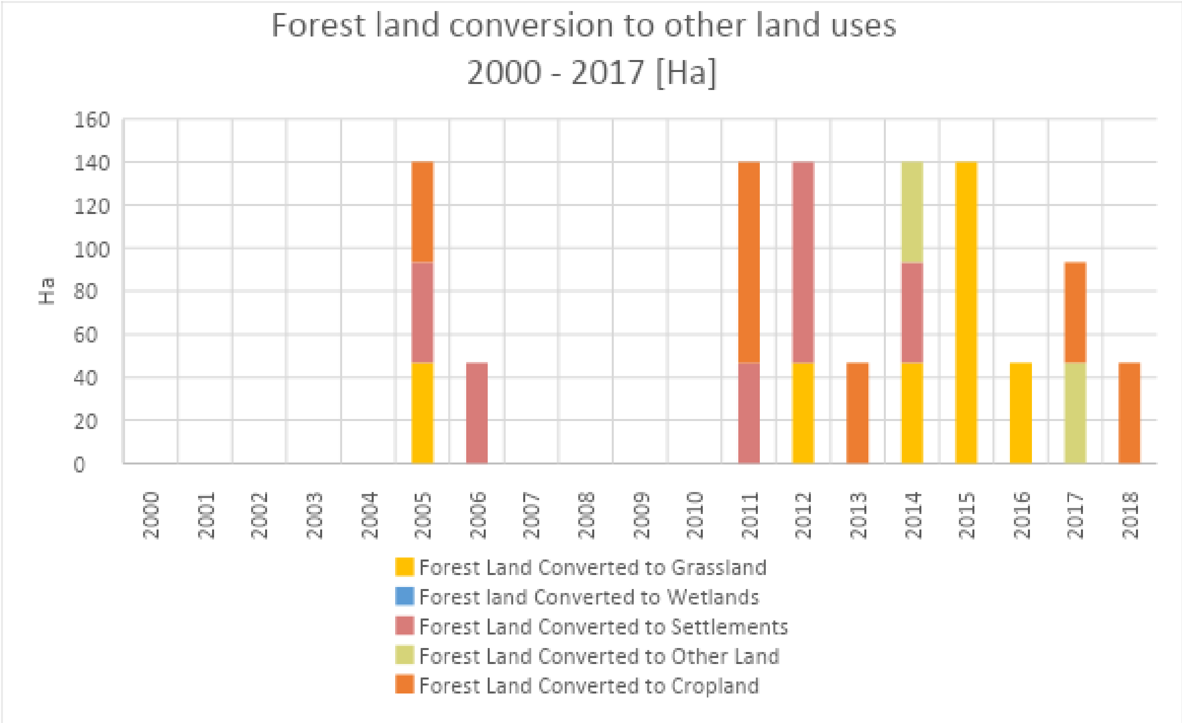


Figure 49 Forest land conversion to other land uses 2001 to 2017 [Ha]

Average net balance of emissions and removals in Forest lands remaining Forest Lands (Undisturbed) for the period 2001 to 2017 was -103.226 tCO2e. Emissions due to natural and anthropogenic disturbances were estimated as 20,233,381tCO2 eq. Average removals from lands converted to Forest lands were estimated as -3.384 tCO2e and emissions from Forest lands converted to other lands were estimates as 26.685 tCO2e. The expected annual removals for the period 2018 to 2025 is -648.028 tCO2e derived from gains in forest lands remaining forest lands post-disturbance, estimated as -644,643 tCO2 e yr-1 and -3.384 tCO2e yr-1. From lands converted to forest lands (table 31).

Regarding forest conversion and degradation, a compounding factor is that small farmers tend to be resource-poor, with low capacity to invest in soil and water conservation measures. In cases where lands are converted to housing and other forms of urban development, land degradation is driven by similar factors particularly where settlements are unplanned and developed without infrastructure to control pollution, runoff, erosion and landslides. In Dominica, land and water resources degradation has been historically driven mainly by clearing of forests in environmentally fragile areas (steep slopes underlain by erodible soils within high rainfall zones) and subsequent replacement by intensive agricultural cultivation. Installation of poorly constructed farm access roads in these areas in many instances contributes to land degradation. Other activities such as poorly managed mining and quarrying operations and expansion of settlement areas in erosion-prone and landslide-prone areas compounds the country's vulnerability to impacts from climate change.

Table 31 NET Historical GHG Emissions [CO2, N2O, CH4) [tCO2eq]

REDD+ Activity	Sub-category	Carbon Pool	Gas	Units	Equation	2000	2001	2002	2003	2004	2005	2006	2007	2008
	Forest lands remaining Forest Lands (Undisturbed) [NET BALANCE ALL]	**AGB, BGB, DOM, SOC**	**CO2, CH4, N20**	**t CO2e / yr**		**-110,612**	**-110,612**	**-110,612**	**-110,612**	**-110,612**	**-110,079**	**-110,079**	**-110,079**	**-110,079**
Conservation	Forest remaining Forest lands (Undisturbed) [Net Balance ABG_BGB]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.7	-110,612	-110,612	-110,612	-110,612	-110,612	-110,079	-110,079	-110,079	-110,079
	F >F (Undisturbed) [Gains]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.9	-107,337	-107,337	-107,337	-107,337	-107,337	-107,337	-107,337	-107,337	-107,337
	F>F before conversion to C [Gains]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.9	-914	-914	-914	-914	-914	-736	-736	-736	-736
	F>F before conversion to G [Gains]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.9	-1,371	-1,371	-1,371	-1,371	-1,371	-1,193	-1,193	-1,193	-1,193
	F>F before conversion to W [Gains]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.9	0	0	0	0	0	0	0	0	0
	F>F before conversion to S [Gains]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.9	-812	-812	-812	-812	-812	-635	-635	-635	-635
	F>F before conversion to O [Gains]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.9	-178	-178	-178	-178	-178	-178	-178	-178	-178
	F >F (Undisturbed) [Losses]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.11	0	0	0	0	0	0	0	0	0
	F >F (Undisturbed) [DOM]	DOM	CO2	t CO2e / yr	Equation 2.23	0	0	0	0	0	0	0	0	0
	F >F (Undisturbed) [SOC]	SOC	CO2	t CO2e / yr	Equation 2.24	0	0	0	0	0	0	0	0	0

