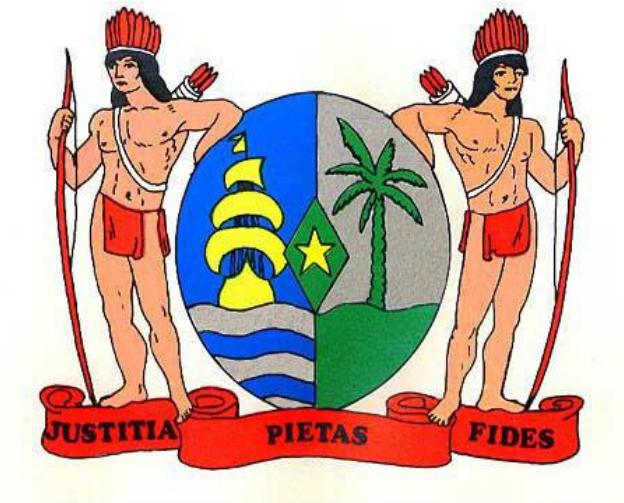
Suriname's Forest Reference Level Report

2022-2030



2024
Paramaribo, Suriname

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- Ministry of Land Policy and Forest Management

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List of abbreviations and acronyms

Acronym	Definition
AD	Activity Data
ADEKUS	Anton De Kom University of Suriname
AFOLU	Agriculture, Forestry and Other Land Use
AGB	Above Ground Biomass
AR	Assessment Report
ASGM	Artisanal Small-scale Gold Mining
BAFTER	Biomass stocks on land type immediately after the conversion
BB	Below ground Biomass
BBEFORE	Biomass stocks on land type before the conversion
BCEFR	Biomass Conversion and Expansion Factor for conversion of removals in merchantable volume to total biomass removals (including bark), tonnes biomass removal
BGB	Below ground Biomass
BTR	Biennial Transparency Report
BUR	Biennial Update Report
BW	Average above ground biomass of land areas affected by disturbances
CATIE	Tropical Agricultural Research and Higher Education Center
CB	Carbon stocks in Biomass
CCONVERSION	Biomass carbon stocks on land converted to another land category
CELOS	Centre for Agricultural Research in Suriname
CF	Carbon fraction of dry matter/ Combustion factor
CG	Carbon stocks due to biomass growth
CL	Cropland
CO2	Carbon dioxide
COP	Conference of the Parties (UNFCCC)
CP	Decisions adopted bu the Conference of the Parties
CSV	Comma-Separated Values
DOM	Dead organic Matter
DW	Deadwood
EF	Emission Factor
EITI	Extractive Industries Transparency Initiative
EU	European Union
FAO	Food and Agriculture Organization (of the United Nations)
FG	Fuelwood removal
FI	Stock change factor for input of organic matter
FIRMS	Fire Information for Resource Management System (NASA)
FL	Forest land
FLU	Stockchangefactorforland-usesystemsorsub-systemforaparticularland-use

FMG	Stock change factor for management regime
FOLU	Forestry and Other Land Use
FRA	Forest Resource Assessment (of FAO)
FREL	Forest Reference Emission Level
FRL	Forest Reference Level
FSC	Forest Stewardship Council
GEF	Global Environmental Facility
Gef	Emission factor
GCCA+	Global Climate Change Alliance+
GHG	Greenhouse gas
GHGI	Greenhouse gas Inventory
GIS	Geographic Information System
GL	Grassland
GOS	Government of Suriname
GPG	Good Practice Guidance
GSOC	Global Soil Organic Carbon
GTOTAL	Mean annual biomass growth
GW	Average annual above-ground biomass growth for a specific woody vegetation type
GWP	Global Warming Potential
HFLD	High Forest cover and Low Deforestation
HWP	Harvested Wood Products
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
ITMO	Internationally Transferred Mitigation Outcomes
KOPI	Name of the statistical portal of SBB
LI	Litter
LU	Land Use
LUA	Land Use Assessment
LULC	Land Use Land Cover
LULUC	Land Use Land Use Change
LULUCF	Land Use, Land Use Change and Forestry
MB	Mass of fuel available for combustion
NA	Not Applicable/ Not Available
NC	National Communication
NDC	National Determined Contribution
NE	Not Evaluated
NFI	National Forest Inventory
NFMS	National Forest Monitoring System
NO2	Nitrous Oxide
NTFP	Non- Timber Forest Product
OL	Otherland
QA/QC	Quality Assessment/ Quality Control
QGIS	Quantum Geographic Information System

REDD	Reducing Emissions from Deforestation and Forest Degradation
ROM	Ministry of Spatial Planning and Environment
SBB	Foundation for Forest Management and Production Control
SBSTA	Subsidiary Body for Scientific and Technological Advice
SD	Standard Deviation
SFISS	Sustainable Forestry Information System Suriname
SFM	Sustainable Forest Management
SIS	Safeguards Information System
SL	Settlement
SOC	Soil Organic Carbon
SOCREF	The reference carbon stock
SOI	Summary of Information
SU	Sampling Unit
TIFF	Tag Image File Format
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
WL	Wetland

Executive summary

a. Date of submission: 08 January 2024

b. Activities included: The FRL serves as a benchmark for all activities included in decision 1/CP.16, paragraph 70:

- Reducing emissions from deforestation
- Reducing emissions from forest degradation
- Conservation of forest carbon stocks
- Sustainable management of forests
- Enhancement of forest carbon stocks.

c. Scale: As indicated in the Decision 1/CP.16, paragraph 71, Suriname has decided to develop a **national** forest reference level (FRL) in accordance with national circumstances. The total land area is 16,366,524 ha, a sampling grid of 26,193 plots was used to allow a national coverage analysis of the land use. All lands assessed were considered as managed lands.

d. Historical reference period: Suriname analyzed the historical period 2001-2021 as the basis for the FRL. The country has had net removals since 2001, shown in figure A below.

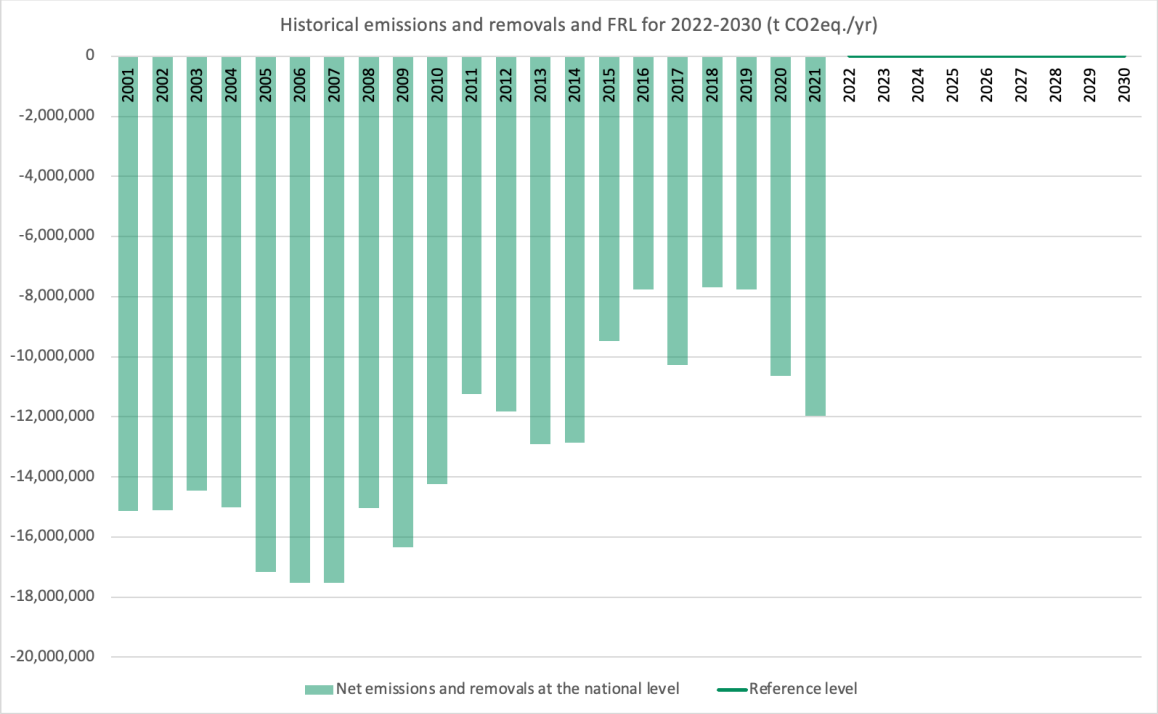


Figure A. Historical emissions and removals, showing net removals for 2001-2021 and the FRL for 2022-2030

e. FREL/FRL type: In light of the ongoing net removals in Suriname, the country adopted a zero FRL, explained in detail under section 3.3 of this report. The zero FRL aims to recognize the full extent of net removals, granting unparalleled environmental integrity to potential REDD+ results. The zero FRL is simple to understand and is based on 20 years of historical data.

f. Results period: 2022-2030.

Table A. Overview net removals from 2001-2021 and zero FRL from 2022-2030

Net removals (t CO2e/yr)		
Year	**Net removals**	**Forest Reference Level**
2001	-15,132,221	
2002	-15,119,988	
2003	-14,456,898	
2004	-15,001,721	
2005	-17,165,993	
2006	-17,531,428	
2007	-17,529,349	
2008	-15,038,997	
2009	-16,346,085	
2010	-14,249,352	
2011	-11,253,267	
2012	-11,811,307	
2013	-12,914,917	
2014	-12,867,926	
2015	-9,488,833	
2016	-7,768,662	
2017	-10,275,134	
2018	-7,691,287	
2019	-7,770,774	
2020	-10,635,753	
2021	-11,970,478	
2022		0
2023		0
2024		0
2025		0
2026		0
2027		0
2028		0
2029		0
2030		0

g. FREL/FRL value per year of results period 2022-2030: 0 t CO2e / year.

1. Introduction

Suriname is a High Forest cover and Low Deforestation (HFLD) country that contributes significantly in reducing the effects of global climate change. Suriname started with the Readiness program of "Reducing Emissions from Deforestation and forest Degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks" (REDD+) in 2014 and finalized this in 2021. Within this period, a national REDD+ strategy was produced, and a Safeguards Information System (SIS) was developed, with the resulting Summary of Information (SOI) document, which has also been submitted to the United Nations Framework Convention on Climate Change (UNFCCC) in May 2021. The Foundation for Forest Management and Production Control (SBB) served as the REDD+ Technical Partner responsible for the preparation of the FREL/FRL and implementation of the National Forest Monitoring System (NFMS). Within the REDD+ Readiness phase, two Forest Reference Emission Level (FREL) reports were also submitted to the UNFCCC, respectively in 2018 and 2021. In November 2022, Suriname also produced two REDD+ Technical Annexes attached to the Biannual Update Report to publish the REDD+ results over the period 2016-2021. Suriname aims to implement REDD+ as a tool for Suriname's sustainable development and to be eligible for results-based payments in accordance with decision 9/CP.19. Also, with the results coming from 2021, Suriname strives to sell them as ITMOs.

In accordance with UNFCCC decision 4/CP.15, this document shows transparently how the FRL for Suriname has been established considering national circumstances. Suriname underlines that pursuant to UNFCCC decisions 13/CP.19 (paragraph 2) and 14/CP.19 (paragraphs 7 and 8), the submission of FRELs/FRLs, as well as subsequent Technical Annexes with results, are voluntary and exclusively meant for the purpose of obtaining and receiving payments for REDD+ actions. This submission therefore does not modify, revise, or adjust in any way other actions currently being undertaken by Suriname and do not affect the REDD+ results already submitted for years 2020 and 2021[1]. With this new submission a more updated and accurate estimation of emissions and removals is provided to the UNFCCC.

Suriname recognizes that the UNFCCC allows for a stepwise approach for the development of the FRL. The current submission is based on best available data, with a description of uncertainty data and remaining gaps. The country strives to constantly improve the availability and quality of data and intends to submit future improved FREL/FRL as needed, considering the feedback that will be provided through the technical assessment.

[1]UNFCCC Lima Information Hub: https://redd.unfccc.int/info-hub.html

Based on the feedback of the previous technical assessments and the updated and available data of the REDD+ activities, this Forest Reference Level (FRL) report has been generated.

Formal submission of the FREL/FRL was done through the National Focal Point of the UNFCCC, which is the Ministry of Spatial Planning and Environment of the Republic of Suriname.

2. National context of Suriname

The forests of Suriname are part of the Amazon and the Guiana Shield region, included in one of the largest blocks of primary tropical rainforest worldwide and marked by high biodiversity levels. These forests provide ecosystem services important on global and local levels, including climate change mitigation, biodiversity preservation, cultural values, livelihoods, and food security for communities, while they also contribute to national incomes of countries in the region (Loftus et al., 2013; de Dijn, B., 2018). The country is rather small with an official reported land surface of 163,800 km^2. Suriname is located on the north-eastern coast of South America, between 2° and 6° North latitude and 54° and 58° West longitude. It borders French Guiana to the east with the Marowijne River and the Lawa River, Brazil to the south, Guyana to the west with the Corantijn River, and the Atlantic Ocean to the north with a very dynamic coastline resulting in land accretion and decrease. Suriname's 15.2 million hectares of forest (SBB, 2021) represent around 0.83% of the total tropical forest (1.8 billion hectare) in the world (FRA/FAO, 2020). Figure 2.1 shows the map of Suriname, with the borders used for forest monitoring purposes and the area of the Forestry belt.

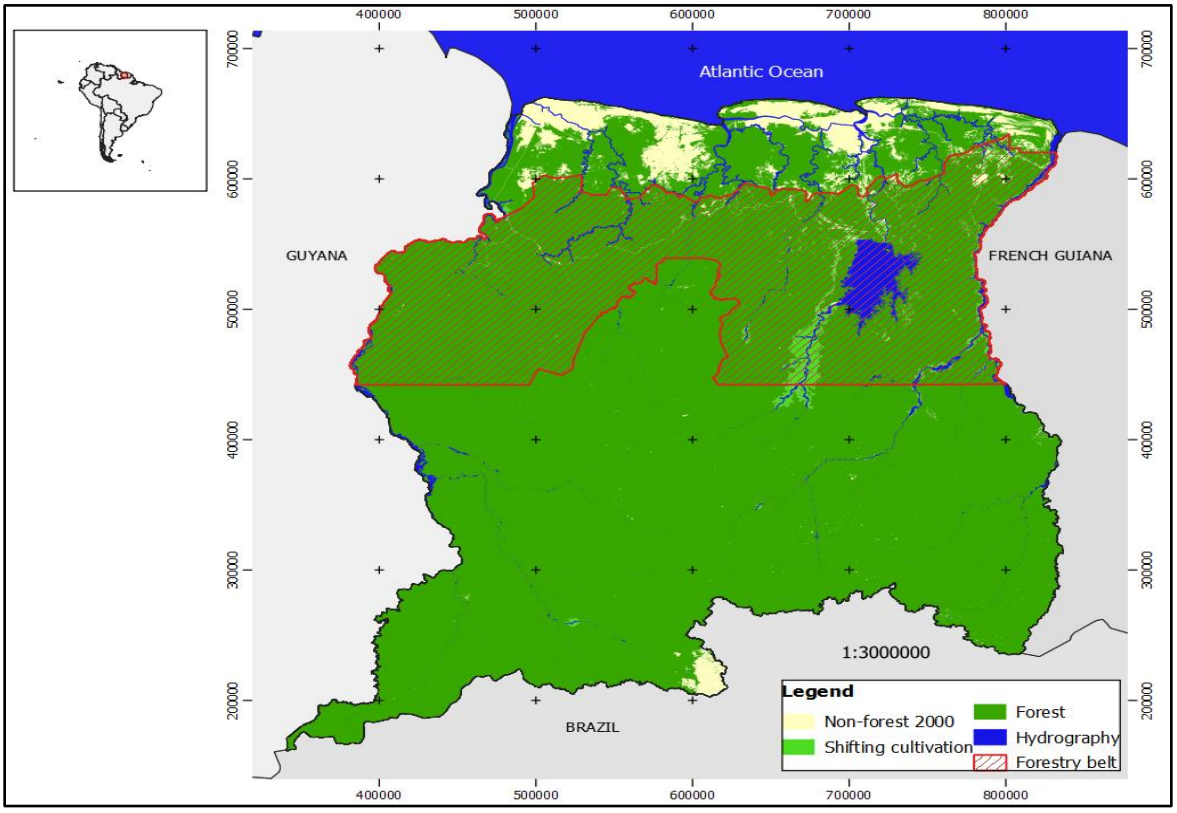


Figure 2-1. Monitoring area of Suriname with the Forestry belt

Commercial logging activities are taking place only north of the 4° N latitude within the Forestry belt, covering an area of 4.5 million hectares, of which ca. 2.7 million ha are currently issued under timber cutting licenses (www.gonini.org). Logging impacts could be reduced by following Sustainable Forest Management (SFM) guidelines, including the enforcement of the Code of Practice (CoP) for sustainable logging (including Reduced Impact Logging or Climate Smart Forestry). This national CoP is currently being reviewed, updated, and finalized. However, many SFM requirements are already integrated in official logging requirements. Applying these guidelines enables maintenance of other forest functions such as protection of water and soil, maintenance of biodiversity, carbon sequestration and soil erosion control (Werger et al., 2011).