REDD+ Activity	Sub-category	Carbon Pool	Gas	Units	Equation	2009	2010	2011	2012	2013	2014	2015	2016	2017
	Forest lands remaining Forest Lands (Undisturbed) [NET BALANCE ALL]	**AGB, BGB, DOM, SOC**	**CO2, CH4, N20**	**t CO2e / yr**		**-110,079**	**-110,079**	**-109,723**	**-109,266**	**-109,266**	**-108,911**	**-107,718**	**-107,439**	**-279**
Conservation	Forest remaining Forest lands (Undisturbed) [Net Balance ABG_BGB]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.7	-110,079	-110,079	-109,723	-109,266	-109,266	-108,911	-107,718	-107,439	-279
	F >F (Undisturbed) [Gains]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.9	-107,337	-107,337	-107,337	-107,337	-107,337	-107,337	-106,880	-106,880	0
	F>F before conversion to C [Gains]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.9	-736	-736	-558	-558	-558	-558	-558	-558	-279
	F>F before conversion to G [Gains]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.9	-1,193	-1,193	-1,193	-1,015	-1,015	-1,015	-279	0	0
	F>F before conversion to W [Gains]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.9	0	0	0	0	0	0	0	0	0
	F>F before conversion to S [Gains]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.9	-635	-635	-457	-178	-178	0	0	0	0
	F>F before conversion to O [Gains]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.9	-178	-178	-178	-178	-178	0	0	0	0
	F >F (Undisturbed) [Losses]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.11	0	0	0	0	0	0	0	0	0
	F >F (Undisturbed) [DOM]	DOM	CO2	t CO2e / yr	Equation 2.23	0	0	0	0	0	0	0	0	0

	F >F (Undisturbed) [SOC]	SOC	CO2	t CO2e / yr	Equation 2.24	0	0	0	0	0	0	0	0	0

REDD + Activity	Sub-category	Carbon Pool	Units	Equation	2000	2001	2002	2003	2004	2005	2006	2007	2008
SFM	**Forest remaining Forest lands (Disturbed) [NET BALANCE ALL]**	**AGB, BGB, DOM, SOC**	**t CO2e / yr**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Forest remaining Forest lands (Disturbance, before conversion) [Net balance AGB_BGB]	Biomass (AGB+BGB)	t CO2e / yr	Equation 2.7	0	0	0	0	0	0	0	0	0
	F >F (Disturbance) [Gains]	Biomass (AGB+BGB)	t CO2e / yr	Equation 2.9	0	0	0	0	0	0	0	0	0
	F >F (Disturbance) Losses	Biomass (AGB+BGB)	t CO2e / yr	Equation 2.11	0	0	0	0	0	0	0	0	0
	Forest remaining Forest lands (Disturbance, before conversion) [DOM]	DOM	t CO2e / yr	Equation 2.23	0	0	0	0	0	0	0	0	0
	Forest remaining Forest lands (Disturbance, before conversion) [SOC]	SOC	t CO2e / yr	Equation 2.24	0	0	0	0	0	0	0	0	0
	Forest remaining Forest lands (Disturbance, before conversion) [CH4]	Non-CO2 emissions due to biomass burning (CH4)	t CO2e / yr	Equation 2.27	0	0	0	0	0	0	0	0	0

	Forest remaining Forest lands (Disturbance, before conversion) [N2O]	Non-CO2 emissions due to biomass burning (N2O)	t CO2e / yr	Equation 2.27	0	0	0	0	0	0	0	0	0

RED D+ Activity	Sub-category	Carbon Pool	Gas	Units	Equation	2009	2010	2011	2012	2013	2014	2015	2016
SFM	**Forest remaining Forest lands (Disturbed) [NET BALANCE ALL]**	**AGB, BGB, DOM, SOC**	**CO2, CH4, N20**	**t CO2e / yr**		**0**	**0**	**0**	**0**	**0**	**0**	**17,744**	**-545**
	Forest remaining Forest lands (Disturbance, before conversion) [Net balance AGB_BGB]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.7	0	0	0	0	0	0	17,744	-545
	F >F (Disturbance) [Gains]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.9	0	0	0	0	0	0	-289	-545
	F >F (Disturbance) Losses	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.11	0	0	0	0	0	0	18,033	0
	Forest remaining Forest lands (Disturbance, before conversion) [DOM]	DOM	CO2	t CO2e / yr	Equation 2.23	0	0	0	0	0	0	0	0
	Forest remaining Forest lands (Disturbance, before conversion) [SOC]	SOC	CO2	t CO2e / yr	Equation 2.24	0	0	0	0	0	0	0	0

	Forest remaining Forest lands (Disturbance, before conversion) [CH4]	Non-CO2 emissions due to biomass burning (CH4)	CH4	t CO2e / yr	Equation 2.27	0	0	0	0	0	0	0	0
	Forest remaining Forest lands (Disturbance, before conversion) [N2O]	Non-CO2 emissions due to biomass burning (N2O)	N2O	t CO2e / yr	Equation 2.27	0	0	0	0	0	0	0	0

REDD+ Activity	Sub-category	Carbon Pool	Gas	Units	Equation	2000	2001	2002	2003	2004	2005	2006	2007	2008
Enhancement of Carbon Stocks	**Land Converted to Forest**	**AGB, BGB, DOM, SOC**	**CO2, CH4, N20**	**t CO2e / yr**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	Land Converted to Forest	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Land Converted to Forest	DOM	CO2	t CO2e / yr	Equation 2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Land Converted to Forest	SOC	CO2	t CO2e / yr	Equation 2.11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Land Converted to Forest	Non-CO2 emissions due to biomass burning (CH4)	CH4	t CO2e / yr	Equation 2.23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Land Converted to Forest	Non-CO2 emissions due to biomass burning (N2O)	N2O	t CO2e / yr	Equation 2.24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Cropland converted to Forest lands	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.15	0	0	0	0	0	0	0	0	0

[Net Balance AGB_BGB]													
C>F [Gains]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.9	0	0	0	0	0	0	0	0	0
C>F [Losses]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.11	0	0	0	0	0	0	0	0	0
C>F [Conversion]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.16	0	0	0	0	0	0	0	0	0
Cropland converted to Forest lands [DOM]	DOM	CO2	t CO2e / yr	Equation 2.23	0	0	0	0	0	0	0	0	0
Cropland converted to Forest lands [SOC]	SOC	CO2	t CO2e / yr	Equation 2.24	0	0	0	0	0	0	0	0	0
Grasslands converted to Forest lands [Net Balance AGB_BGB]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.15	0	0	0	0	0	0	0	0	0
G>F [Gains]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.9	0	0	0	0	0	0	0	0	0
G>F [Losses]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.11	0	0	0	0	0	0	0	0	0
G>F [Conversion]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.16	0	0	0	0	0	0	0	0	0
Grasslands converted to Forest lands [DOM]	DOM	CO2	t CO2e / yr	Equation 2.23	0	0	0	0	0	0	0	0	0
Grasslands converted to Forest lands [SOC]	SOC	CO2	t CO2e / yr	Equation 2.24	0	0	0	0	0	0	0	0	0
Wetlands converted to Forest lands [Net Balance AGB_BGB]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.15	0	0	0	0	0	0	0	0	0
W>F [Gains]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.9	0	0	0	0	0	0	0	0	0

W>F [Losses]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.11	0	0	0	0	0	0	0	0	0
W>F [Conversion]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.16	0	0	0	0	0	0	0	0	0
Wetlands converted to Forest lands [DOM]	DOM	CO2	t CO2e / yr	Equation 2.23	0	0	0	0	0	0	0	0	0
Wetlands converted to Forest lands [SOC]	SOC	CO2	t CO2e / yr	Equation 2.24	0	0	0	0	0	0	0	0	0
Settlements converted to Forest lands [Net Balance AGB_BGB]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.15	0	0	0	0	0	0	0	0	0
S>F [Gains]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.9	0	0	0	0	0	0	0	0	0
S>F [Losses]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.11	0	0	0	0	0	0	0	0	0
S>F [Conversion]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.16	0	0	0	0	0	0	0	0	0
Settlements converted to Forest lands [DOM]	DOM	CO2	t CO2e / yr	Equation 2.23	0	0	0	0	0	0	0	0	0
Settlements converted to Forest lands [SOC]	SOC	CO2	t CO2e / yr	Equation 2.24	0	0	0	0	0	0	0	0	0
Other lands converted to Forest lands [Net Balance AGB_BGB]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.15	0	0	0	0	0	0	0	0	0
O>F [Gains]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.9	0	0	0	0	0	0	0	0	0
O>F [Losses]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.11	0	0	0	0	0	0	0	0	0
O>F[Conversion]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.16	0	0	0	0	0	0	0	0	0

	Other lands converted to Forest lands [DOM]	DOM	CO2	t CO2e / yr	Equation 2.23	0	0	0	0	0	0	0	0	0
	Other lands converted to Forest lands [SOC]	SOC	CO2	t CO2e / yr	Equation 2.24	0	0	0	0	0	0	0	0	0
	Lands converted to Forest lands [CH4]	Non-CO2 emissions due to biomass burning (CH4)	CH4	t CO2e / yr	Equation 2.27	0	0	0	0	0	0	0	0	0
	Lands converted to Forest lands [N2O]	Non-CO2 emissions due to biomass burning (N2O)	N2O	t CO2e / yr	Equation 2.27	0	0	0	0	0	0	0	0	0

REDD+ Activity	Sub-category	Carbon Pool	Gas	Units	Equation	2009	2010	2011	2012	2013	2014	2015	2016	2017
Enhancement of Carbon Stocks	**Land Converted to Forest**	**AGB, BGB, DOM, SOC**	**CO2, CH4, N20**	**t CO2e / yr**		**0.0**	**0.0**	**0.0**	**0.0**	**-29030.8**	**-1540.7**	**-1540.7**	**-29014.2**	**203.2**
	Land Converted to Forest	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.7	0.0	0.0	0.0	0.0	-28070.3	-580.1	-580.1	-26722.8	2494.5
	Land Converted to Forest	DOM	CO2	t CO2e / yr	Equation 2.9	0.0	0.0	0.0	0.0	-167.9	-167.9	-167.9	-335.8	-335.8
	Land Converted to Forest	SOC	CO2	t CO2e / yr	Equation 2.11	0.0	0.0	0.0	0.0	-792.7	-792.7	-792.7	-1955.5	-1955.5
	Land Converted to Forest	Non-CO2 emissions due to biomass burning (CH4)	CH4	t CO2e / yr	Equation 2.23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Land Converted to Forest	Non-CO2 emissions due to biomass burning (N2O)	N2O	t CO2e / yr	Equation 2.24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cropland converted to Forest lands [Net Balance AGB_BGB]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.15	0	0	0	0	-28,070	-580	-580	-580	2,030
C>F [Gains]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.9	0	0	0	0	-580	-580	-580	-580	-580
C>F [Losses]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.11	0	0	0	0	0	0	0	0	2,611
C>F [Conversion]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.16	0	0	0	0	-27,490	0	0	0	0
Cropland converted to Forest lands [DOM]	DOM	CO2	t CO2e / yr	Equation 2.23	0	0	0	0	-168	-168	-168	-168	-168
Cropland converted to Forest lands [SOC]	SOC	CO2	t CO2e / yr	Equation 2.24	0	0	0	0	-793	-793	-793	-793	-793
Grasslands converted to Forest lands [Net Balance AGB_BGB]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.15	0	0	0	0	0	0	0	-26,143	464
G>F [Gains]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.9	0	0	0	0	0	0	0	-580	-580
G>F [Losses]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.11	0	0	0	0	0	0	0	0	1,044
G>F [Conversion]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.16	0	0	0	0	0	0	0	-25,563	0
Grasslands converted to Forest lands [DOM]	DOM	CO2	t CO2e / yr	Equation 2.23	0	0	0	0	0	0	0	-168	-168
Grasslands converted to Forest lands [SOC]	SOC	CO2	t CO2e / yr	Equation 2.24	0	0	0	0	0	0	0	-1,163	-1,163
Wetlands converted to	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.15	0	0	0	0	0	0	0	0	0