Regarding the deforestation in Suriname, data have shown that this has historically been very low[2]. However, due to an increased demand for natural resources, the deforestation rate has increased. The main driver of deforestation is mining (mainly for gold), especially Artisanal Small-scale Gold Mining (ASGM). The extent to which gold mining activities occur can be associated with the trend of the gold price worldwide (SBB, 2021). Nevertheless, Suriname intends to keep the status as a HFLD country, but with the ongoing development and plans this seems very challenging. The intention to conditionally remain a HFLD country is reflected by the first HFLD Conference on Climate Finance Mobilization which was hosted by Suriname in February 2019, where the Krutu of Paramaribo Joint Declaration[3] HFLD Climate Finance Mobilization was established. Furthermore, this is also mentioned in the Nationally Determined Contribution[4] report of 2020 (GOS, 2020) and is in line with the Suriname National REDD+ Strategy. For this to be possible without hampering national development, adequate compensation for the global climate mitigation service is necessary.

In terms of conservation, 13.5% of the country's surface is within protected areas (GOS, 2009). Suriname has drafted a Nature Conservation Law that should replace the Nature Conservation Act of 1954. The Nature Conservation Law should enable improved management of its protected areas. At the moment, this should still be treated in the National Assembly of the government.

[2] Data on the KOPI statistical portal: https://www.gonini.org/SBB/index.php

[3] 1 Krutu of Paramaribo Joint Declaration on HFLD Climate Finance Mobilization We, Heads of Delegation and representatives of High

[4] The Republic of Suriname Nationally Determined Contribution 2020

3. Differences with previously submitted information

To have a clear overview of the previous FREL submission to the UNFCCC and the current FRL, table 3.1 has been created.

Table 3-1. Overview differences between FREL 2021 and current FRL

FREL 2021	CURRENT FRL
Scope of activities: ● Reducing emissions from deforestation ● Reducing emissions from forest degradation	**Scope of activities:** ● Reducing emissions from deforestation ● Reducing emissions from forest degradation ● Conservation of forest carbon stocks ● Sustainable management of forests ● Enhancement of forest carbon stocks
Pools included: ● Above-ground biomass ● Below-ground biomass ● Deadwood	**Pools included:** ● Above-ground biomass ● Below-ground biomass ● Deadwood ● Soil organic Carbon
The FREL/FRL was calculated based on linear projections of gross emissions from deforestation and forest degradation.	Suriname analyzed the historical period of 20010-2021 as the basis for the application of the zero FRL for 2022-20302026.
Not consistent with GHG inventory.	The same FRL data, methods and assumptions will be the basis of the National GHG Inventory that will be updated. The updated GHG inventory will be published as part of the 1st BTR of Suriname under the Paris Agreement.
Activity data Use of maps from different periods to evaluate only deforestation and degradation. Not all inputs contain annual data. Deforestation covers the following time periods: ● Conversion Forest to Non-forest without forest fire (2000-2009; 2009-2013; 2013-2014; 2014-2015; 2015-2016; 2016-2017; 2017-2018; 2018-2019) ● Conversion Shifting cultivation to Non-forest without forest fire (2000-2009; 2000-2013; 2000-2015; 2016-2017; 2018-2019) ● Conversion Forest to Non-forest with forest fire (2000-2009; 2000- 2013; 2000- 2015; 2000-2017) Degradation:	**Activity data** The information on AD used was obtained from a land use and land-use change assessment, which was conducted based on a sample-based methodology (IPCC approach 3). This assessment was carried out through CfRN LUAapp, which is a free online tool that enables data collection, satellite image viewing and interpretation. In conjunction with Google Earth, Bing Maps and Google Earth Engine, users can analyze high and very high resolution satellite imagery. The land use assessment covers the following information: ● Annual land use, land use change information covering the time series 2001 to 2021. ● Evaluation of all land use categories and subcategories according to the IPCC (Forestland, Cropland, Grassland, Wetland,

● Roundwood production in volume m^3 (Annually from 2000-2019) ● Fuelwood production in volume m^3 (Annually from 2000-2019) ● Conversion Forest to Shifting cultivation through forest fire (2000-2009; 2009-2013; 2013-2014; 2014-2015; 2015-2016; 2016-2017; 2017-2018; 2018-2019)	Settlement, Other land). This allows us to know all the dynamics of remaining lands and converted lands for all defined land use categories. ● Evaluation of forest degradation through the analysis of disturbances in Forestland (Infrastructure, Mining, Shifting Cultivation, Windbreaks, Fires) ● Evaluation of the variable fd (fraction of biomass affected by disturbance evaluated) Roundwood production information comes from national statistics. However, Suriname is working on integrating this category into spatial analysis.
Emission factors Deforestation: - Non-CO2 Forest fire emissions (t C ha-1) - Non-mangrove forest carbon stocks (t C ha-1): Based on 212 NFI plots - Mangrove forest carbon stocks (t C ha-1):Based on 13 NFI plots - Shifting cultivation to deforestation (t C ha-1) Degradation: - Roundwood production (t C ha-1): Unextracted wood, logging infrastructure and extracted wood - Fuelwood production (t C ha-1): From extracted wood - Shifting cultivation (t C ha-1): Based on change in carbon stocks, though forest fires.	**Emission/removal factors** The information on emission and removal factors was not only obtained for certain activities such as deforestation and degradation, but for the land use approach for all categories and dynamics. Information from the following variables was used: AGB, BGB, DOM, Gw, R, CF, SOCRef, FLU, FMG, FI, BCEFr, Unextracted wood emissions, Damage EF, D, fd, Gef, Mb * Cf, GWP. The sources of information were national and default values. <u>National Studies:</u> - SBB, CELOS, CATIE, ADEKUS, 2017. *Technical Report State-of-the-art study. Best estimates for emission factors and carbon stocks for Suriname.* - A. Roopsind et al., 2017. *Quantifying uncertainty about forest recovery 32-years after selective logging in Suriname.* For. Ecol. Manage.391 (2017). - Zalman et al., 2019. *Opportunities for carbon emissions reduction from selective logging in Suriname.* <u>Default values</u>: 2006 IPCC Guidelines for Greenhouse Gas Inventories and 2019 Refinement to the 2006 IPCC Guidelines. Vol. 4 Some more inventory plots were set up in the <u>mangrove forest</u> and previously established inventory plots in these forests have been re-measured. This has

	provided more information and data related to carbon stock and growth rate of mangrove forest.
FREL/FRL type Linear projection based on simple regression of historical emissions	**FREL/FRL type** Zero FRL approach

4. Key elements of the FRL

In line with decisions 4/CP.15, 12/CP.17 and 13/CP.19, countries preparing their FREL/FRL need to consider and make choices on, among others, the scale or geographic area covered, historical period and scope of REDD+ activities included. This section presents the decisions made on the scale, scope, historical period, pools, and gasses and proposed FRL for Suriname.

4.1 Scale (geographic area)

Suriname is submitting a national FRL, covering 16,366,524 ha (total country area), which includes all forest areas in the country.

4.2 Scope of activities

This current FRL serves as the benchmark for assessing the following REDD+ activities:

a. Reducing emissions from deforestation
b. Reducing emissions from forest degradation
c. Conservation of forest carbon stocks
d. Sustainable management of forests
e. Enhancement of forest carbon stocks

The two previous FREL reports served as a benchmark for two REDD+ activities: reducing emissions from deforestation and reducing emissions from forest degradation. This was decided based on the availability of data at that time. In the past few years, data related to forestry has been improved and national capacity has been built. Therefore, the scope of the activities for this FRL consist of all five REDD+ activities.

This updated FRL follows a land-based approach, including all forest-related emissions by sources and removals by sinks. The REDD+ activities aim to mitigate emissions and maintain removals in these land uses and forest types. Figure 4.1 serves as an illustration of where REDD+ activities may have a mitigation impact.

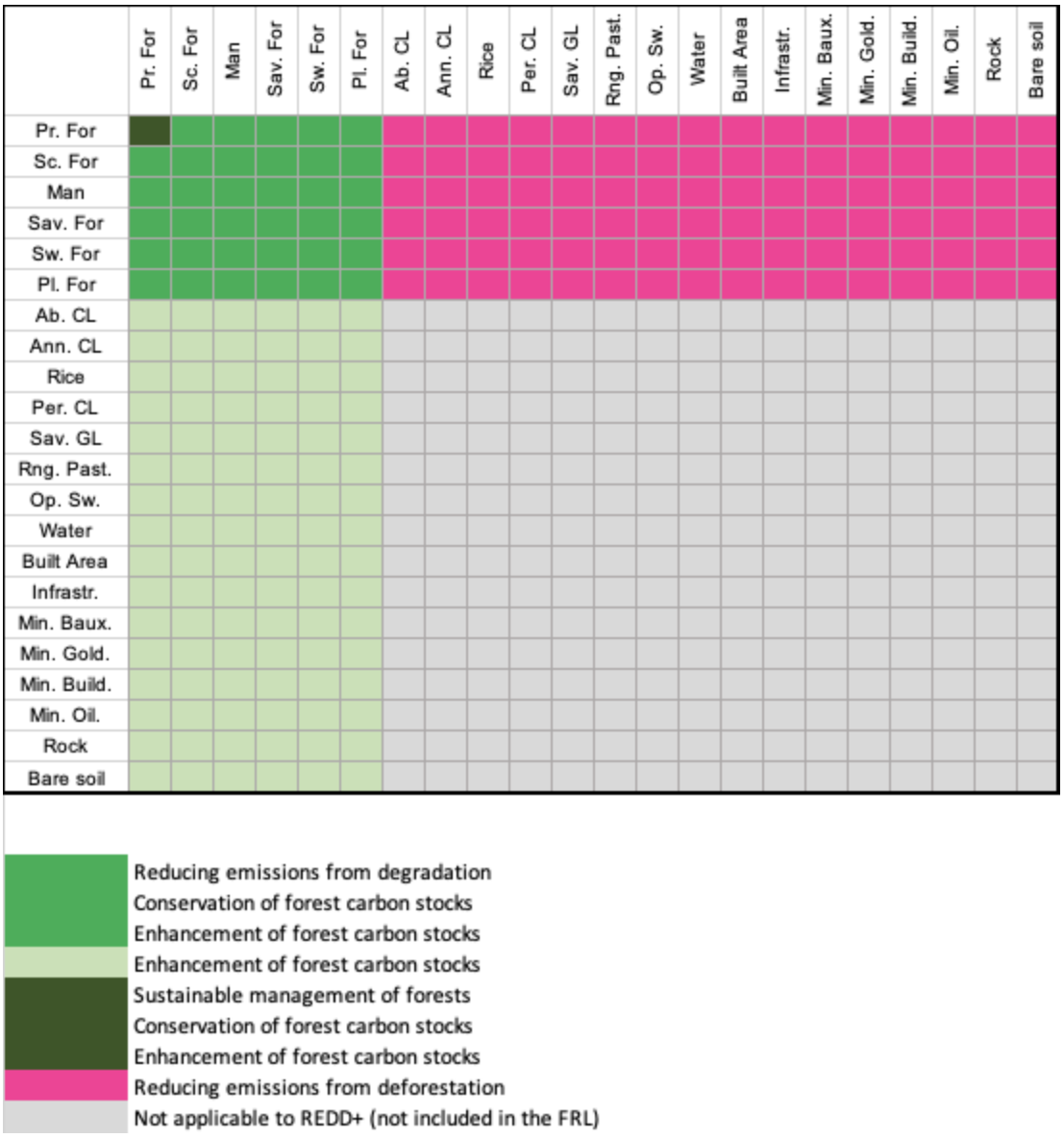


Figure 4-1. Overview of where REDD+ activities may have mitigation impact.
Legend: Pr. For: Primary Forest. Sc. For: Secondary Forest. Man: Mangrove forest. Sav. For: Savannah Forest. Sw. For: Swamp Forest. Pl. For: Plantation forest. Ab. CL: Abandoned Cropland. Ann. CL: Annual Cropland. Per. CL: Per. CL: Permanent Cropland. Sav. GL: Savannah Grassland. Rng. Past: Rangeland Pasture. Op. Sw: Open Swamp. Infrastr: Infrastructure. Min. Baux: Mining Bauxite. Min. Gold: Mining Gold. Min. Oil: Mining Oil.

4.3 Zero FRL approach

The proposed FRL is based on the national forest-related Greenhouse gas (GHG) emissions and removals, including Forest land remaining Forest land and Forest land conversions to and from the other IPCC land use categories and country specific subcategories, as well as non-CO2 emissions from biomass burning.

The selected FRL has a value of zero, meaning that Suriname will only seek results-based payments for net removals after considering all forest-related emissions and removals in the country. This is the basis for REDD+ at the national level which guides the current efforts by the government and local stakeholders.

Suriname's zero FRL aims to recognize the country's special circumstance of being a net carbon remover. According to Suriname's first BUR (including the latest national GHG inventory submitted to the UNFCCC), the country has a national net balance of -14,268.7 Gg CO2eq for the year 2017 (latest reporting year), where the agriculture sector resulted in 538.1 Gg CO2eq, the energy sector in 2,949.4 Gg CO2eq., the industrial processes and product use (IPPU) in 8.5 Gg CO2eq., and the waste sector in 95.5 Gg CO2eq. Together, these sectors comprised 3,591.5 Gg CO2eq. The LULUCF sector had net removals of -17,860.2 Gg CO2eq.

This GHG balance shows that Suriname has already achieved the balance in emission and removals that the Paris Agreement requests of countries by the second half of the century (Article 4, paragraph 1 of the Paris Agreement). Further, due to the magnitude of emissions from the non-LULUCF sectors versus the LULUCF sector, it is expected that Suriname will continue to have a negative balance (net removals) even when considering all sectors of the economy. This grants unparalleled environmental integrity to the REDD+ results that would be offered by Suriname as a result of the zero FRL approach.

Table 4.1 below explains how Suriname's zero FRL approach fully aligns with COP decisions for REDD+ reference levels, particularly decision 12/CP.17:

Table 4-1. Overview of zero FREL/FRL elements aligned with COP decisions

Modalities for submission of FREL/FRL (12/CP.17)	Elements for justification
7. Agrees that, in accordance with decision 1/CP.16, paragraph 71(b), forest reference emission levels and/or forest reference levels expressed in tonnes of carbon dioxide equivalent per year are benchmarks for assessing each country's performance in implementing the activities referred to in decision 1/CP.16, paragraph 70;	● Suriname's zero FRL is expressed in tons of CO_2 equivalent per year. ● It is a special benchmark designed for assessing Suriname's efforts in maintaining yearly net removals (*when considering all forest-related emissions by sources and removals by sinks*). ● By setting the FRL at zero, Suriname expresses its intention to get recognition for all net removals.

8. Decides that forest reference emission levels and/or forest reference levels, in accordance with decision 1/CP.16, paragraph 71(b), shall be established taking into account decision 4/CP.15, paragraph 7, and maintaining consistency with anthropogenic forest- related greenhouse gas emissions by sources and removals by sinks as contained in each country's greenhouse gas inventories;	• Suriname's zero FRL is based on the estimation of emissions and removals during a historical reference period, *i.e.* time-series in the national GHG inventory. • This updated FRL includes new data and methods, which resulted in updated time-series, will be the basis for the updated national GHG inventory to be included in Suriname's first BTR under the Paris Agreement.
9. Invites Parties to submit information and rationale on the development of their forest reference emission levels and/or forest reference levels, including details of national circumstances and if adjusted include details on how the national circumstances were considered, in accordance with the guidelines contained in the annex to this decision and any future decision by the Conference of the Parties;	• By applying the Zero FRL approach, Suriname is considering their national circumstance of being a net carbon remover, *i.e*. having net removals rather than net emissions. • This circumstance is the main reason behind the application of the approach, *i.e.* to recognize all removals. • Suriname contributes to reducing CO_2 from the global CO_2 concentrations and thus has a direct impact in the stabilization of the climate. • Net removals are additional every year. Consequently, the best FRL approach is to set it at zero to get full recognition of these countries' contribution to climate change mitigation. • This approach does not require adjustments.
10. Agrees that a step-wise approach to national forest reference emission level and/or forest reference level development may be useful, enabling Parties to improve the forest reference emission level and/or forest reference level by incorporating better data, improved methodologies and, where appropriate, additional pools, noting the importance of adequate and	• Suriname's Zero FRL approach applies to national scale only. • Suriname may use the step-wise approach to improve the estimation of emissions and removals that underlie the Zero FRL approach, following IPCC guidance and guidelines, and as methods, data and knowledge improves.

predictable support as referenced by decision 1/CP.16, paragraph 71;	
11. Acknowledges that subnational forest reference emission levels and/or forest reference levels may be elaborated as an interim measure, while transitioning to a national forest reference emission level and/or forest reference level, and that interim forest reference emission levels and/or forest reference levels of a Party may cover less than its entire national territory of forest area;	● The Zero FRL approach applies to national scale only, as it attempts to recognize national-level efforts in conserving national-level net removals.
12. Agrees that a developing country Party should update a forest reference emission level and/or forest reference level periodically as appropriate, taking into account new knowledge, new trends and any modification of scope and methodologies;	● See above, on paragraph 10.
(a) Information that was used by Parties in constructing a forest reference emission level and/or forest reference level, including historical data, in a comprehensive and transparent way;	● Before applying a Zero FRL approach, Suriname first estimated emissions and removals following IPCC guidance and guidelines, in consistency with the national GHG inventory. ● Through this process Suriname confirmed that they have net removals, and thus the country decided to adopt the zero FRL approach. ● The estimation of historical emissions and removals, and the understanding that it presents yearly net removals, is what enables Suriname to apply this approach, and as such, it is based on historical data.

(b) Transparent, complete, consistent and accurate information, including methodological information, used at the time of construction of forest reference emission levels and/or forest reference levels, including, inter alia, as appropriate, a description of data sets, approaches, methods, models, if applicable and assumptions used, descriptions of relevant policies and plans, and descriptions of changes from previously submitted information;	● This zero FRL approach is based on transparent, complete, consistent, and accurate information, just as any other FREL/FRL should. ● There is no special treatment of Suriname's Zero FRL versus any other FRL with regards to these principles.
(c) Pools and gases, and activities listed in decision 1/CP.16, paragraph 70, which have been included in forest reference emission levels and/or forest reference levels and the reasons for omitting a pool and/or activity from the construction of forest reference emission levels and/or forest reference levels, noting that significant pools and/or activities should not be excluded;	● Suriname's FRL includes all significant pools, activities and GHGs, providing a complete representation of forest-related emissions by sources and removals by sinks. ● Suriname's zero FRL ensures that the IPCC category forest land remaining forest land is included, a key category in the forest sector.
(d) The definition of forest used in the construction of forest reference emission levels and/or forest reference levels and, if appropriate, in case there is a difference with the definition of forest used in the national greenhouse gas inventory or in reporting to other international organizations, an explanation of why and how the definition used in the construction of forest reference emission levels and/or forest reference levels was chosen.	● The forest definition used is consistent with the national GHG inventory.

Note on non-permanence
Suriname's zero FRL aims to recognize national net removals. However, if net emissions were to occur, no REDD+ results can be claimed. In such a case, Suriname would not claim results and would also reflect these net emissions in the national REDD+ accounting for the corresponding NDC period, by subtracting any reversals from the total REDD+ results. The accounting is reset for each subsequent NDC period.

4.4 Historical reference period

Suriname analyzed the historical reference period of 2001-2021 as the basis for the application of the zero FRL for 2022-2030. Each year represents a calendar year, covering January 1 to December 31.

4.5 Pools and Gases

Pools
The following carbon pools are included in this FREL/FRL for Suriname:

- Above-Ground Biomass of trees, palms and lianas (AGB);
- Below-Ground Biomass of trees and palms (BGB);
- Dead organic matter, including downed and standing deadwood (DOM).
- Soil organic carbon (SOC)

Litter is not included in this FREL/FRL based on its significance, in line with decision 13/CP.19, annex, paragraph 2f. *Justification based on significance*: according to Crabbe et al. (2012), litter only contributes ca. 2-6% to the total carbon stock. However, the downed dead wood with a diameter greater than 5cm, present in 1-5% of the litter, was included in the FRL as DOM. This means that the remaining litter component with a diameter smaller than 5cm contributes less than 5% to the total carbon stock. Because of no reliable complete national dataset, as well as the presented data showing that the contribution of litter smaller than 5 cm is not significant, litter is not included in this FRL. The intention is to collect this data on a national level, during the planned National Forest Inventory (NFI), which is highly dependable on available funding.

Table 4-2. Overview of the pools included relevant to forest

Pools included				Soil organic carbon	
Land-use category	**Land-use subcategory**	**Biomass**	**Dead organic matter**	**Mineral soils**	**Organic soils**
Forest land (FL)	FL remaining FL	Yes	Yes*	Yes*	NO
	Land converted to FL	Yes	Yes	Yes	NO
Cropland (CL)	FL converted to CL	Yes	Yes	Yes	NO
Grassland (GL)	FL converted to GL	Yes	Yes	Yes	NO
Wetlands (WL)	FL converted to WL	Yes	Yes	Yes	NO
Settlements (S)	FL converted to SL	Yes	Yes	Yes	NO
Other land (OL)	FL converted to OL	NO	NO	NO	NO

Yes: included, Yes*: included under Tier 1 assumption, NO: Not Occurring.

Gasses

In addition to carbon dioxide (CO2) emissions and removals, this FRL includes methane (CH4) and nitrous oxide (N2O) emissions from biomass burning. Emissions in carbon dioxide equivalents (CO2e) are reported using the 100-year global warming potentials (GWPs) contained in IPCC's fifth Assessment Report (AR 5).[5]

[5] Suriname uses the GWP from AR5 following decision 18/CMA.1, annex, paragraph 37, for National GHG Inventories to be included in Biennial Update Reports (BTRs) under the Paris Agreement.

5. Alignment with IPCC Guidance and Guidelines

This chapter will describe the information used by Suriname to construct its current FRL, such as the IPCC guidelines that have been used and the set of good practices provided by these guidelines that Suriname applied.

IPCC guidelines used

Decision 12/CP.17 annex states that information used to develop a FREL/FRL should be guided by the most recent IPCC guidance and guidelines. Therefore, the IPCC 2006 Guidelines for National Greenhouse Gas Inventories (AFOLU sector) and the 2019 Refinement to the 2006 IPCC Guidelines were used for the formulation of this FRL.

Good Practice

To ensure the quality of GHG inventories, the IPCC guidelines 2006 provide a set of good practices that Suriname applied as follows:

- Transparency (and completeness):

All background information used to produce the FRL for Suriname is openly available. National reports and documentation are made available through an online shared folder at Share folder FRL Suriname[6]. This folder also includes Suriname's "*Emissions and Removals estimation tool*", which provides explicit calculations on how all activity data, emission factors and removal factors data were used to calculate the emissions and removals in this FRL. All spatially explicit information on forest cover change is available through the open-access geoportal "Gonini" (https://www.gonini.org/). Since 2021, SBB has also launched a statistical portal "KOPI", where national logging specific data is made available (https://kopi.sbb.sr/).

- Accuracy:

After the second FREL, there was a transition from the wall-to-wall method for land representation to a systematic sampling approach. This approach allows for the estimation of uncertainty based on the proportions of samples related to each land-use and land-use change class following basic statistical principles for systematic sampling[7]. Additional to the land representation, the accuracy of the timber production volumes is determined based on expert judgment by SBB, with SBB data approved by other local institutions such as the General Bureau of Statistics and the National Planning Office.

- Completeness:

All methodologies used, intermediate results and decisions made are presented and documented so that it is possible to reconstruct the FRL (in agreement with decision

[6] Full link: https://drive.google.com/drive/folders/1LAO7j0LHAxVQ2K9NzMdyaP99Z4oCZS0D?usp=drive_link

[7] Suriname followed the guidance in the 2006 IPCC guidelines for national GHG inventories in sections 3A.2.2 and Annex 3A.3 for the collection of activity data and the estimation of uncertainty.

13/CP.19). Please visit the Shared folder and the Gonini geoportal for access to all information, as presented above.

- Consistency:

Same methodologies for all years in the time-series were used. Consistent data sets were used to estimate emissions and removals from sources/sinks. The current FRL and the data for the update of the upcoming National GHG inventory estimations were produced simultaneously, leading to consistency of these two products. The Forest and Other Land Use (FOLU) emissions and removals within the previous GHG inventory 2000- 2017 were estimated based on Land Use Land Cover maps of two years 2000 and 2015 and available Deforestation maps before more accurate and robust Land use change data was gathered with the LUA app. Since the NFMS became operational, regular data is available on the forest cover change using well described national methodologies. Additional data was also collected and processed on emissions due to selective logging and carbon stocks. The national staff responsible for the NFMS and FRL has developed strong capacity by designing methodologies and procedures and building the different data collection components in-house, with support from international partner organizations. This ensures consistent application of the methodologies in the future.

Consistency with the previous National GHG Inventory

Suriname submitted its first BUR in 2022 together with two REDD+ Technical Annexes based on the two previous FREL reports, which were submitted respectively in 2018 and 2021. In 2023, the third National Communication (NC3) of Suriname, including an updated National GHG inventory, was submitted to the UNFCCC. Both reports, BUR and NC3, covered the GHG inventory for the period of 2000 until 2017. The GHG inventory for the Forestry and Other Land Uses (FOLU) sector was estimated based on available Land Use Land Cover Maps for the year 2000 and 2015 and was sought to have consistency with the previously submitted FRELs which were based on deforestation and forest degradation. In the context of this current FRL, a more robust data collection methodology (systematic point sampling for 2001- 2021) has been developed to produce a more consistent time series and data set which can be used for both GHG inventory and development of FRL in order to comply with the consistency, as one of the good practices from the 2006 IPCC guidelines.

6. Information used to construct the FRL

This chapter will describe the data sources and methodologies that have been used to produce this data, together with the quality assessment/ quality control (QA/QC). Table 6.1 shows a summary of the data sources used to construct the FREL/FRL.

Table 6-1. Overview of the data sources used to construct the FRL

Applied methodology	2006 IPCC Guidelines for Greenhouse Gas Inventories 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Time-series	2001 to 2021. Annual information in tons CO2e/yr
Data sources for representing land	**CfRN LUA assessment, May 2023** Land use and land use change areas have been calculated based on a systematic sampling assessment undertaken on the CfRN LUA App. The whole country was covered by a systematic grid of 2.5 x 2.5km which represents 26,193 plots assessed. To match the national definition of a minimum area to qualify as a forest, a 1ha plot of 100m x 100m is selected. For the spatial distribution of the plots, a sampling design is used that overlaps the national NFI grid. All six IPCC land use classes were observed with a subdivision of 22 national land categories. The assessment was done in May-October 2023, which started with a training in February 2023, attended by a team of 16 experts from various institutions.
Data sources for activity data area under degradation	**CfRN LUA assessment, May 2023** Forest areas affected by disturbances including infrastructure, shifting cultivation, fires, mining and windbreaks were monitored through the high resolution images on the CfRN LUA App.
Data sources for activity data of Roundwood-Fuelwood	Roundwood production data is derived from national timber statistics. The fuel wood consumption data is an estimate based on a national fuel wood consumption survey conducted in 2015. The Foundation for Forest Management and Production Control (SBB) produces annual Forest sector analysis reports, containing the annual roundwood production and fuelwood consumption data. Furthermore, SBB

	also contributes to the bi-annual National environmental statistics report produced by the General Bureau of Statistics of Suriname.
Data source for estimating carbon stocks	National Studies: - SBB, CELOS, CATIE, ADEKUS, 2017. *Technical Report State-of-the-art study. Best estimates for emission factors and carbon stocks for Suriname.* - A. Roopsind et al., 2017. *Quantifying uncertainty about forest recovery 32-years after selective logging in Suriname.* For. Ecol. Manage., 391 (2017). - Zalman et al., 2019. *Opportunities for carbon emissions reduction from selective logging in Suriname.* Default values: - 2006 IPCC Guidelines for Greenhouse Gas Inventories and 2019 Refinement to the 2006 IPCC Guidelines. Vol. 4

6.1 Land Representation

The information on Activity data (AD) used was obtained from a land use and land-use change assessment, which was conducted based on a sample-based methodology using the CfRN LUA app for the years 2001-2021. Likewise, the information on the disturbances was obtained through that LULUC analysis.

According to the 2006 and 2019 IPCC guidelines, Suriname 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 locations. It is a sampling approach, different to wall-to-wall approach (maps). The assessment was carried out with the CfRN LUAapp, which is a free, open-access image visualization and interpretation tool useful for projects requiring land cover and/or land use information. The CfRN LUA app allows simultaneous visual interpretations of satellite imagery.

6.1.2 Sampling design

Sampling scheme design includes defining the sample plot size and layout and choosing a sampling method for the spatial distribution of plots across the monitoring area. These parameters (table 6.2) are aligned with the national definition of forest as well as the existing scheme for the national forest inventory (NFI).

Table 6-2. Overview sampling design

Sampling method	Sample creation	Plot size	Total plots
Systematic	Every 2.5 km	1 ha	26193

A systematic sampling method is used, where a grid of equally distributed sample plots is created to cover the monitoring area (see figure 6.1). These sample plots are permanent; points cannot be removed, but can be added through a statistical method called “intensification”.

To match the national definition of a minimum area to qualify as a forest, a 1ha plot of 100m x 100m is selected. For the spatial distribution of the plots, a sampling design is used that overlaps the national NFI grid. The national NFI grid was generated during a pilot NFI project in 2012. The NFI sampling design used in that pilot project is based on a principal 20 x 20km systematic grid of permanent Sampling Units (SU) covering the entire country. For LULC monitoring, this grid is intensified to 2.5 x 2.5 km.

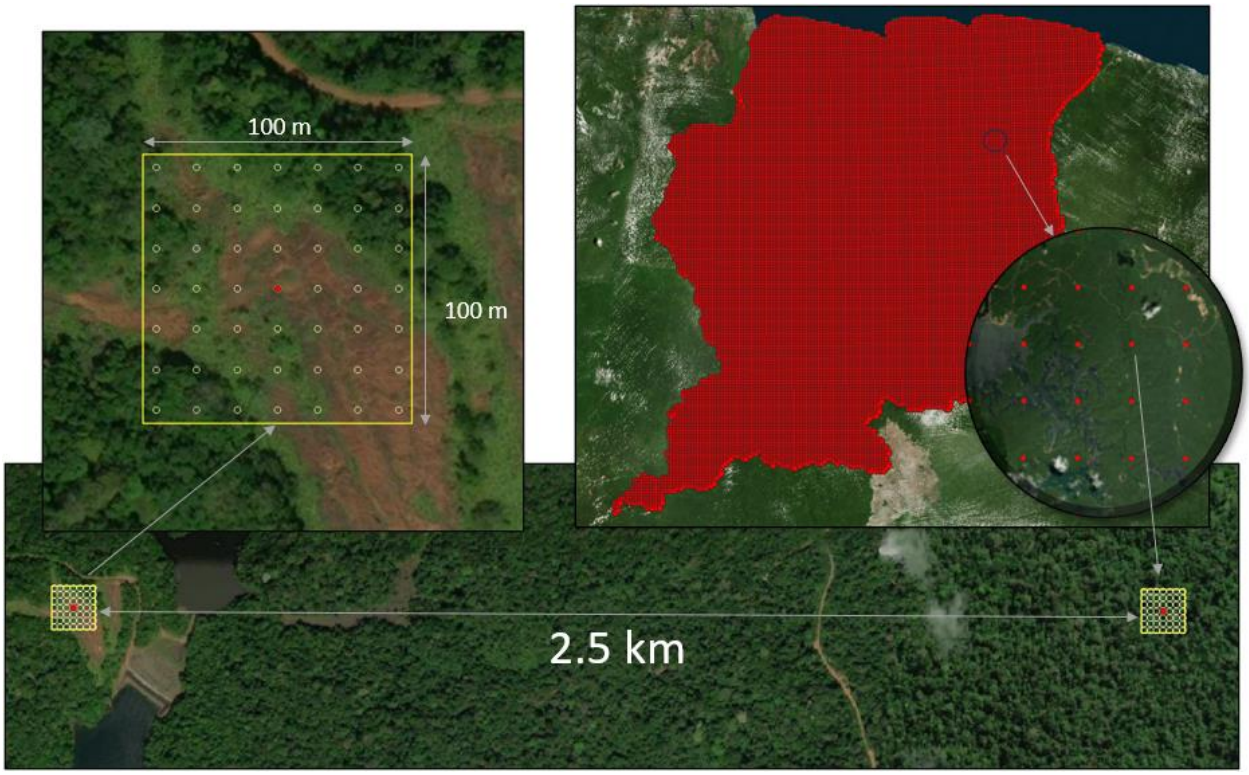


Figure 6-1. Sample plots covering the monitoring area

6.1.3 Land use categories and classification

Definitions and characteristics

The land use categories that have been used are based on the IPCC classes used for greenhouse gas inventory reporting.