Forest lands [Net Balance AGB_BGB]													
W>F [Gains]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.9	0	0	0	0	0	0	0	0	0
W>F [Losses]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.11	0	0	0	0	0	0	0	0	0
W>F [Conversion]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.16	0	0	0	0	0	0	0	0	0
Wetlands converted to Forest lands [DOM]	DOM	CO2	t CO2e / yr	Equation 2.23	0	0	0	0	0	0	0	0	0
Wetlands converted to Forest lands [SOC]	SOC	CO2	t CO2e / yr	Equation 2.24	0	0	0	0	0	0	0	0	0
Settlements converted to Forest lands [Net Balance AGB_BGB]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.15	0	0	0	0	0	0	0	0	0
S>F [Gains]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.9	0	0	0	0	0	0	0	0	0
S>F [Losses]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.11	0	0	0	0	0	0	0	0	0
S>F [Conversion]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.16	0	0	0	0	0	0	0	0	0
Settlements converted to Forest lands [DOM]	DOM	CO2	t CO2e / yr	Equation 2.23	0	0	0	0	0	0	0	0	0
Settlements converted to Forest lands [SOC]	SOC	CO2	t CO2e / yr	Equation 2.24	0	0	0	0	0	0	0	0	0
Other lands converted to Forest lands [Net Balance AGB_BGB]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.15	0	0	0	0	0	0	0	0	0
O>F [Gains]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.9	0	0	0	0	0	0	0	0	0

	O>F [Losses]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.11	0	0	0	0	0	0	0	0	0
	O>F[Conversion]	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.16	0	0	0	0	0	0	0	0	0
	Other lands converted to Forest lands [DOM]	DOM	CO2	t CO2e / yr	Equation 2.23	0	0	0	0	0	0	0	0	0
	Other lands converted to Forest lands [SOC]	SOC	CO2	t CO2e / yr	Equation 2.24	0	0	0	0	0	0	0	0	0
	Lands converted to Forest lands [CH4]	Non-CO2 emissions due to biomass burning (CH4)	CH4	t CO2e / yr	Equation 2.27	0	0	0	0	0	0	0	0	0
	Lands converted to Forest lands [N2O]	Non-CO2 emissions due to biomass burning (N2O)	N2O	t CO2e / yr	Equation 2.27	0	0	0	0	0	0	0	0	0

REDD+ Activity	Sub-category	Carbon Pool	Gas	Units	Equation	2000	2001	2002	2003	2004	2005	2006	2007	2008
Deforestation	**Forest converted to other land uses**	**AGB, BGB, DOM, SOC**	**CO2, CH4, N20**	**t CO2e / yr**		**0**	**0**	**0**	**0**	**0**	**17858**	**32370**	**4490**	**4490**
	Forest converted to other land uses	Biomass (AGB+BGB)	CO2	t CO2e / yr		0.0	0.0	0.0	0.0	0.0	8920.8	24522.1	0.0	0.0
	Forest converted to other land uses	DOM	CO2	t CO2e / yr		0.0	0.0	0.0	0.0	0.0	5859.8	3358.3	0.0	0.0

REDD+ Activity	Sub-category	Carbon Pool	Gas	Units	Equation	2009	2010	2011	2012	2013	2014	2015	2016	2017
	Forest converted to other land uses	SOC	CO2	t CO2e / yr		0.0	0.0	0.0	0.0	0.0	3077.6	4489.8	4489.8	4489.8
	Forest converted to other land uses	Non-CO2 emissions due to biomass burning (CH4)	CH4	t CO2e / yr		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Forest converted to other land uses	Non-CO2 emissions due to biomass burning (N2O)	N2O	t CO2e / yr		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Forest converted to Cropland	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.16	0.00	0.00	0.00	0.00	0.00	4605.47	0.00	0.00	0.00
	Forest converted to Cropland	DOM	CO2	t CO2e / yr	Equation 2.23	0.00	0.00	0.00	0.00	0.00	1953.27	0.00	0.00	0.00
	Forest converted to Cropland	SOC	CO2	t CO2e / yr	Equation 2.24	0.00	0.00	0.00	0.00	0.00	695.98	695.98	695.98	695.98
	Forest converted to Grassland	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.16	0.00	0.00	0.00	0.00	0.00	2677.90	0.00	0.00	0.00
	Forest converted to Grassland	DOM	CO2	t CO2e / yr	Equation 2.23	0.00	0.00	0.00	0.00	0.00	1953.27	0.00	0.00	0.00
	Forest converted to Grassland	SOC	CO2	t CO2e / yr	Equation 2.24	0.00	0.00	0.00	0.00	0.00	1066.18	1066.18	1066.18	1066.18
	Forest converted to Wetland	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Forest converted to Wetland	DOM	CO2	t CO2e / yr	Equation 2.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Forest converted to Wetland	SOC	CO2	t CO2e / yr	Equation 2.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Forest converted to Settlement	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.16	0.00	0.00	0.00	0.00	0.00	1637.43	24522.11	0.00	0.00
	Forest converted to Settlement	DOM	CO2	t CO2e / yr	Equation 2.23	0.00	0.00	0.00	0.00	0.00	1953.27	3358.26	0.00	0.00
	Forest converted to Settlement	SOC	CO2	t CO2e / yr	Equation 2.24	0.00	0.00	0.00	0.00	0.00	1315.47	2727.62	2727.62	2727.62
	Forest converted to Other land	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Forest converted to Other land	DOM	CO2	t CO2e / yr	Equation 2.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Forest converted to Other land	SOC	CO2	t CO2e / yr	Equation 2.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Deforestation	**Forest converted to other land uses**	**AGB, BGB, DOM, SOC**	**CO2, CH4, N20**	**t CO2e / yr**		**4490**	**4490**	**23134**	**66837**	**43022**	**55702**	**73117**	**44369**	**79281**
	Forest converted to other land uses	Biomass (AGB+BGB)	CO2	t CO2e / yr		0.0	0.0	11102.9	47763.0	27490.2	32436.5	47111.7	21603.4	51021.1
	Forest converted to other land uses	DOM	CO2	t CO2e / yr		0.0	0.0	4472.0	7693.1	3358.3	7264.8	6716.5	2381.6	5739.9
	Forest converted to other land uses	SOC	CO2	t CO2e / yr		4489.8	4489.8	7558.8	11381.0	12173.7	16000.7	19289.3	20383.8	22520.4
	Forest converted to other land uses	Non-CO2 emissions due to biomass burning (CH4)	CH4	t CO2e / yr		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Forest converted to other land uses	Non-CO2 emissions due to biomass burning (N2O)	N2O	t CO2e / yr		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Forest converted to Cropland	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.16	0.00	0.00	6497.39	0.00	27490.15	0.00	0.00	0.00	23530.99
	Forest converted to Cropland	DOM	CO2	t CO2e / yr	Equation 2.23	0.00	0.00	2518.69	0.00	3358.26	0.00	0.00	0.00	2381.62
	Forest converted to Cropland	SOC	CO2	t CO2e / yr	Equation 2.24	695.98	695.98	2449.55	2449.55	3242.20	3242.20	3242.20	3242.20	3966.57
	Forest converted to Grassland	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.16	0.00	0.00	0.00	2677.90	0.00	26193.63	47111.71	21603.42	0.00
	Forest converted to Grassland	DOM	CO2	t CO2e / yr	Equation 2.23	0.00	0.00	0.00	1953.27	0.00	3358.26	6716.51	2381.62	0.00
	Forest converted to Grassland	SOC	CO2	t CO2e / yr	Equation 2.24	1066.18	1066.18	1066.18	2132.35	2132.35	3328.44	6617.00	7711.56	7711.56