For a more detailed description of the LULC classes, please visit Annex I. Protocol LULC monitoring.

Forest definition

The definition of forest is based on nationally appropriate criteria chosen in line with the IPCC guidelines. It is also aligned with what is used within the countries of the Guiana Shield. The definition of forest is described as followed:

Land covered primarily by trees, but also often containing shrubs, palms, bamboo, herbs, grass and climbers, with a minimum tree crown cover of 30% (or equivalent stocking level), with the potential to reach a minimum canopy height at maturity in situ of 5 meters, and a minimum area of 1.0 ha.[8]

Forest Land is sub-categorized in six classes: Primary forest, Secondary forest, Mangrove forest, Savannah forest, Planted forest and Swamp forest. The classification of each land use class presented in this FRL are included in table 6.3 below (for more information and definitions see Annex I. Protocol LULC monitoring).

[8]In the previous FRELs, shifting cultivation was included as Forest land. However, in this third FRL, shifting cultivation plots with a minimum area of 1 ha is reflected as the conversion of Forest land to Cropland. Regenerated shifting cultivation plots are seen as a form of a degradation agent and classified as Secondary forest which falls under Forest Land remaining Forest Land.

Table 6-3. Overview land use class description

Land Use Category Level 1	Sub-Land Use category Level 2	Sub-Land Use category Level 3	Description
Forestland	Primary Forest		Land covered primarily by trees, but also often containing shrubs, palms, bamboo, herbs, grass and climbers.
	Secondary forest		Areas that after the complete removal of forest vegetation, are in an advanced process of natural regeneration of shrubs and/or trees and include regenerated shifting cultivation areas.
	Mangrove forest		Mangroves are the characteristic littoral plant formations of tropical and subtropical sheltered coastlines. They have been variously described as 'coastal woodland', 'tidal forest' and 'mangrove forest'. Generally mangroves are trees and bushes growing below the high-water level inundated with saline water.
	Savanna forest		This type of forest shows two storeys, the upper storey is closed, fairly dense and regular and reaches up to 25—30 m, as the tallest trees rise above the general level with broad round crowns without becoming emergents. The lower storey consists in general of many slender trees with very narrow crowns which give the forest a staky appearance. A herb stratum is sometimes practically absent, in other cases it is dense and usually dominated by Bromelia alta L. B. Smith (bosananas).
	Swamp forest	high, low	These forests are marked by very wet conditions all year round. The shorter the inundation period the more it resembles the rainforest. It varies from open woodland to single or more storeys 10-20 meter high forest and can be found in permanently inundated terrain
Cropland	Annual	rice, mais, banana...	An annual plant definition is a plant that completes its entire life cycle in one year or one growing season. Rice plantation is also an annual crop, but due to the easy to detect patterns and the well-known locations (predominantly occurring in the district Nickerie), this crop is separately classified as "Annual-Rice".

	Perennial	apples, citrus, nuts,..	Perennial crops are typically considered as those that are more permanent, requiring a number of growth cycles before fruit is produced.
	Abandoned	Plantations	Land that was once used for agriculture activities, but has already been abandoned and is now covered or saturated by water for all or part of the year.
Grassland	Open savanna		Open savanna is a mixed woodland grassland ecosystem characterized by trees that fall below the threshold values used in the Definition of Forest. Note. only visible/open occurrences of typical savanna patterns are classified, which is not fully compatible with the morphological definition of "savanna".
	Rangelands/meadows and Pasture		Rangelands include natural grassland, savannas, many wetlands, some deserts, tundra, and certain forb and shrub communities. Pastures are those lands that are primarily used for the production of adapted, domesticated forage plants for livestock.
Wetland	Open swamp		Land that is covered or saturated by water for all or part of the year and is not covered with trees that fall under the definition of forest.
	Water bodies	Rivers/creeks	Areas that are covered or saturated by water for all or part of the year, but also have grass/shrub vegetation on top of it.
Settlement	Built area		High concentration of houses, buildings, streets and other public facilities.
	Infrastructure	(road, airstrip, airport, wet infrastructure, ports, dam, dike, logyards)	All developed land, including transportation infrastructure and human settlements of any size, unless they are already included under other categories. This should be consistent with national definitions.
	Mining	Gold	The process of extracting gold from the surface of the earth consists of exploration and exploitation activities in areas > 1ha.
		Bauxite	Quarries of bauxite are hundreds of hectares in size. As is the case with gold mines, they are often left open and damaged, with no rehabilitation.
		Oil	Land where petroleum mining is occurring. The plots are divided and a system of roads is paved between them.

		Building material	Extraction of building material used for construction.
Otherland	Rocks		Rocks have a bright brownish color on satellite images, where elevation data can be used as ancillary
	Bare soil		Bare soil mostly occurs near/at the borders of rivers/water bodie

In Annex I. Protocol LULC monitoring, the information included is: land use definitions, hierarchy of land classes, matrix of impossible and possible land use conversions, team of experts for data collection, interpretation keys as well as disturbances.

Disturbances

Disturbances are punctual events that affect the land, in particular some of the carbon pools present on these lands. According to the IPCC, there are two types of disturbances:

1. Natural disturbances that happen without any human intervention, for example hurricanes or storms;
2. Anthropogenic disturbances that are created by some specific management practices that can be controlled or not, for example fires.

The disturbances assessment was done also through Land use assessment (Approach 3). Disturbances can be seen, while doing the classification of the plot. Based on previous classification activities, knowledge is built on the occurring national disturbances.

Disturbances are identified as:

1. Shifting cultivation: This occurs mainly in the vicinity of villages and rivers. It is a traditional agriculture method, with cultivated areas usually smaller than 1 ha, and have a fallow period of at least four years (Fleskens et al., 2010), after which the slash and burn activity is repeated. The fires occurring in this agriculture method can be confirmed with FIRMS data.
2. Fires: Due to agricultural practices in the interior of Suriname, all shifting cultivation areas present biomass burning.
3. Mining: Mining areas < 1ha, are seen as disturbances caused by mining
4. Infrastructure: Infrastructure developments < 1ha, are seen as disturbances caused by infrastructure
5. Windbreaks/Flooding: Windbreaks are naturally occurring storms, usually causing disruptions smaller than 1 ha. Floodings are abandoned areas that are flooded or parts that are flooded during rainy seasons and or areas that are underwater all year round.

Area estimation

After the assessment was finished, CSV database from the LULUC assessment with all information recorded for each of the plots from 2001 to 2021 was extracted.

Each plot assessed has a story of land use and land use change and disturbance that may have occurred, such as fire. Each plot represents an area of the country. The sum of all the plots represents the country area. To calculate the area of each plot, the plot is multiplied by an expansion factor.

The proportion of each assignment category (pi), also known as the expansion factor, is obtained by dividing the number of points in the given category (ni), by the total number of points available for collection (n).

$$pi = ni/n$$

The area is calculated by multiplying the proportion of each category (expansion factor) by the total area inventoried.

$$Ai = \text{A x } p\text{i}$$

Table 6-4. Area per land use in 2021 in Ha

Country area	16,366,524		Area
Expansion factor	625	pi	ADi
Area per land use in 2021	No. Plots		ha
Primary Forest	23413	0.8939	14,629,459
Secondary Forest	326	0.0124	203,699
Mangrove	104	0.0040	64,984
Savannah Forest	35	0.0013	21,870
Swamp Forest	727	0.0278	454,261
Planted Forest	20	0.0008	12,497
Abandoned Cropland	39	0.0015	24,369
Annual Crops	79	0.0030	49,363
Annual Crops-Rice	93	0.0036	58,110
Perennial	10	0.0004	6,248
Savanah	151	0.0058	94,351
Rangelands and Pasture	35	0.0013	21,870
Open Swamp	541	0.0207	338,040
Water Body	440	0.0168	274,931
Built Area	61	0.0023	38,115
Infrastructure	7	0.0003	4,374
Mining Bauxite	3	0.0001	1,875
Mining Gold	89	0.0034	55,611
Mining Building material	2	0.0001	1,250
Mining Oil	3	0.0001	1,875
Rock	11	0.0004	6,873
Bare soil	4	0.0002	2,499
Total general	**26193**		**16,366,524**

Land Use Assessment plots for 2021. Suriname

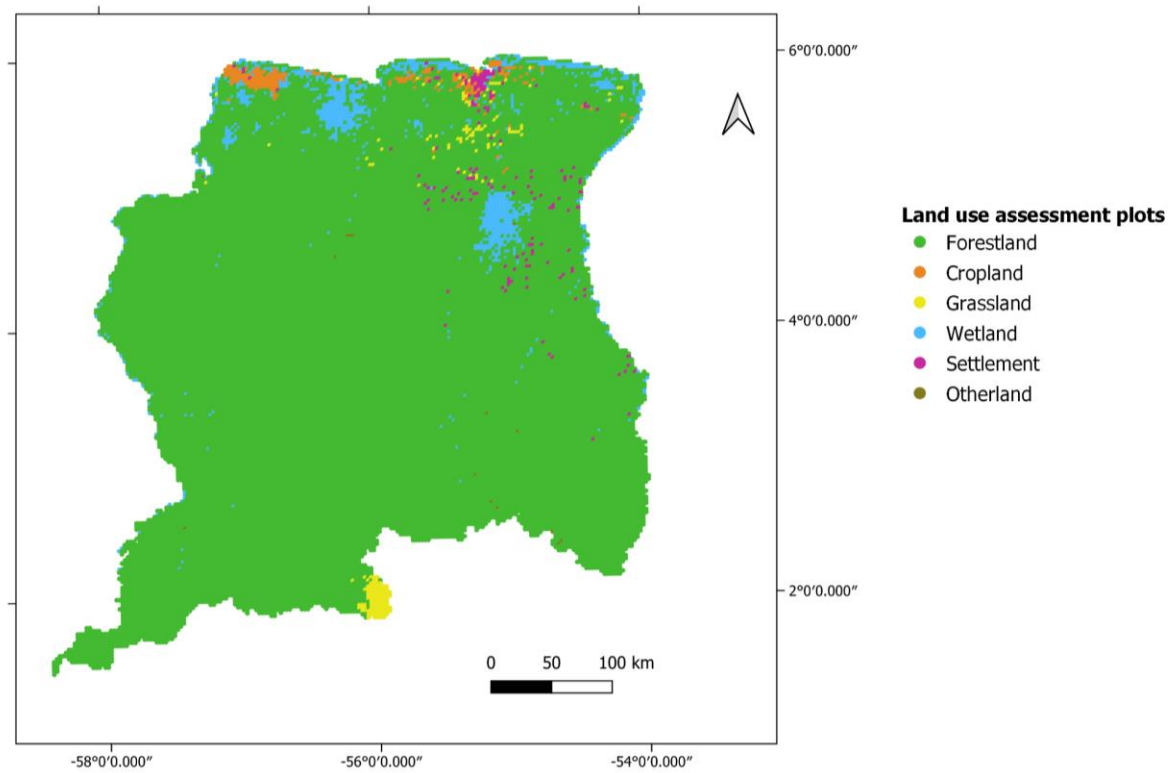


Figure 6-2. Land Use Assessment plots for 2021 representing IPCC classes

6.2 Emissions and removals estimation tool

To ensure a consistent application of the IPCC equations, their parameters, as well as the emission and removal factors, a tool was developed in Microsoft Excel, in which all calculations for the period 2001-2021 are made explicit. This tool applies the same equations for all years of the time series, providing consistency.

The tool is available in the Share folder FREL/FRL 2024.
The tool contains the following information:

Table 6-5. Overview of tab descriptions in the Tool's spreadsheet

Tab in Spreadsheet	Tab Description
Reporting table	This sheet includes the summary results for the GHG inventory for IPCC categories 3B and 3C and Total for REDD+. Annual emissions and removals (t CO2 eq)
Graph	Includes a Graph for net emissions and removals of forest-related sources and sinks (tons of CO2 eq/year)
Completeness	This sheet provides information on the sources and sinks included in the GHG inventory. Land-based carbon stock changes and Land-based non-CO2 emissions included.
Land AD	This sheet includes the annual area estimates of land-use and land-use change for the period 2001-2022. Values in hectares.
Land_EF	This sheet contains the following tables: Table 1. Emission and Removal Factors per land-use or land-use change category. Table 2. Carbon stocks by pool per land-use change category (Units: tons C/ha). These values are used to estimate Emission and Removal Factors above. Table 3. Annual increment in biomass (carbon gains). Table 4. Parameters for the estimation of soil organic carbon emissions and removals. Table 5. Land-use categories (full names). Annex. Emission factors values, references, errors and uncertainties
Land_ΔC	This sheet contains the estimates of emissions and removals for each land-use and land-use change for the period 2001-2022. Values in tons of CO2 equivalent per year.
FL_ΔCL	This tab includes the estimation for carbon losses associated with Forest land remaining Forest land. This sheet contains the following tables: Table 6. Annual roundwood removals. Table 7. Annual fuelwood removals. Table 8. Annual carbon losses in biomass due to disturbances. Table 9. Greenhouse gas emissions from fire.

Clarification Notes:

The tool employs land use change matrices as suggested by the 2006 IPCC guidelines, Volume 4, Chapter 3. Ancillary, tabular information is also provided for the implementation of the gain-and-loss method in the category Forest land remaining Forest land and for the estimation of non-CO2 emissions from biomass burning. Land use and

land use change matrices are multiplied by an emission and removal factors matrix. The emission and removal factors are built from the carbon stocks contained in tables 1, 2, 3 and 4, referred to above.

The equations were applied to each of the land use and land use changes included in the matrix. For the purposes of this FRL, only the emission and removals related to forests are presented in the tool. For purposes of the updated National GHG Inventory in the upcoming BTR, this tool will be expanded to cover the estimation of emissions and removals in other land use and land uses, effectively covering the entire LULUCF sector in consistency with REDD+.

To ensure that any lagged emissions and removals that result from lands in transition are estimated accurately (following IPCC assumption the land converted is under transition for 20 years), two types of matrices are applied as presented in the figure below. On the left we show the matrices reflecting the area of land and land use change in the year of transition, and on the right, we show the matrices with lagged emissions and any removals factor from biomass, DOM and SOC that may occur as a result of previous land use changes. Together, these matrices provide accurate annual estimations of emissions and removals for each year of the historical reference period.

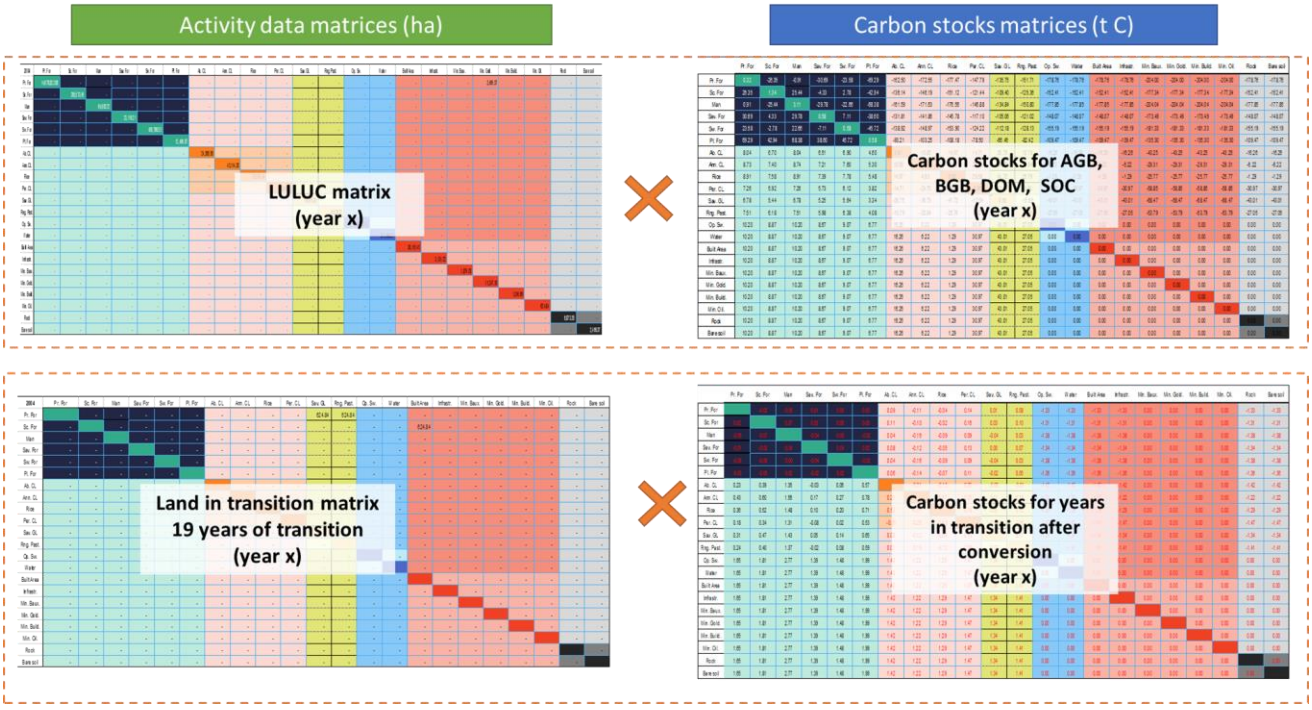


Figure 6-3. Overview of the multiplication of Activity data matrices and Carbon stocks matrices showing LULC- and Land in transition matrix and Carbon stocks for ABG, BGB, DOM, SOC and Carbon stocks for years in transitions after conversion

Assumptions related to the use of the matrices

Assumptions related to the conversion of Forest land to other land uses: 100% of biomass and DOM stocks are assumed to be lost in the year of conversion. SOC carbon stock changes take 20 years to reach new stability following IPCC guidance, except for Forest land conversion to mining. In Suriname, mining activity completely removes the top layer of soil, hence for any forest land that is converted to mining[9] we assume a complete loss of SOC in the year of conversion.

Assumptions for Lands converted to forest land: Biomass, DOM, SOC need 20 years to gain new stability. Note on the use of matrices in the Excel Tool: Biomass gains (1/20th per year) are reflected in the yearly matrices (left-hand side) starting on year 2 after conversion, while DOM and SOC carbon stock gains are reflected on the right-hand side matrix showing lagged emissions and any removals.

Assumption for Forest land remaining Forest land: following IPCC's suggestion for Tier 1, DOM and SOC carbon stocks are assumed to remain constant over time.

The IPCC equations, described in the following section, were applied to each of the land use dynamics included in the matrix of land use and land use change. However only the estimations related to forest are presented in this report. Following IPCC methods of multiplying Activity data with Emission factors.

Table 6-6. Method applied for the estimations of emissions/removals on Forest land

Carbon pool	Land category	
	Forest land remaining forest land	**Land converted to/from forest land**

[9] Mining is classified under Settlements.

Biomass	**Gain-loss method** Gains: 2006 IPCC GL equation 2.9 - Section 6.3.3 of this report - *Details of estimation included in calculation sheet Land_ΔCO2 using estimation Matrix* Losses: equations 2.11 - *Details of estimation included in calculation sheet Land_ΔCL*	**Carbon stock change** difference following 2006 IPCC GL equation 2.15 - Section 6.3.6 of this report - *Details of estimation included in calculation sheet Land_ΔCO2 using estimation Matrix*
Dead organic matter	The Tier 1 assumption - zero changes - Section 6.3.4 of this report	**Carbon stock change** following 2006 IPCC GL equation 2.23 - Section 6.3.7 of this report - *Details of estimation included in calculation sheet Land_ΔCO2 using estimation Matrix and Transition matrix*
Soil	The Tier 1 assumption - zero changes - Section 6.3.5 of this report	**Carbon stock change** following 2006 IPCC GL equation 2.25 - section 6.3.8 of this report - *Details of estimation included in calculation sheet Land_ΔCO2 using using estimation Matrix and Transition matrix*
Fire	**Non CO2** - 2006 IPCC GL equation 2.27 - Section 6.3.9 of this report - *Details of estimation included in calculation sheet Land_ΔCL*	All fires are assumed in forest land remaining forest land.

6.3 IPCC Methodologies applied

Note: Please also refer to the section above for additional information on the assumptions related to the treatment of carbon pools in land use permanence's and transitions.

In this section we provide information on the specific category-level methodologies employed, including a description of the data and assumptions used to estimate GHG emissions and removals.

For the estimation of GHG emissions and removals for the Forest and Land Use Change Sector, Suriname 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 carbon stocks (above-ground biomass, below-ground biomass, deadwood and soil organic carbon) and Non-CO_2 emissions from fires (CH_4 and N_2O). It includes the analysis for Forest Land remaining Forest land and Forest lands converted to and from another land-use category.

Suriname's FRL was conducted following a series of steps and using a range of data from diverse sources. IPCC methodology tiers 1, and 2 were applied. All definitions, methods and assumptions are described below.

6.3.1 Annual carbon stock changes for the entire AFOLU sector estimated as the sum of changes in all land-use categories. Equation 2.1, Chapter, Volume 4

The FRL only includes forest-related emissions and removals, per COP decisions, however, the estimation procedures follow the same general structure outlined in the 2006 IPCC guidelines, as follows:

$$\Delta CAFOLU = \Delta CFL + \Delta CCL + \Delta CGL + \Delta CWL + \Delta CSL + \Delta COL$$

Where:

ΔC = carbon stock change

Indices denote the following land-use categories:

AFOLU = Agriculture, Forestry and Other Land Use
FL = Forest Land
CL = Cropland
GL = Grassland

WL = Wetlands
SL = Settlements
OL = Other Land

For purposes of the National GHG Inventory, the forest-related time-series presented in this FRL will be added (following the equation above) to the AFOLU totals, ensuring consistency.

6.3.2 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)

$$\Delta CLUi = \Delta CAB + \Delta CBB + \Delta CDW + \Delta CLI + \Delta CSOC + \Delta CHWP$$

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 6-7. Pools included

	Included
ΔC_{AB}	Yes
ΔC_{BB}	Yes
ΔC_{DW}	Yes
ΔC_{DOM_LI}	No[10]
ΔC_{SOC}	Yes
ΔC_{HWP}	No

Clarification Notes
Data on HWP is not available yet.

[10] Excluded based on its significance as described earlier in the report.

6.3.3 Change in biomass carbon stocks (above-ground biomass and below-ground biomass) in Forest land remaining Forest land

Annual change in carbon stocks in biomass in Forest land remaining Forest land (gain-loss method) (Equation 2.7, Ch2, V4)

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

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 Forest land (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 6-8. Carbon fraction value chosen

Parameter	Value	Range/error	Reference
Carbon fraction [tonne C (tonne d.m.)$^{-1}$]	0.47	(0.44 - 0.49)	2006 IPCC Guidelines. Vol. 4, Chap. 4. Table 4.3. Default value for tropical and subtropical.

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 6-9. R ratio of below-ground biomass to above-ground biomass, in tonne d.m. below-ground biomass (tonne d.m. above-ground biomass)$_{-1}$

R (ratio of below-ground biomass to above-ground biomass)			
Sub-category	**Value**	**Error/range, reported**	**Reference**
Primary forest	0.24	(0.22 - 0.33) Range	SBB, CELOS, CATIE, ADEKUS, 2017. Technical Report State-of-the-art study Best estimates for emission factors and carbon stocks for Suriname. Carbon in roots was estimated by applying a root-to-shoot ratio factor of 0.24, based on IPCC 2006 default values for tropical forest.
Secondary forest	0.24	(0.22 - 0.33) Range	
Mangrove forest	0.24	(0.22 - 0.33) Range	
Savanna forest	0.24	(0.22 - 0.33) Range	

R (ratio of below-ground biomass to above-ground biomass)			
Swamp forest	0.24	(0.22 - 0.33) Range	
Planted Forest	0.24	(0.22 - 0.33) Range	
Abandoned Cropland	0.34	15%	2019 Refinement to the2006 IPCC Guidelines. Vol. 4, Chap. 5. Table 5.2. Tropical all. All regions. Fallow. The radius is obtained by dividing the values of BGB and AGB
Annual Cropland	0	NA	
Rice cultivation	0	NA	
PerennialCropland	0.23	24%	2019 Refinement to the2006 IPCC Guidelines. Vol. 4, Chap. 5. Table 5.2. Tropical all. All regions. Shaded perennial. The radius is obtained by dividing the values of BGB and AGB
Savannah Grassland	0.24	(0.22 - 0.33) Range	Carbon in roots was estimated by applying a root-to-shoot ratio factor of 0.24, based on IPCC 2006 default values for tropical forest.
Rangeland pasture	0.24	(0.22 - 0.33) Range	Carbon in roots was estimated by applying a root-to-shoot ratio factor of 0.24, based on IPCC 2006 default values for tropical forest.
Open Swamp	NA	NA	
Water	NA	NA	
Built Area	NA	NA	
Infrastructure	NA	NA	
Mining Bauxite	NA	NA	
Mining Gold	NA	NA	
Mining Buildings	NA	NA	
Mining Oil	NA	NA	
Rock	NA	NA	
Bare Soil	NA	NA	

Table 6-10. Average annual above-ground biomass growth for a specific woody vegetation type, tonnes d. m. ha^{-1} yr^{-1}

Gw (t.d.m) Average annual AGB growth for a specific woody vegetation type			
Sub-category	**Value**	**Uncertainty (%)**	**Reference**
Primary forest	0.55	(1.51-3.26) (95% CI) (S.E 0.21)	A. Roopsind et al. Quantifying uncertainty about forest recovery 32-years after selective logging in Suriname.For. Ecol. Manage., 391 (2017), pp. 246-25. The value is given for non-logged forest, in Mg C per year (0.26). That value is estimated with Table 2. Considering increment MgC ha-1 yr-1 2.39 (1.51-3.26) (95% CI)and the value of mortality 2.13 Mg C ha-1 yr-1 (S.E 0.21) (the value is divided by 0.47 to obtain t.d.m)
Secondary forest	2.3	1.1	2019 Refinement to the2006 IPCC Guidelines for National Greenhouse Gas Inventories. Table 4.9. Tropical rainforest North and South America. Secondary> 20 years
Mangrove forest	5.34		Preliminary value (National Study done in the context of the GCCA+ phase 2 project with support of the UNDP Suriname)
Savanna forest	1	90%	2019 Refinement to the2006 IPCC Guidelines for National Greenhouse Gas Inventories. Table 4.9. Tropical shrublands. North and South America. Secondary> 20 years
Swamp forest	1	90%	2019 Refinement to the2006 IPCC Guidelines for National Greenhouse Gas Inventories. Table 4.9. Subtropical humid forest. North and South America. Secondary> 20 years
Planted Forest	1	90%	2019 Refinement to the2006 IPCC Guidelines for National Greenhouse Gas Inventories. Table 4.9. Tropical shrublands. North and South America. Secondary> 20 years

Annual decrease in carbon stocks due to biomass losses in Forest land remaining Forest land (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 6-11. H. annual wood removals, roundwood, m3 yr-1

Year	*H_log_conv*	*Uncertainty*	*Source*
2001	162,308	5%	*Source: Bosbouwstatistieken. Productie, export en import van hout en houtproducten in 2022. Stichting voor Bosbeheer en Bostoezicht, directoraat Bosbouw Economische Diensten, afdeling Statistieken. Paramaribo. SBB.*
2002	153,812	5%	
2003	155,461	5%	
2004	159,412	5%	
2005	180,891	5%	
2006	193,056	5%	
2007	166,365	5%	
2008	197,394	5%	
2009	206,975	5%	
2010	246,158	5%	
2011	365,715	5%	
2012	435,549	5%	
2013	394,146	5%	
2014	492,773	5%	
2015	568,176	5%	
2016	583,376	5%	
2017	862,907	5%	
2018	1,083,350	5%	
2019	1,074,710	5%	

2020	523,820	5%	
2021	624,516	5%	

Table 6-12. Emissions factors for round wood production

Unextracted wood emissions **(Mg C ha-1)**	*Source*
0.70	Based on Zalman et al. (2019), unextracted wood emissions (Mg C ha-1) include branches and roots. This factor replaces the BCEFr in IPCC equation 2.12. This value is deemed more accurate as it is based on direct measurements in 10 logging concessions across Suriname.

Table 6-13. Emissions factors for round wood production (cont'd)

collateral damage (Mg C ha-1)	**skid trail emissions** (Mg C ha-1)	**haul road emission** (Mg C ha-1)	**log deck emissions** (Mg C ha-1)	***Total Damage emisión factor logging*** **(Mg C ha-1)**	**Source**
0.57	*0.31*	*0.51*	*0.06*	**1.44**	Damage EF is based on Zalman et al. (2019), including collateral damage, skid trail emissions, haul road emissions, and log deck emissions. Extracted wood emissions are considered to be represented by H.

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 6-14. Annual volume of fuelwood removal of whole trees, m3 yr-1

Year	***FGtrees***	*Uncertainty*	*Source*
2001	121,263.0	15%	*Source: Expert analyses based on survey data (Forest economic department from SBB)*
2002	118,305.0	15%	
2003	115,420.0	15%	
2004	112,605.0	15%	
2005	109,858.0	15%	
2006	107,179.0	15%	
2007	104,565.0	15%	
2008	102,014.0	15%	
2009	99,526.0	15%	
2010	97,099.0	15%	
2011	94,730.0	15%	
2012	92,420.0	15%	
2013	90,166.0	15%	
2014	87,912.0	15%	

2015	85,714.0	15%	
2016	83,571.0	15%	
2017	81,482.0	15%	
2018	79,445.0	15%	
2019	77,459.0	15%	
2020	75,400.0	15%	
2021	73,390.0	15%	

Annual carbon losses in biomass due to forest 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

Clarification note:

The activity data for the Areas affected by disturbance were obtained from the LUA assessment (May 2023), through an evaluation of forest areas affected by disturbances including infrastructure, shifting cultivation, fires, mining, and windbreaks were monitored through the high resolution images on the CfRN LUA App.

In the same way, from this land use assessment, the fraction of biomass lost in disturbance (fd) was registered for each disturbance, type of vegetation and year.