Forest converted to Wetland	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Forest converted to Wetland	DOM	CO2	t CO2e / yr	Equation 2.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Forest converted to Wetland	SOC	CO2	t CO2e / yr	Equation 2.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Forest converted to Settlement	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.16	0.00	0.00	0.00	4605.47	45085.07	0.00	1637.43	0.00	0.00
Forest converted to Settlement	DOM	CO2	t CO2e / yr	Equation 2.23	0.00	0.00	0.00	1953.27	5739.88	0.00	1953.27	0.00	0.00
Forest converted to Settlement	SOC	CO2	t CO2e / yr	Equation 2.24	0.00	2727.62	2727.62	4043.10	6799.12	6799.12	8114.59	8114.59	8114.59
Forest converted to Other land	Biomass (AGB+BGB)	CO2	t CO2e / yr	Equation 2.16	0.00	0.00	0.00	0.00	0.00	0.00	4605.47	0.00	0.00
Forest converted to Other land	DOM	CO2	t CO2e / yr	Equation 2.23	0.00	0.00	0.00	0.00	0.00	0.00	1953.27	0.00	0.00
Forest converted to Other land	SOC	CO2	t CO2e / yr	Equation 2.24	0.00	0.00	0.00	0.00	0.00	0.00	1315.47	1315.47	1315.47

Dominica is one of the few carbon-neutral countries in the world, largely due to carbon sequestration. It is important to note that the forest disturbance regime is driven by storms. Wind damage to forests is not unusual, and the forest types in Dominica developed in the face of intermittent storms. Not the storms as such, but the increased frequency and intensity of storms constitute an unusual threat for Dominica's forests. Forests have been seriously disturbed by Hurricane Maria, but their recovery capacity is naturally high. Agriculturally driven deforestation is no longer a threat. There are no alarming degradation phenomena, no pressing unmet needs for wood, and no indications that forestry problems are closely linked to widespread poverty.

Forest resources management should therefore aim at increasing the resilience of forests to climate change. Specifically, forest adaptation should focus mainly on natural regeneration, while plantations may help increase the value of abandoned agricultural land.

Risk Assessment

Small Island Developing States, in particular those in the Caribbean Region are amongst the most vulnerable to the effects and negative impacts of climate change and other natural hazards. Since the 1950's the Caribbean has had 324 disasters, representing more than 64% of all natural disasters globally. Such disasters bring with them devastating human and economic impacts. Hurricane Maria in 2017, is estimated to have cost Dominica 225 percent of its GDP (Ötker & Srinivasan, 2018)[44]. Table 32 provides a summary of all natural disasters for Dominica over the years.

After the devastating effects of Hurricane Maria in 2017, the Government of Dominica has commenced its attempts to transform the island into the world's first climate resilient country. In its efforts to do this, the country has developed a National Development Resilient Strategy (NDRS), enacted a new Climate Resilience Act, 2018 and established CREAD- a Climate Resilience Execution Agency of Dominica, to implement Dominica's recovery and resilience plan.

Dominica's Protected Areas (PA) System[45] plays a critical role in both disaster prevention and recovery by maintaining intact and healthy ecosystems necessary to mitigate natural disasters. Intact habitats and vegetation help stabilize soils, reducing floods, drought, and landslide occurrences as well as sedimentation runoff, and provide a physical barrier for tsunamis and ocean incursion. In addition, PA's provide opportunities for temporary and permeant employment in often rural and marginalized communities, to engage in climate change and mitigation management and education and outreach activities with communities and conserve the many natural resources that are harvested by local and indigenous communities either for commercial or subsistence use. It is not surprising therefore, that the establishment and effective management of the countries protected areas plays a critical role in Enhancing the resilience of ecosystems and sustainable use of natural resources, which is one of seven development objectives in the NDRP.

[43] Photo: https://www.dominica-island.info/dominica-land-crab/

[44] Ötker, I and Srinivasan, K. 2018. Bracing for the storm: For the Caribbean, building resilience is a matter of survival", March 2018 . International Monetary Fund. Finance and Development, Volume 55 (1)pp 48-51

[45] Source: Draft Dominica Protected Areas system Plan 2020

Table 32 Historic Natural Disasters in Dominica (1979-2013)

Date	Event	Impact	Date	Event	Impact
2013 Dec 24	Trough, flash flooding and landslides	Damage to housing and infrastructure	2003	Seismic activity north	
2013 April	Heavy rains, 30+ landslides across the country	Damage to roads and agriculture	2001	Drought	
2013 Sept 5	Landslide Morne Prosper	Roads blocked	1999 April	Landslides in the north 100+	Damage to roads and housing
2011 Jul 29	Landslide Soufriere	Roads blocked	1999	Hurricane Lenny	Coastal Damage
2011 Jul 28	Miracle Lake flooding ayou)	Damage to ecosystem, agriculture, fisheries and road network	1998 to 2000	Seismic activity in the south	
2011	Storm Ophelia	Damage to housing and infrastructure	1997	Landslide Bagatelle	
2010-2011	Severe Drought and extended rainy season of 2010	Loss of income in agricultural sector	1995	Hurricane Luis	Damage to housing, agriculture and infrastructure
2010 May 24	San Sauver Landslide	Disaster Zone	1995	Hurricane Marilyn (Cat 1)	Damage to housing, agriculture and infrastructure
2009 Jul	Flooding	Damage to infrastructure	1995	Hurricane Iris	Damage to housing, agriculture and infrastructure
2008	Hurricane Omar	Damage to coast and fishing industry	1989	Hurricane Hugo	
2007	Hurricane Dean (Cat 2)	Damage to agriculture and housing	1988	Hurricane Gilbert	
2007	Landslide Campbell		1986 Nov 11	Landslide Good Hope	
2007	Landslide		1986 Nov 12	Landslide Castle Bruce	
2007 Nov 29	Earthquake (6.5 Richter Scale)	Housing Infrastructure	1984	Hurricane Klaus	
2004 Nov 21	Earthquake	Damage to churches and housing in the north	1983	Landslide Bellevue Chopin	
2004 Nov	Series of landslides	1980	Hurricanes Frederick & Allen (Cat 1)	Economy Agriculture	
2003	Carholm landslide	Damage to agriculture and Tourism	1979 Aug 29	Hurricane David (Cat 5)	Total devastation
2003	Landslide Bellevue Chopin				

There are three main categories of natural hazards-:

i) *Geological hazards*: driven by the earths processes i.e. earthquakes, tsunamis and volcanic activity

ii) *Meteorological & Hydrological hazards*: driven by weather processes i.e extreme temperatures, high winds, cyclones, hurricanes, storms, floods, droughts, landslides

iii) *Biological hazards*: driven by biological processes i.e disease epidemics and insect/animal plagues

Dominica is particularly prone to geophysical and meteorological hazards. While Dominica's NPAS are important contributors of Disaster Risk Reduction, PA's themselves are also at risk from climate change and natural hazards. A risk analysis of climate change and natural hazards to Dominica's PAS is presented in table 4.

Table 33 A Natural Hazard Risk Assessment for Dominica's Protected Areas System

		Impact				
		Negligible	**Minor**	**Moderate**	**Major**	**Catastrophic**
Likelihood	**Almost certain**				Landlsides, Floods	Hurricanes & Storms
	Likely					
	Possible			Phreatic eruption	Earthquakes	
	Unlikely			Sea-level rising, temperature increases		
	Rare		Pandemics		Droughts	Volcano eruption, Tsunami

Risk Level	Low	Moderate	High	Extreme

Uncertainty Assessment

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 Dominica 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; 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), Dominica 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

Some of the emission factor estimates of uncertainty ranges were generated by expert judgement, involving country experts who decided on the mean value as well as the uncertainty range. For the values selected by IPCC defaults, the rages provided were used. AGB values as well as SOC ref values, the standard deviation was calculated using the source data.

The uncertainty of each selected value was estimated using the following equation *(See Excel fille > EF-Values sheet)*:

If the range values were provided:

$$U(EF) = \frac{(Upper\ Limit\ (EF) - Lower\ Limit\ (EF))/2}{EF} * 100$$

If the standard deviation was provided:

$$U(EF) = \frac{Z_{a/2} x\ SD(EF)}{EF} * 100$$

Where,

Z: 1.96
SD: Standard deviation of the EF value
EF: Emissions Factor value

Table 34 Uncertainty values for selected emission factors

Parameter in the IPCC equa	Notation	Units according to the IPCC	Category	Value	National Value (tier 2)	Default Value (tier 1)	Error o range reported	Lower CI	Upper CI	SD	Uncertainty (%)

tions												
Wood carbon fraction of dry matter			**Elfin and Cloud forest**	FCLOUD	**0.47**		X	(0.44 - 0.49)	0.44	0.49		5.3
	Cf	[t C (t d.m.)$^{-1}$]	**Montane Rainforest**	FRAIN	**0.47**		X	(0.44 - 0.49)	0.44	0.49		5.3
			Semi-evergreen Forest	FEVER	**0.47**		X	(0.44 - 0.49)	0.44	0.49		5.3
			Deciduous - Coastal Forest	FDEC, FDRYS, FLIT	**0.47**		X	(0.44 - 0.49)	0.44	0.49		5.3
Average annual ABG growth for a specific woo	Gw	[t d.m. ha-1 yr-1]	**Elfin and Cloud forest**	Undisturbed	**0.00**		X					0
				Disturbed (Hurricane, fire, logging, Shift.Cult)	**4.40**		X	SD:1.6			1.6	71.3
			Montane Rainforest	Undisturbed	**0.00**		X					0
				Disturbed (Hurricane, fire, logging, Shift.Cult)	**5.90**		X	SD: 2.3			2.3	76.4
			Semi-evergreen Forest	Undisturbed	**2.70**		X	SD: 1.1			1.1	79.9
				Disturbed (Hurricane, fire, logging, Shift.Cult)	**5.20**		X	SD: 2.5			2.5	94.2
			Deciduous - Coastal Forest	Undisturbed	**1.60**		X	SD: 1.1			1.1	134.8
				Disturbed (Hurricane, fire, logging, Shift.Cult)	**3.90**		X	SD: 2.4			2.4	120.6