Table 6-15. Overview of the Area of disturbances per vegetation type

A disturbance (per vegetation types)													
	Primary Forest				*Secondary Forest*			*Swamp Forest*		*Mangrove*		*Savannah Forest*	*Planted Forest*
Year	*Infrastructure*	*Mining*	*Shifting Cultivation*	*Windbreaks (Natural)*	*Infrastructure*	*Mining*	*Shifting Cultivation*	*Infrastructure*	*Mining*	*Infrastructure*	*Mining*	*Infrastructure*	*Infrastructure*
2001	3,124	3,749			625	625	6,873						
2002	625	3,749		625			8,748						
2003	1,250	1,875					6,873						
2004	1,875	3,124	1,250	1,250			4,374						
2005	1,250	1,250					1,250						
2006		1,875					1,875						
2007	1,875	2,499					2,499						
2008	625	3,749			625		1,875						
2009	625	3,124					4,374	625					
2010	625	4,374					2,499			625			
2011	4,374	3,749					3,124						
2012	4,374	4,374	625				2,499						
2013	3,124	4,374	625				2,499					625	
2014	3,749	3,749	625				625					625	
2015	6,248	7,498		625	1,250		7,498	625					
2016	7,498	8,748	625	625			11,872						625
2017	7,498	4,999	625		625	1,250	4,999		625				

2018	6,248	5,624	1,875		625		7,498						
2019	6,248	1,875	1,250				6,248				625		
2020	2,499	4,374	625		625		5,624						
2021	625	6,873	625			625	8,748						
2022	625	9,373	625				1,250						
	Source: CfRN LUA App – Annual time serie – 2001 to 2021												

Table 6-16. Values for fraction of biomass loss due to disturbances

Fraction of biomass lost in disturbance (fd)													
	Primary Forest				Secondary Forest			Swamp Forest		Mangrove		Savannah Forest	Planted Forest
Year	Infrastructure	Mining	Shifting Cultivation	Windbreaks (Natural)	Infrastructure	Mining	Shifting Cultivation	Infrastructure	Mining	Infrastructure	Mining	Infrastructure	Infrastructure
2001	0.27	0.39	-	-	0.60	0.10	0.23	-	-	-	-	-	-
2002	0.32	0.43	-	0.04	-	-	0.41	-	-	-	-	-	-
2003	0.24	0.40	-	-	-	-	0.31	-	-	-	-	-	-
2004	0.32	0.22	0.26	0.23	-	-	0.25	-	-	-	-	-	-
2005	0.28	0.13	-	-	-	-	0.35	-	-	-	-	-	-
2006	-	0.16	-	-	-	-	0.33	-	-	-	-	-	-
2007	0.26	0.24	-	-	-	-	0.35	-	-	-	-	-	-
2008	0.30	0.43	-	-	0.15	-	0.52	-	-	-	-	-	-
2009	0.12	0.24	-	-	-	-	0.24	0.30	-	-	-	-	-
2010	0.45	0.37	-	-	-	-	0.33	-	-	0.20	-	-	-
2011	0.25	0.30	-	-	-	-	0.24	-	-	-	-	-	-
2012	0.33	0.24	0.50	-	-	-	0.33	-	-	-	-	-	-
2013	0.31	0.21	0.40	-	-	-	0.35	-	-	-	-	0.20	-
2014	0.31	0.25	0.20	-	-	-	0.40	-	-	-	-	0.14	-
2015	0.34	0.29	-	0.25	0.11	-	0.28	0.44	-	-	-	-	-
2016	0.26	0.23	0.34	0.04	-	-	0.26	-	-	-	-	-	0.30
2017	0.32	0.22	0.36	-	0.14	0.13	0.54	-	0.30	-	-	-	-

2018	0.30	0.26	0.22	-	0.08	-	0.34	-	-	-	-	-	-
2019	0.19	0.18	0.12	-	-	-	0.44	-	-	-	0.15	-	-
2020	0.17	0.39	0.27	-	0.20	-	0.24	-	-	-	-	-	-
2021	0.50	0.15	0.58	-	-	0.23	0.49	-	-	-	-	-	-
2022	0.02	0.15	0.20	-	-	-	0.13	-	-	-	-	-	-
Source: CfRN LUA App – Annual time serie – 2001 to 2021													

6.3.4. Change in dead organic matter carbon stock in forest land remaining forest land

We applied IPCC's Tier 1 assumption for DOM carbon stocks for all forest land sub-categories, *i.e.* stocks do not change over time if the land remains within the same land-use category.

6.3.5. Change in soil organic carbon stock in forest land remaining forest land

We applied IPCC's Tier 1 assumption, *i.e.* that there are no SOC carbon stock changes in Forest land Remaining Forest land. We assume that forest disturbances do not affect SOC carbon stocks.

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

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

Table 6-17. Overview of Area of land converted to a land-use category

A: area of land converted to a land-use category		
LU	**Sub-Category**	**Source**
Non-F>F	**Non-Forest Lands > Forest Lands**	**LULUC Assessment CfRN LUA App – Annual time series 2001-2021**
F>C	**Forest lands > Croplands**	
F>G	**Forest lands > Grasslands**	
F>W	**Forest lands > Wetlands**	
F>S	**Forest lands > Settlements**	
F>O	**Forest lands > Other lands**	

Table 6-18. Overview of Aboveground Biomass carbon per sub-category

Carbon AGB (t C/ha)			
Sub-category	**Value**	**Uncertainty (%)**	**Reference**
Primary forest	137.91	10.64	SBB, CELOS, CATIE, ADEKUS, 2017. Technical Report State-of-the-art study Best estimates for emission factors and carbon stocks for Suriname
Secondary forest	113.81	72.97	Table 15. Source: SBB, CELOS, CATIE, ADEKUS, 2017. Technical Report State-of-the-art study Best estimates for emission factors and carbon stocks for Suriname
Mangrove	119.83	NE	Additional research to SBB, CELOS, CATIE, ADEKUS, 2017. Technical Report State-of-the-art study. Best estimates for emission factors and carbon stocks for Suriname * Note: Mangrove forest carbon stocks have been updated based on 13 NFI plots (source: second FREL of Suriname)
Savanna forest	117.52	72.5	Table 15. Source: SBB, CELOS, CATIE, ADEKUS, 2017. Technical Report State-of-the-art study. Best estimates for emission factors and carbon stocks for Suriname. Low Savanna
Swamp forest	122.29	42.63	Table 15. Source: SBB, CELOS, CATIE, ADEKUS, 2017. Technical Report State-of-the-art study. Best estimates for emission factors and carbon stocks for Suriname. Low swamp
Plantated Forest	141	90	2019 Refinement to the2006 IPCC Guidelines. Table 4.8. Tropical rain forest, America, Pinus sp. Value 300 tdm, converted to carbon is 141.
Abandoned Cropland	11.1	75	2019 Refinement to the2006 IPCC Guidelines. Vol. 4, Chap. 5. Table 5.1. Fallow (Mean)
Annual Cropland	5	75	IPCC Guidelines 2006. Volume 4, Chapter 5. Table 5.9. Annual cropland

Rice cultivation	0	0	
Permanent Cropland	24	28	2019 Refinement to the2006 IPCC Guidelines. Vol. 4, Chap. 5. Table 5.1. tropical shaded perennial (Mean)
Savannah Grassland	33.61	46.4	2019 Refinement to the2006 IPCC Guidelines. Vol. 4, Chap. 4. Table 4.7. Tropical shrublands, North and South America, Primary
Rangeland pasture	20.68	26	2019 Refinement to the2006 IPCC Guidelines. Vol. 4, Chap. 4. Table 4.7. Subtropical steppe, North and South America, Primary
Open Swamp	NA	NA	
Water	NA	NA	
Built Area	NA	NA	
Infrastructure	NA	NA	
Mining Bauxite	NA	NA	
Mining Gold	NA	NA	
Mining Buildings	NA	NA	
Mining Oil	NA	NA	
Rock	NA	NA	
Bare Soil	NA	NA	

Table 6-19. Overview of Belowground Biomass carbon per sub-category

Carbon BGB (t C/ha)			
Stratum	**Value**	**Uncertainty (%)**	**Reference**
Pr	33.10	10.64% / (0.22-0.33) Range	SBB, CELOS, CATIE, ADEKUS, 2017. Technical Report State-of-the-art study Best estimates for emission factors and carbon stocks for Suriname. Carbon in roots was estimated by applying a root-to-shoot ratio factor of 0.24, based on IPCC 2006 default values for tropical forest.
Secondary forest	27.31	72.97% / (0.22-0.33) Range	
Mangrove	28.76	NE / (0.22-0.33) Range	
Savanna forest	28.20	72.5% / (0.22-0.33) Range	
Swamp forest	29.35	42.63% / (0.22-0.33) Range	
Planted Forest	33.84	90% / (0.22-0.33) Range	
Abandoned Cropland	3.74	75%/ 15%	Carbon in roots was estimated by applying a root-to-shoot ratio factor of 0.24, based on IPCC 2006 default values for tropical forest.
Annual Cropland	0.00	NA	
Rice cultivation	0.00	NA	
Permanent Cropland	5.50	28%/ 24%	
Savannah Grassland	8.07	46.4%/ (0.22-0.33) Range	
Rangeland pasture	4.96	2% / (0.22-0.33) Range	
Open Swamp	NA	NA	
Water	NA	NA	
Built Area	NA	NA	
Infrastructure	NA	NA	
Mining Bauxite	NA	NA	

Mining Gold	NA	NA	
Mining Buildings	NA	NA	
Mining Oil	NA	NA	
Rock	NA	NA	
Bare Soil	NA	NA	

Clarification notes:

It is assumed that all the biomass is lost during the year of conversion when we have a forest converted to another land. When a land is converted to forest only a fraction of 1/20 is gained on the year of conversion. The remaining carbon gains to achieve the full re-stocking of biomass carbon stocks are accounted for under the forest land remaining forest land category the 19 years following the conversion through the application of IPCC's equation 2.9 (this is to avoid double counting).

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

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

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

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 6-20. Values for dead wood and litter stock

DOM (t C/ha) Dead wood + Standing deadwood						
Stratum	**Total Value DOM**	**Value standing DW**	**Error**	**Value downed DW**	**Error**	**Reference**
Primary forest	6.42	1.92	68% (U)	4.50	94% (U)	SBB, CELOS, CATIE, ADEKUS, 2017. Technical Report State-of-the-art study Best estimates for emission factors and carbon stocks for Suriname
Secondary forest	9.97	4.09	1.79 (S.E)	5.88	5.16 (S.E)	Table 16. Source: SBB, CELOS, CATIE, ADEKUS, 2017. Technical Report State-of-the-art study Best estimates for emission factors and carbon stocks for Suriname
Mangrove	27.88	27.88	27.08	0	NA	Additional research to SBB, CELOS, CATIE, ADEKUS, 2017. Technical Report State-of-the-art study Best estimates for emission factors and carbon stocks for Suriname * Note: Mangrove forest carbon stocks have been updated based on 13 NFI plots (source second FREL of Suriname)
Savanna forest	1.01	1.01	0.94 (S.E)	0	NA	Table 16. Source: SBB, CELOS, CATIE, ADEKUS, 2017. Technical Report State-of-the-art study Best estimates for emission factors and carbon stocks for Suriname. Low Savanna
Swamp forest	2.17	2.17	0	0	0	Table 16. Source: SBB, CELOS, CATIE, ADEKUS, 2017. Technical Report State-of-the-art study Best estimates for emission

						factors and carbon stocks for Suriname. Low swamp
Planted Forest	12.7	8.4	(Range: 1.2 - 21.2)	4	Range: (2.0 - 9.0	2019 Refinement to the2006 IPCC Guidelines. Vol 4, Ch. 2. Table 2.2. Tropical moist forest, Broadleaf deciduous. Litter 4.3 Range: (2.0 - 9.0). Deadwood 8.4 (Range: 1.2 - 21.2)

6.3.8. 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.

Table 6-21. SOC ref values by Land use and sub-categories of land use

SOCref (t C, ha)			
Stratum	**Value**	**SD**	**Reference**
Interior	26.57	3.28	Information on soil organic carbon (SOC) content was obtained from the global soil organic carbon map (GSOCmap; FAO, 2019). The information related to the country's soil carbon stock was downloaded and a union of the SOC information was carried out for each of the sampling points in LUAapp, which allowed obtaining a reference value (SOCref) by land use and subcategories.
Secondary forest	26.25	2.98	
Mangrove	27.57	1.78	
Savanna forest	26.75	2.57	
Swamp forest	27.52	2.33	
Planted Forest	27.19	2.38	
Abandoned Cropland	28.41	1.74	
Annual Cropland	28.16	2.42	
Rice cultivation	29.85	1.38	
Permanent Cropland	27.94	1.97	
Savannah Grassland	26.79	4.29	
Rangeland pasture	28.15	2.12	
Open Swamp	0.00	NA	
Water	0.00	NA	

Built Area	0.00	NA	
Infrastructure	0.00	NA	
Mining Bauxite	0.00	NA	
Mining Gold	0.00	NA	
Mining Buildings	0.00	NA	
Mining Oil	0.00	NA	
Rock	0.00	NA	
Bare Soil	0.00	NA	

Clarification Notes

Information on soil organic carbon (SOC) content was obtained from the global soil organic carbon map (GSOCmap; FAO, 2019). The official shape file of Suriname's national territory was uploaded in the online map, the information related to the country's soil carbon stock was downloaded.

The result is a TIFF image that was processed in QGIS Desktop version 3.1.6. Suriname has spatially explicit information on land uses obtained through LUAapp assessment described in the activity data section. Thus, the process consisted in linking the SOC information for each of the plots, which will then allow allocating the SOC ref value by land use and sub-categories of land use.

Figure 6-4. Global soil organic carbon map for Suriname

The result of this process is a SOC value for each plot. Then, information is organized by land use and sub-category and an average value is estimated.

Table 6-22. FLU, FMG and FI Values for values by Land use and sub-categories of land use

SOIL STOCK CHANGE FACTORS FOR LAND-USE CONVERSIONS (dimensionless)							
Stratum	**FLU**	**Uncertainty**	**FMG**	**Uncertainty**	**FI**	**Uncertainty**	**Reference**
Interior	1.00	N.A	1.00	N.A	1.00	N.A	2019 Refinement to the2006 IPCC Guidelines. Vol 4, Ch. 4. Section 4.2.3.2. Tier 1
Secondary forest	1.00	N.A	1.00	N.A	1.00	N.A	
Mangrove	1.00	N.A	1.00	N.A	1.00	N.A	
Savanna forest	1.00	N.A	1.00	N.A	1.00	N.A	
Swamp forest	1.00	N.A	1.00	N.A	1.00	N.A	

SOIL STOCK CHANGE FACTORS FOR LAND-USE CONVERSIONS (dimensionless)							
Planted Forest	1.00	N.A	1.00	N.A	1.00	N.A	
Abandoned Cropland	1.00	N.A	1.00	N.A	1.00	N.A	
Annual Cropland	0.83	±11%	1.04	±7%	1.00	N.A	2019 Refinement to the2006 IPCC Guidelines. Vol 4, Ch. 5. FLU: Long term cultivated, tropical, Moist/Wet. FMG: Tillage, Reduced, Tropical, Moist/Wet. FI: Input, Medium, All, Dry/Moist/Wet
Rice cultivation	0.83	±11%	1.04	±7%	1.00	N.A	2019 Refinement to the 2006 IPCC Guidelines. Vol 4, Ch. 5. FLU: Long term cultivated, tropical, Moist/Wet. FMG: Tillage, Reduced, Tropical, Moist/Wet. FI: Input, Medium, All, Dry/Moist/Wet
Permanent Cropland	1.01	±25%	1.04	±7%	1.00	N.A	2019 Refinement to the2006 IPCC Guidelines. Vol 4, Ch. 5. FLU: Land use Perennial tree crop, Tropical, Dry and Moist/Wet. FMG: Tillage, Reduced, Tropical, Moist/Wet. FI: Input, Medium, All, Dry/Moist/Wet
Savannah Grassland	1.00	N.A	1.00	N.A	1.00	N.A	2019 Refinement to the 2006 IPCC Guidelines. Vol 4, Ch. 6. FLU:(All), FMG: Nominally managed - none degraded, FI: Medium
Rangeland pasture	1.00	N.A	1.00	N.A	1.00	N.A	2019 Refinement to the 2006 IPCC Guidelines. Vol 4, Ch. 6. FLU:(All), FMG: Nominally managed - none degraded, FI: Medium
Open Swamp	NA	N.A	NA	N.A	NA	NA	
Water	NA	N.A	NA	N.A	NA	NA	

SOIL STOCK CHANGE FACTORS FOR LAND-USE CONVERSIONS (dimensionless)							
Built Area	NA	NA	NA	NA	NA	NA	
Infrastructure	NA	NA	NA	NA	NA	NA	
Mining Bauxite	NA	NA	NA	NA	NA	NA	
Mining Gold	NA	NA	NA	NA	NA	NA	
Mining Buildings	NA	NA	NA	NA	NA	NA	
Mining Oil	NA	NA	NA	NA	NA	NA	
Rock	NA	NA	NA	NA	NA	NA	
Bare Soil	NA	NA	NA	NA	NA	NA	

6.3.9. Non-CO2 Emissions

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

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

Where:

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

A = area burnt, ha

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

Cf = combustion factor, dimensionless

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

Table 6-23. Values for estimation Non-CO2 emissions

Year	Area burnt (ha)	Source
2001	6,873.28	LUAapp land use assessment. (Due to agricultural practices in Suriname, all forest areas that present shifting cultivation, present biomass burning. Therefore, it is assumed that the surface affected by Shifting cultivation has fires)
2002	8,747.81	
2003	6,873.28	
2004	5,623.59	
2005	1,249.69	
2006	1,874.53	
2007	2,499.37	
2008	1,874.53	
2009	4,373.90	
2010	2,499.37	
2011	3,124.22	
2012	3,124.22	
2013	3,124.22	
2014	1,249.69	
2015	7,498.12	
2016	12,496.87	
2017	5,623.59	
2018	9,372.65	
2019	7,498.12	

2020	6,248.43	
2021	9,372.65	

Table 6-24. Values for estimation Non-CO2 emissions

Mb * Cf Mass of fuel available for combustion and combustion factor	**G_{ef} for CH_4** Emission factor, g kg-1 dry matter burnt	**G_{ef} for N_2O** Emission factor, g kg-1 dry matter burnt	**References**
42.20 *(23.6 SE)*	**6.80** *(± 2.0)*	**0.20** *(NA)*	Mb * Cf: 2006 IPCC Guidelines. Vol 4, Chapter 2, Table 2.4 All secondary tropical forests. G_{ef} for CH_4 AND N_20: 2006 IPCC Guidelines. Vol 4, Chapter 2, Table 2.5. Values for tropical forest.