dyvegetationtype												
Ratioofbelowgroundbiomasstoabovegroundbiomass	R		**Elfin and Cloud forest**	Natural	**0.221**		X	SD: 0.036			0.036	31.9
			Montane Rainforest	Natural	**0.221**		X	SD:0.036			0.036	31.9
			Semi-evergreen Forest	Natural	**0.284**		X	SD:0.061			0.061	42.1
			Deciduous - Coastal Forest	Natural	**0.379**		X	SD:0.04			0.04	20.7
BasicWoodD	D	[t C m-3]	**Elfin and Cloud forest**		**0.598**						0.99	324.30
			Montane Rainforest		**0.672**						0.82	239.00

ensity			**Semi-evergreen Forest**		**0.601**						0.87	283.99
			Deciduous - Coastal Forest		**0.655**						0.70	209.37
Above-ground biomass	AGB - BW, B_BEFORE , B_AFTER	[t d.m. / ha]	**Elfin and Cloud forest**		**19.2**	X						45.4
			Montane Rainforest		**279.6**	X						130.3
			Semi-evergreen Forest		**227.6**	X						225.5
			Deciduous - Coastal Forest		**41.5**	X						122.5
Fraction of biomass loss due to disturbances	fd		**Elfin and Cloud forest**	Affected by hurricane	**0.85**	x			0.8	0.9		5.9
			Montane Rainforest	Affected by hurricane	**0.90**	x			0.85	0.95		5.6
			Semi-evergreen Forest	Affected by hurricane	**0.90**	x			0.85	0.95		5.6
				Affected by Shifting Cultivation	**0.60**	x			0.55	0.65		8.3
			Deciduous - Coastal Forest	Affected by hurricane	**0.85**	x			0.8	0.9		5.9
Litter	Litter	[t C ha-1]	**Elfin and Cloud forest**		**0.00**				0	0		0
			Montane Rainforest		**4.80**		x	Range: 2.1-16.4	2.1	16.4		149.0

Stocks			**Semi-evergreen Forest**		**5.90**		x	Range: 1.9-14.8	1.9	14.8		109.3
			Deciduous - Coastal Forest		**2.40**		x	Range: 2.1-2.7	2.1	2.7		12.5
Deadwood	DW	[t C ha^{-1}]	**Elfin and Cloud forest**		**3.3**				3	3.6		9.1
			Montane Rainforest		**14.8**		x	Range: 0.6 - 218.9	9.8	19.8		33.8
			Semi-evergreen Forest		**8.0**		x	Range: 1.9-14.8	1.9	14.8		80.6
			Deciduous - Coastal Forest		**9.0**		x	Range:1.3-17.3	1.3	17.3		88.9
Soil organic carbon	SOC ref	[t C/ ha]	**Elfin and Cloud forest**		**195.8**	x					32.8	32.8
			Montane Rainforest		**164.8**	x					33.2	39.4
			Semi-evergreen Forest		**156.9**	x					38.2	47.7
			Deciduous - Coastal Forest		**153.6**	x					42.6	54.4
Factor for land use systems	FLU	Dimensionless	**Forestland**		**1.0**		x					75
Factor for man	FMG	Dimensionless	**Forestland**		**1.0**		x					75

agement regime												
Factor for input of organic matter	FI	Dimensionles s	**Forestland**		**1.0**		x					75

The calculated values were then used in equations 3.1 and 3.2 for the combination of uncertainties with the uncertainties of the activity data.

As activity data were estimated using proportions (See 2006 IPCC GL, V4, Chapter 3), the uncertainty of the activity data was estimated using the following equation:

$$U(AD) = \frac{Z^{*} \times s\_ADi}{ADi} \times 100$$

Where,

Z= 1,96if ni>30 or 2,365 if ni<30*s_AD/ADi*100

Standard Error (ADi) is equal to:

$$s_{ADi} = Country\ Total\ Area \times \sqrt{\frac{(pi \times (1 - pi)}{(N - 1)}}$$

ni: Number of plots per subcategory of land use

N: Total Number of plots (21991)

pi: ni/N

Table 35 Example of Uncertainties calculated for Activity Data

LULUC transition		pi	ADi	SD_ADi	U_ADi
			ha	ha	%
Row Labels	Count of Transition Coding	[ni/N]	[pi* total area]	[TotalArea*SQRT(pi*(1-pi)/(N-1))	[1,96if ni>30 or 2,365 if ni<30*s_AD/ADi*100]
CC/CANNUAL/_	130.0	0.1	6074.8	510.9	16.5
CC/CPER/_	84.0	0.1	3925.2	417.1	20.8
CF/CANNUAL>FRAIN_2013/Hurricane_2017	1.0	0.0	46.7	46.7	236.5
CG/CANNUAL>GGRASS_2014/_	1.0	0.0	46.7	46.7	236.5
CG/CPER>GGRASS_2014/_	1.0	0.0	46.7	46.7	236.5
CG/CPER>GGRASS_2018/_	1.0	0.0	46.7	46.7	236.5
CG/CPER>GWGRASS_2017/_	1.0	0.0	46.7	46.7	236.5
CS/CANNUAL>SSET_2016/_	1.0	0.0	46.7	46.7	236.5
CS/CPER>SSET_2014/_	1.0	0.0	46.7	46.7	236.5
FC/FCLOUD>CANNUAL_2011/_	1.0	0.0	46.7	46.7	236.5
FC/FDEC>CANNUAL_2005/_	1.0	0.0	46.7	46.7	236.5
FC/FDSCRUB>CANNUAL_2011/_	1.0	0.0	46.7	46.7	236.5
FC/FEVER>CANNUAL_2017/_	1.0	0.0	46.7	46.7	236.5
FC/FEVER>CANNUAL_2018/_	1.0	0.0	46.7	46.7	236.5
FC/FRAIN>CANNUAL_2013/_	1.0	0.0	46.7	46.7	236.5
FF/FCLOUD/Hurricane_2017	108.0	0.1	5046.7	469.1	18.2
FF/FDEC/Hurricane_2015	1.0	0.0	46.7	46.7	236.5
FF/FDEC/Hurricane_2017	148.0	0.1	6915.9	541.8	15.4
FF/FDSCRUB/Hurricane_2017	35.0	0.0	1635.5	273.5	32.8
FF/FELF/Hurricane_2017	42.0	0.0	1962.6	298.9	29.9
FF/FEVER/Hurricane_2017	218.0	0.1	10186.9	641.6	12.3
FF/FEVER/Shifting Cultivation_2015	1.0	0.0	46.7	46.7	236.5
FF/FLIT/Hurricane_2017	76.0	0.0	3551.4	397.7	22.0
FF/FRAIN/Hurricane_2017	603.0	0.4	28177.6	906.9	6.3