6.4 Historical emissions and removals used for constructing the Forest Reference level (FRL)

According to our estimations of historical emission and removals, and in line with what has been submitted to the UNFCCC in previous National Communications and in the first BUR, Suriname is a net carbon remover which means that the country removes more carbon than it emits CO2. The table 6.24 presents the emissions and removals in tonnes of CO2 equivalent for the historical period from 2001 to 2021. The FRL described in this report will cover the implementation period of 2022 to 2030. The graph in figure 6.5 shows emissions and removals for 3B and 3C categories related to forest and it is clearly seen the capacity of removals in Suriname compared to the emissions.

Table 6-25. Annual emissions and removals (t CO2 eq) for historical period of the FREL

**Only estimates in Forest Lands are considered for the FRL. Estimates for the GHG inventory will be estimated in the corresponding reports.*

Categories	*Annual emissions and removals (t CO2 eq)*									
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
3B Land	-15,202,820	-15,209,841	-14,527,496	-15,059,484	-17,178,829	-17,550,682	-17,555,022	-15,058,251	-16,391,011	-14,275,024
3B1 Forest land (FL)	-16,137,606	-15,677,234	-16,937,454	-16,931,855	-18,044,340	-18,021,134	-17,558,081	-16,858,807	-17,329,115	-16,615,307
3B1a FL remaining FL	-16,137,606	-15,677,234	-16,937,454	-16,931,855	-18,044,340	-18,021,134	-17,558,081	-16,858,807	-17,329,115	-16,615,307
Carbon Gains	-20,066,733	-20,065,998	-20,059,255	-20,056,318	-20,054,849	-20,054,115	-20,054,115	-20,051,177	-20,049,708	-20,046,036
Carbon Losses	3,929,127	4,388,765	3,121,801	3,124,462	2,010,509	2,032,981	2,496,034	3,192,370	2,720,593	3,430,730
Wood-removals	849,068	804,623	813,250	833,918	946,279	1,009,917	870,291	1,032,610	1,082,730	1,287,705
Firewood	578,910	564,788	551,015	537,576	524,462	511,673	499,193	487,015	475,137	463,551
Disturbances	2,501,150	3,019,353	1,757,536	1,752,968	539,767	511,391	1,126,550	1,672,745	1,162,726	1,679,474
3B1b Land converted to FL	0	0	0	0	0	0	0	0	0	0
3B2 Cropland (CL)	0	0	0	0	395,318	259	259	395,577	518	518
3B2a CL remaining CL	-	-	-	-	-	-	-	-	-	-
3B2bi Forest Land converted to CL	0	0	0	0	395,318	259	259	395,577	518	518
3B3 Grassland (GL)	0	0	658,601	-206	-206	-206	-206	-206	-206	-206
3B3a GL remaining GL	-	-	-	-	-	-	-	-	-	-
3B3bi Forest land converted to GL	0	0	658,601	-206	-206	-206	-206	-206	-206	-206
3B4 Wetlands (WL)	0	0	0	0	0	0	0	0	0	0
3B4a WL remaining WL	-	-	-	-	-	-	-	-	-	-
3B4bi Forest land converted to WL	0	0	0	0	0	0	0	0	0	0

nents (SL)	934,786	467,393	1,751,357	1,872,578	470,399	627,259	3,007	1,405,185	937,792	2,339,971
3B5a SL remaining SL	-	-	-	-	-	-	-	-	-	-
3B5bi Forest land converted to SL	934,786	467,393	1,751,357	1,872,578	470,399	627,259	3,007	1,405,185	937,792	2,339,971
3B6 Other land (OL)	0	0	0	0	0	0	0	0	0	0
3B6a OL remaining OL	-	-	-	-	-	-	-	-	-	-
3B6bi Forest land converted to OL	0	0	0	0	0	0	0	0	0	0
3C Aggregate sources and non-CO2 emissions sources on land	70,599	89,853	70,599	57,763	12,836	19,254	25,672	19,254	44,926	25,672
3C1 Biomass burning	70,599	89,853	70,599	57,763	12,836	19,254	25,672	19,254	44,926	25,672
3C1a Biomass Burning in FL	70,599	89,853	70,599	57,763	12,836	19,254	25,672	19,254	44,926	25,672
HWP										
Total for REDD+	**-15,132,221**	**-15,119,988**	**-14,456,898**	**-15,001,721**	**-17,165,993**	**-17,531,428**	**-17,529,349**	**-15,038,997**	**-16,346,085**	**-14,249,352**

Table 6-26. Annual emissions and removals (t CO2 eq) for historical period of the FREL (Cont'd)

Categories	*Annual emissions and removals (tCO2eq)*										
	2011	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
3B Land	-11,285,357	-11,843,398	-12,947,008	-12,880,762	-9,565,850	-7,897,024	-10,332,897	-7,787,558	-7,847,791	-10,699,934	-12,066,749
3B1 Forest land (FL)	-15,890,530	-15,118,725	-15,683,955	-15,442,690	-12,537,033	-12,190,880	-11,151,726	-10,266,022	-11,471,443	-14,679,835	-13,011,869
3B1a FL remaining FL	-15,890,530	-15,118,725	-15,683,955	-15,442,690	-12,537,033	-12,190,880	-11,151,726	-10,266,022	-11,471,443	-14,679,835	-13,011,869
Carbon Gains	-20,038,693	-20,033,552	-20,027,810	-20,022,803	-20,014,725	-20,007,381	-20,005,912	-19,997,967	-19,992,092	-19,982,545	-19,981,077
Carbon Losses	4,148,163	4,914,827	4,343,855	4,580,114	7,477,691	7,816,501	8,854,187	9,731,946	8,520,649	5,302,711	6,969,208
Wood-removals	1,913,133	2,278,450	2,061,862	2,577,800	2,972,250	3,051,764	4,514,050	5,667,234	5,622,037	2,740,434	3,267,222
Firewood	452,241	441,213	430,452	419,692	409,199	398,968	388,995	379,270	369,789	359,960	350,364
Disturbances	1,782,789	2,195,164	1,851,541	1,582,621	4,096,243	4,365,769	3,951,141	3,685,441	2,528,823	2,202,318	3,351,622
3B1b Land converted to FL	0	0	0	0	0	0	0	0	0	0	0
3B2 Cropland (CL)	395,836	777	396,095	396,354	336,233	792,153	2,035	668,346	2,682	2,682	2,682
3B2a CL remaining CL	-	-	-	-	-	-	-	-	-	-	-
3B2bi Forest land converted to CL	395,836	777	396,095	396,354	336,233	792,153	2,035	668,346	2,682	2,682	2,682
3B3 Grassland (GL)	-206	-206	935,667	292,995	346,937	694,339	346,394	-1,369	346,213	-1,550	-1,550
3B3a GL remaining GL	-	-	-	-	-	-	-	-	-	-	-
3B3bi Forest land converted to GL	-206	-206	935,667	292,995	346,937	694,339	346,394	-1,369	346,213	-1,550	-1,550
3B4 Wetlands (WL)	0	0	0	0	0	0	0	0	0	355,544	3,152
3B4a WL remaining WL	-	-	-	-	-	-	-	-	-	-	-

3B4bi Forest land converted to WL	0	0	0	0	0	0	0	0	0	355,544	3,152
nents (SL)	4,209,543	3,274,757	1,405,185	1,872,578	2,288,014	2,807,364	470,399	1,811,488	3,274,757	3,623,225	940,836
3B5a SL remaining SL	-	-	-	-	-	-	-	-	-	-	-
3B5bi Forest land converted to SL	4,209,543	3,274,757	1,405,185	1,872,578	2,288,014	2,807,364	470,399	1,811,488	3,274,757	3,623,225	940,836
3B6 Other land (OL)	0	0	0	0	0	0	0	0	0	0	0
3B6a OL remaining OL	-	-	-	-	-	-	-	-	-	-	-
3B6bi Forest land converted to OL	0	0	0	0	0	0	0	0	0	0	0
3C Aggregate sources and non-CO2 emissions sources on land	32,090	32,090	32,090	12,836	77,017	128,361	57,763	96,271	77,017	64,181	96,271
3C1 Biomass burning	32,090	32,090	32,090	12,836	77,017	128,361	57,763	96,271	77,017	64,181	96,271
3C1a Biomass Burning in FL	32,090	32,090	32,090	12,836	77,017	128,361	57,763	96,271	77,017	64,181	96,271
HWP	-	-	-	-	-	-	-	-	-	-	-
Total for REDD+	**-11,253,267**	**-11,811,307**	**-12,914,917**	**-12,867,926**	**-9,488,833**	**-7,768,662**	**-10,275,134**	**-7,691,287**	**-7,770,774**	**-10,635,753**	**-11,970,478**

Figure 6-5. Emissions and removals for 3B and 3C categories related to forest

7. Assessment of Uncertainty

7.1 Uncertainty Activity data

7.1.1 Random error

According to the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, a random error is a random variation above or below a mean value. Random error is inversely proportional to precision.

For the estimation of random error, the following equation has been used:

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

where:

AD = area

ADi = Standard deviation of area

ni = number of plots

The confidence interval is derived from the calculation of the standard error of area estimation (described in Appendix 3.A.3.5 of Volume 4 – 2006 IPCC GL) obtained by the following equation:

$$SD_i = A\ x\ \sqrt{\frac{p_i\ x\ (1 - p_i)}{n - 1}}$$

where:

Pi= proportion of points in the particular land use category

A = total known area,

n= total number of sample points.

Ultimately, the 95 percent confidence interval is obtained by multiplying the standard error by the independent coefficient for the confidence level, i.e. 1.96.

The Uncertainty related to Forestland remaining is 0.3%. As we can see in table 7.1, it is observed that areas with a larger surface area have lower uncertainty and the smaller the sample the greater the uncertainty estimated. This is particularly for lands in transitions.

Table 7-1. Overview of the Random error

	Random error %												
years	Total Forest land remaining Uncertainty	Primary Forest	Secondary Forest	Mangrove	Savannah Forest	Swamp Forest	Planted Forest	Any land use to Forest	Forest to cropland	Forest to grassland	Forest to Wetland	Forest to Settlement	Forest to otherland
2001	0.3	0.4	10.8	19.2	33.1	7.2	52.9	-	-	-	-	167.2	-
2002	0.3	0.4	10.8	19.2	33.1	7.2	52.9	-	-	-	-	236.5	-
2003	0.3	0.4	10.8	19.2	33.1	7.2	52.9	-	-	167.2	-	118.2	-
2004	0.3	0.4	10.8	19.2	33.1	7.2	52.9	-	-	-	-	118.2	-
2005	0.3	0.4	10.8	19.2	33.1	7.2	52.9	-	236.5	-	-	236.5	-
2006	0.3	0.4	10.8	19.2	33.1	7.2	52.9	-	-	-	-	236.5	-
2007	0.3	0.4	10.8	19.2	33.1	7.2	52.9	-	-	-	-	-	-
2008	0.3	0.4	10.8	19.2	33.1	7.2	52.9	-	236.5	-	-	136.5	-
2009	0.3	0.4	10.8	19.2	33.1	7.2	52.9	-	-	-	-	167.2	-
2010	0.3	0.4	10.8	19.2	33.1	7.2	52.9	-	-	-	-	105.8	-
2011	0.3	0.4	10.8	19.2	33.1	7.2	52.9	-	236.5	-	-	78.8	-
2012	0.3	0.4	10.8	19.2	33.1	7.2	52.9	-	-	-	-	89.4	-
2013	0.3	0.4	10.8	19.2	33.1	7.2	52.9	-	236.5	136.5	-	136.5	-
2014	0.3	0.4	10.8	19.2	33.1	7.2	52.9	-	236.5	236.5	-	118.2	-
2015	0.3	0.4	10.8	19.2	33.1	7.2	52.9	-	236.5	236.5	-	105.8	-
2016	0.3	0.4	10.8	19.2	33.1	7.2	52.9	-	167.2	167.2	-	96.5	-
2017	0.3	0.4	10.8	19.2	33.1	7.2	52.9	-	-	236.5	-	236.5	-
2018	0.3	0.4	10.8	19.2	33.1	7.2	52.9	-	167.2	-	-	118.2	-
2019	0.3	0.4	10.8	19.2	33.1	7.2	52.9	-	-	236.5	-	89.4	-
2020	0.3	0.4	10.8	19.2	33.1	7.2	52.9	-	-	-	236.5	83.6	-
2021	0.3	0.4	10.8	19.2	33.1	7.2	52.9	-	-	-	-	167.2	-

7.1.2 Systematic error-Interpretation error

According to IPCC (2019), a systematic error, refers to lack of accuracy, that can occur because of failure to capture all relevant processes involved or because the available data are not representative of all real-world situations, or because of instrument error.

The accuracy of activity data obtained from satellite images largely depends on the quality of image interpretation. Analyzing changes in vegetation, identifying land-use patterns, and detecting changes in infrastructure are examples of tasks that require precise interpretation. To ensure the quality of this data, control protocols are implemented, including the review of a subset of monitoring plots by an external reviewer.

Interpretation Error and its Minimization.

Interpreting satellite images can be affected by various factors, such as image quality, spatial resolution, and landscape complexity. Interpretation errors can lead to incorrect reports, which have significant implications for decision-making based on this data. By including an external review of 5% of monitoring plots, a key element is introduced to reduce the inherent error in the process. The fresh and objective perspective of an external reviewer can identify errors or misunderstandings that might go unnoticed in an internal review. Table 7.2 shows an overview of plots for the quality control.

Table 7-2. Overview plots for quality control

	Total Plots	Total %
Plots for LUA (Suriname)	26,193	100
QC for Accuracy Assessment	1,310	5

The result of this assessment shows that 91% of the plots result in the same interpretation after the double check. The error of interpretation is 9%. Table 7.3 shows an overview of these results.

Table 7-3. Overview results of the interpretation error

Plots evaluated	Plots with different interpretation	Plots with same interpretation	Error %	Accuracy (%)
1,310	123	1,187	9	91

7.2 Uncertainty Emission factors

The data obtained from the following national studies provide information on uncertainty, standard deviation, and errors:

- "State-of-the-art study. Best estimates for emission factors and carbon stocks for Suriname" by SBB, CELOS, CATIE, ADEKUS in 2017.
- "Quantifying uncertainty about forest recovery 32-years after selective logging in Suriname" by A. Roopsind et al. in 2017 (For. Ecol. Manage., 391 (2017)).
- "Opportunities for carbon emissions reduction from selective logging in Suriname" by Zalman et al. in 2019.

Some default values obtained from 2006 IPCC Guidelines for Greenhouse Gas Inventories and 2019 Refinement to the 2006 IPCC Guidelines. Vol. 4, also provides information on uncertainties, standard deviation, error, or ranges for the default values.

The details of uncertainties of emission factors are described in the tables included in the section ***5.4 IPCC Methodologies applied.***

8. Description of policies and plans

A key strategic instrument that guides the development planning in Suriname is the *National Development Plan*, which has a constitutional base and sets out the State's social economic development for a period of 5 years. The Development Plan 2022-2026 aimed at both strengthening the economic development capacity of the country and achieving sustainable development, by combining economic and social development with the responsible use of the environment. Furthermore, there are other national documents that indicate the direction of the development for the forestry and mining sector. Table 8.1 shows a summary of the relevant policies and plans given in different documents for the forestry sector, while table 8.2 shows the summary of policies and plans relevant for the mining sector.