FG/FDEC>GWGRASS_2012/_	1.0	0.0	46.7	46.7	236.5
FG/FDSCRUB>GWGRASS_2005/_	1.0	0.0	46.7	46.7	236.5
FG/FEVER>GWGRASS_2015/_	2.0	0.0	93.5	66.1	167.2
FG/FEVER>GWGRASS_2016/_	1.0	0.0	46.7	46.7	236.5
FG/FLIT>GGRASS_2015/_	1.0	0.0	46.7	46.7	236.5
FG/FRAIN>GGRASS_2014/_	1.0	0.0	46.7	46.7	236.5
FO/FDSCRUB>OMIN_2014/_	1.0	0.0	46.7	46.7	236.5
FO/FRAIN>OOTHER_2017/_	1.0	0.0	46.7	46.7	236.5
FS/FDSCRUB>SSET_2011/_	1.0	0.0	46.7	46.7	236.5
FS/FDSCRUB>SWSET_2005/_	1.0	0.0	46.7	46.7	236.5
FS/FDSCRUB>SWSET_2014/_	1.0	0.0	46.7	46.7	236.5
FS/FEVER>SWSET_2012/_	1.0	0.0	46.7	46.7	236.5
FS/FRAIN>SWSET_2006/_	1.0	0.0	46.7	46.7	236.5
FS/FRAIN>SWSET_2012/_	1.0	0.0	46.7	46.7	236.5
GF/GWGRASS>FRAIN_2016/Hurricane_2017	1.0	0.0	46.7	46.7	236.5
GG/GGRASS/_	26.0	0.0	1215.0	236.4	46.0
GG/GWGRASS/_	29.0	0.0	1355.1	249.4	43.5
OO/OMIN/_	2.0	0.0	93.5	66.1	167.2
OO/OOTHER/_	7.0	0.0	327.1	123.4	89.2
SS/SSET/_	27.0	0.0	1261.7	240.8	45.1
SS/SWSET/_	34.0	0.0	1588.8	269.7	33.3
WW/WWET/_	5.0	0.0	233.6	104.4	105.6
Sum					**7729.8**

The analysis in this submission involves mainly the sum of products of emission factors and activity data. Equations 3.1 and 3.2 were used to combine the uncertainties of individual uncertainties estimated for the emission factors and activity data for each land use sub-category (Forest land, Cropland, Grassland, Wetland, Settlement and Other Lands) as provided in the attached Excel file *(See Excel fille > EF-Values sheet)*[46], and each equation applied for estimating GHG emissions and removals following the methodological guidance from 2006 IPCC GLs, V4, Ch2, as indicated in the above section Chapter 5. Then, the uncertainties associated with the emissions and removals for each land-use category were combined to obtain the uncertainties in the whole categories of Forest land remaining forest land and forest land converted to and from other land-use categories.

It is expected that the uncertainties for each year of the time series will be provided in time for the technical analysis of the FRL[47].

[46] https://docs.google.com/document/d/1R4EN581a3W0TBKJqJrshzSAnEBfiWyA5/edit?usp=sharing&ouid=102526969717149054724&rtpof=true&sd=true

[47] Progress can be already assessed in each Land use sheet of the excel file starting in columns AF to BF in forest lands sheet. It works in parallel to the GHG estimations

Improvement Plan

The Government of the Commonwealth of Dominica (GoCD) is seeking to improve its capacities in forest resources management by developing a Capacity and Needs Assessment (Phase 1) and subsequently an updated National Forest Inventory (Phase 2), as a critical input to support long-term sustainable forestry management[48]. Phase 1 of this consultancy will focus on enabling Dominica to clearly identify needs and goals as it relates to the Forestry sector, including building capacity within the forestry sector to undertake and maintain the forestry inventory. Phase 2 will consist of the development of an updated National Forest Inventory that includes a high-resolution forest cover GIS database. Both phases are expected to:

1. Inform various forest resource management and conservation planning activities (e.g. development of sustainable forest management plans, a timber and lumber industry, reforestation of degraded/deforested areas, community (Kalinago) forest management projects, among others);
2. Support compliance with reporting responsibilities and other commitments under the various international conventions to which Dominica is a signatory (UNFCCC, UNCBD, UNESCO, UNCCD, etc);

[48] The estimated funding envelope for this consultancy assignment is approximately USD 350,000. Interested firms should keep this estimate in mind when expressing interest in this consultancy and also when preparing full technical and financial proposals.

3. Support the advancement of Dominica's resilience and environmental agendas;
4. Collect data necessary to quantify risk associated with impacts of climate change and natural hazards on forests, in order to better plan for budgetary allocations and other risk financing instruments; and
5. Inform future REDD+ (Reducing Emissions from Deforestation and Forest Degradation) initiatives in Dominica that can ultimately lead to the establishment of a Payment for Ecosystem Services (PES) scheme.

It is anticipated that the project will be executed in two phases over a total period of 12 months. Phase 1 is expected to last approximately 3 to 4 months and Phase 2 is expected to be carried out in 9 months.

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.

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.

Graveson R. (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

IPCC. 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories. S Eggleston, L Buendia, K Miwa, et al. (eds.). Hayama, Japan: Institute for Global Environmental Strategies. Available at http://www.ipcc-nggip.iges.or.jp/public/2006gl.

IPCC. 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Edited by E Calvo Buendia et al., IPCC, 2019, https://www.ipcc.ch/report/2019-refinement-to-the-2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/.

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.