Table 8-1. Summary of policies and plans relevant for forestry

Forestry
Regulating policies and laws: Forest Management Act (1992), National Forest Policy (2005), Strategic Action Plan for the Forest Sector, Code of Practice, Environmental Framework Law (2020). **National Development Plan 2022-2026:** The policy related to forestry in this period is focused on: 1. Certification of forest exploitation 2. Encouraging wood processing instead of round wood export 3. Increasing the contribution of non-timber forest products (NTFPs) to the national economy 4. Designating a geographical location for wood processing companies 5. Transform SBB into an authority. **National REDD+ Strategy:** The REDD+ strategy aims to further stimulate the sustainable management of forests. Specifically, the following measures are included: 1. Phasing out extensive management (unplanned logging) and stimulating Reduced Impact Logging, as already implemented by FSC-certified companies 2. Completing and implementing Practice Guidelines for sustainable logging 3. Revising forestry levies so that sustainable management is stimulated (this can possibly be linked to the financial compensation of the REDD+ program) 4. Increasing the efficiency of local wood processing 5. Streamlining concession policy, especially of the ministries responsible for mining and logging concessions 6. Reviewing the issuance policy of concessions and community forests 7. Revision of the Forest Management Act. **National Determined Contribution (2020)**

1. Conditional contribution to remain a HFLD country with a forest cover of 93%
2. Unconditional contribution to encourage Sustainable Forest Management

Projects to strengthen capacity of the forestry sector to be initiated:

1) Global Environmental Facility (GEF 7): Sustainable Forest Management Impact Program: Amazon Sustainable Landscapes.
2) Proposed joint Team Europe Initiative for Guyana – Suriname in the area of Forest Governance (EU-project)
3) Pilot project "Climate Smart Forestry" (in collaboration with Conservation international)
4) IDB project: Promoting Sustainable Forest Management

Table 8-2. Summary of policies and plans relevant for small-scale gold mining

Artisanal and Small-scale gold mining
Regulating policies and laws: Mining Decree (1986), Extractive Industries Transparency Initiative (EITI - member since 2017), Minamata Convention (ratified 2018), and the Environmental Framework Law (2020), Concept Mining Act (2023). **National Development Plan 2022-2026:** The policy related to forestry in this period is focused on: 1. Regulate small-scale gold mining activities aiming for improvement of the technology used, limited area for the activities and for reduction of the impact on the environment. 2. Rehabilitate abandoned mining areas through internationally available funds. 3. The Mining Act dates from 1984 and needs to be amended/renewed. **National REDD+ Strategy:** Also, in the context of REDD+, the government will focus on regulation and organization of small-scale gold mining activities so that they are carried out in a more controlled way, in a restricted area, with improved technology and with reduced impact on the environment. **Ongoing project:** A Global Environment Facility (GEF) funded project on *'Improving Environmental Management in the Mining Sector of Suriname, with Emphasis on Artisanal and Small-scale Gold Mining'* is being implemented in the period 2018-2025.

9. Plans for improvement and capacity building needs

Within the country's process of building capacity for determining the FRL and establishing the NFMS, Suriname has focused strongly on building national expertise within its responsible institutions, also supported through South-South technology exchange and collaboration with international backstopping experts. This creates an enabling environment for the sustainability of the NFMS, as a component of a broader environmental monitoring and information system.
Although it is true that Suriname considerably improved its activity data, through data collection that allowed consistency throughout the time series, in addition to being able to represent the 6 IPCC land categories, improvements have also been recognized that can be implemented in future data collections. These are:

- Logging disturbance: It was not possible to obtain spatial information on the disturbances within the forestry belt during the Land Use change assessment for the total historical period. The disturbances that correspond to logging can be added spatially explicit to future assessments starting from 2015, when sentinel images became available. The Sustainable Forestry Information System Suriname (SFISS) is a roundwood tracking system, used by SBB since 2019, which can provide spatial information to validate the logging spatially explicit activity data.
- Fire disturbance: although fire could be observed through the plots where shifting cultivation was detected, more analysis, ancillary data, and parallel studies will need to be undertaken to make sure the areas affected by fire have been captured accurately.
- NFI: The country is seeking funding to continue the National Forest Inventory to collect carbon stock data directly from the national forests. This work is crucial to improve estimates. The priority should be given to primary and secondary forests as these are the areas with the highest surface and represent big removal capacity.
- Uncertainty: For this submission the country provided a qualitative assessment of the related uncertainty of emission/removal factors. The random and systematic error of the activity data provides some estimates of the uncertainty related to the activity data. As the data used is all tier 1, error is expected to be high. In the future, the country would like to include a quantitative estimation of the uncertainty using the propagation of error following IPCC guidelines.
- Harvest Wood Product (HWP): not included in this submission due to lack of data. The country will work on including this information in future submissions.

References

Crabbe, S., Somopawiro, R., Hanoeman, W., Playfair, M., Tjon, K., Djosetro, M., Pinas, B., Wortel, V., Sanches, M., Sanches, C., Soetosenojo, A., 2012. Results of forest carbon assessment and monitoring project Suriname. Paramaribo.

Fleskens L. and Jorritsma F." A Behavioral Change Perspective of Maroon Soil Fertility Management in Traditional Shifting Cultivation in Suriname". 2010. Human Ecology (2010) 38:217–236. doi: 10.1007/s10745-010-9307-5

Frey, C., Penman, J., Hanle, L., Monni, S., Ogle, S., 2006. Uncertainties. IPCC Guidel. Natl. Greenh. Gas Invent. Vol. 1 Gen. Guid. Report. 3.1-3.66. doi:10.1111/j.1749-6632.2009.05314.x

GOS, 2009. Suriname biodiversity profile. http://www.gov.sr/media/232015/country profile surinam e_aug2009.pdf

GOS, 2019. National REDD+ Strategy of Suriname. Paramaribo, Suriname.

GOS, 2020. Nationally Determined Contribution 2020. https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Suriname%20Second/Suriname%20Second%20NDC.pdf

GOS, 2021. 2022-2026 Development Plan for the period 2022-2026 by the Government of the Republic of Suriname, publication of the National Planning Office Suriname (Stichting Planbureau Suriname). December 2021

IPCC, 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Agriculture, Forestry and Other Land Use Chapter 4 forest land 2006. Forestry 4, 1–29. doi:10.1016/j.phrs.2011.03.002

IPCC, 2019. 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 4 Agriculture, Forestry and Other Land Use.

Loftus, Sabá, and Sara Svensson. REDD+ for the Guiana Shield 1st Working Group Report. REDD+ for the Guiana Shield project, ONF International. December 5, 2013. Accessed December 2023.

SBB, CELOS, CATIE, ADEKUS, 2017. Technical Report State-of-the-art study: Best estimates for emission factors and carbon stocks for Suriname 1–56.

SBB, 2021. Technical report: Forest cover monitoring in Suriname using remote sensing techniques. Stichting voor Bosbeheer en Bostoezicht, directoraat Onderzoek en Ontwikkeling, afdeling Forest Cover Monitoring Unit. Juni 2021, Paramaribo.

SBB, 2023. Bosbouwstatistiek, Productie, Export en Import van hout en houtproducten 2022

Roopsind, A., Wortel, V., Hanoeman, W., Putz, F.E., 2017. Quantifying uncertainty about forest recovery 32-years after selective logging in Suriname. For. Ecol. Manage. 391, 246–255. doi:10.1016/j.foreco.2017.02.026

Werger, M. J.A (ed.). 2011. Sustainable management of tropical rainforest: the CELOS Management System. Tropenbos International, Paramaribo, Suriname. 282 p.

Zalman, Joey, Peter W. Ellis, Sarah Crabbe, and Anand Roopsind. 2019. "Opportunities for Carbon Emissions Reduction from Selective Logging in Suriname." Forest Ecology and Management 439:9–17. doi: 10.1016/j.foreco.2019.02.026.

Annexes

Annex I. Protocol LULC monitoring

Land Use and Land Use Change assessment using the Land Use Assessment App

Technical team

In the data collection process, experience of national experts is integrated, where knowledge exchange has led to a better understanding of national circumstances. This was done during the validation and training phase, towards the production of Activity Data (AD). When it comes to the production of AD, Suriname is taking steps towards the elimination of temporal inconsistencies by producing yearly AD for the whole time-series, starting from 2001 onwards. This will be done by producing data using a sampling approach within the Land Use Assessment App.

A workshop[11] was held in February 2023, where national stakeholders are informed about the status of Suriname in terms of the carbon financing mechanism and the importance of the production of AD that complies with the IPCC guidelines. During the workshop, participants validated the classification scheme and the transition matrix. Input from the workshop is assessed and included in this protocol, to be used for the official mapathon. Figure 1 shows the participants of the validation workshop.

Figure 1. Participants of the validation workshop

During the technical sessions, participants from various institutions, with expertise from field experience and/or specific land uses are trained in sample classification, within the LUA app. During this session, participants also shared data to use as ancillary data. This data will aid in image interpretation, during the classification process. During the training phase, a “training” LUA project is used.

[11] Shared folder with presentations

Figure 2. Capacity building of technical team in sample interpretation

Prior to the official mapathon, participants were calibrated for classification in the field (figure 3). The official mapathon was held in May 2023, where 16 participants from various institutions participated.

Figure 3. Calibrated for classification in the field

Land use classification system

The classification system is built hierarchically, primarily based on the recognition of the land key elements, the assessment of their socio-economic functions and the adoption of the "predominant land use" criteria in the classification scheme settled by rules. These rules are set up through hierarchical relationships, using the existing LULC datasets to obtain hierarchical relationships among key land elements. Key land element is defined as a physical component of the land that characterizes one or more land cover classes and/or land use categories.
The classification system of Suriname is built with multiple levels, where existing LULC datasets are used to understand the cross-scale spatial dynamics of the land use systems. With the inventory of the LULC datasets produced using the wall-to-wall method, a hierarchical framework is set up. The top level includes the distinction between forest and non-forest, followed by level 2, including the International Panel on Climate Change (IPCC) six class land use system (Forest Land, Cropland, Grassland, Wetlands, Settlements, and Other Land), where more specific national classes are defined in the following levels (Figure 5).

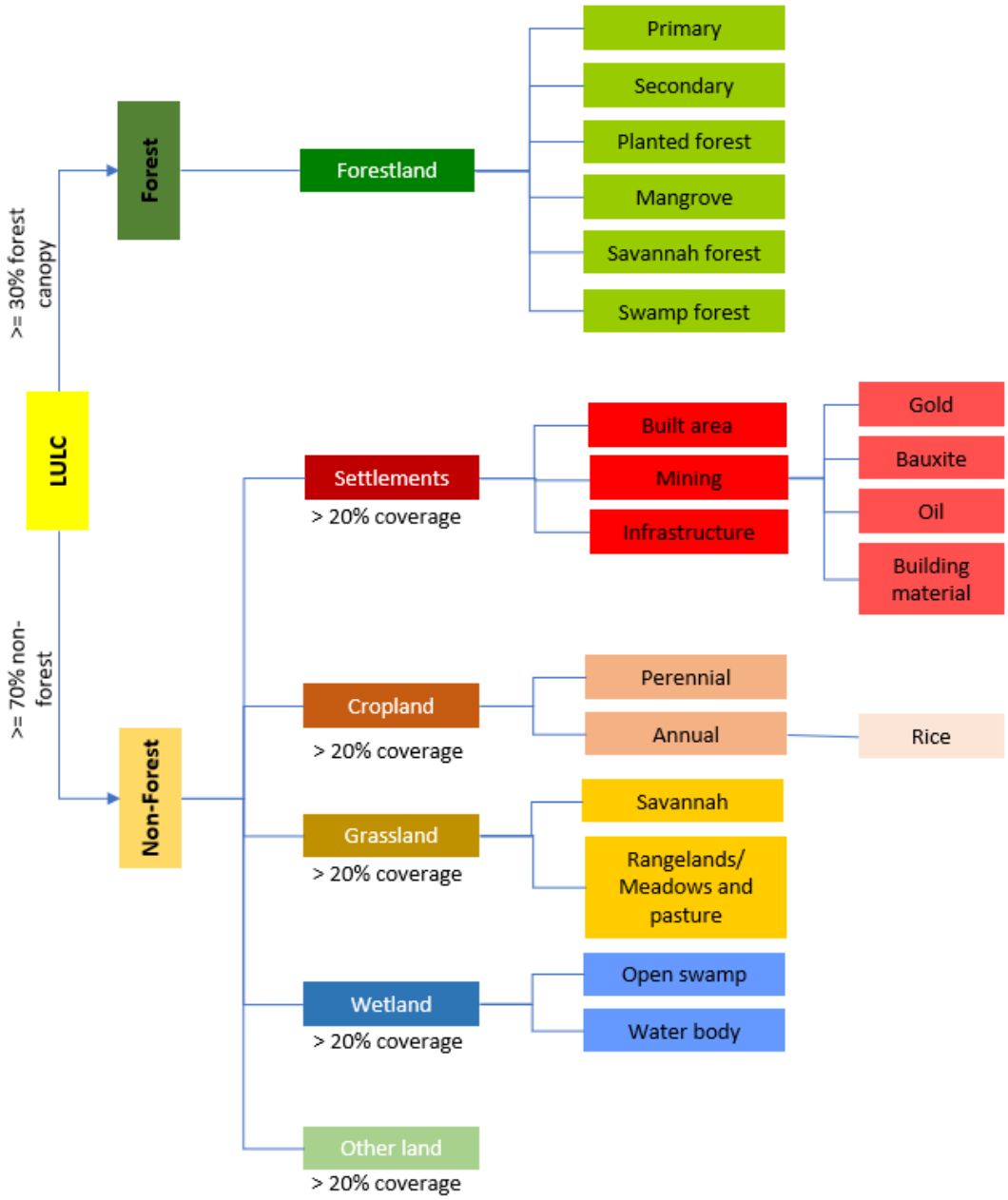


Figure 4. Classification scheme and hierarchy

Referring to the forest definition, samples with a canopy cover >= 30% are classified as forest and samples with a non-forest coverage >= 70% are classified as non-forest. Within the non-forest, the hierarchy is built using the analysis of the main drivers of deforestation within LULC datasets, where Settlements > Cropland > Grassland > Wetland > Other land, using a threshold of 20%.

Definitions and characteristics

The land use categories that have been used are based on the IPCC classes used for greenhouse gas inventory reporting.

Forestland

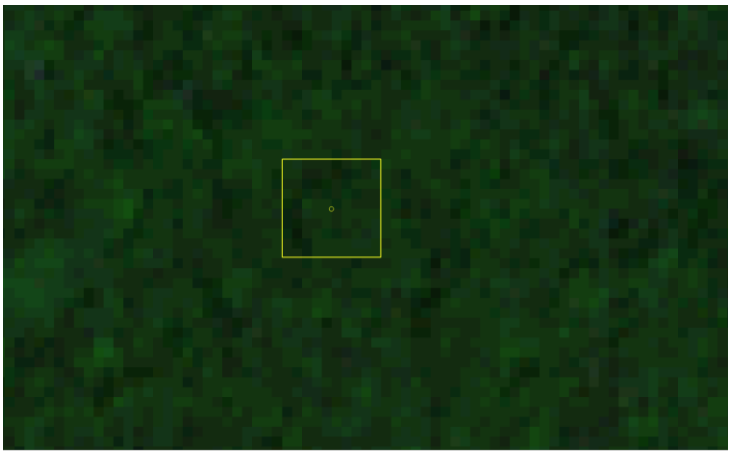
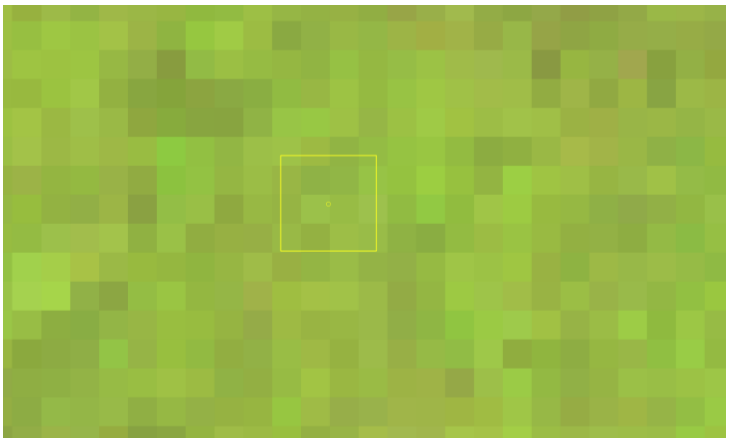
The definition of forest is based on nationally appropriate criteria chosen in line with the Marrakesh Accords (UNFCCC, 2001)[12] and is described as followed:

Land covered primarily by trees, but also often containing shrubs, palms, bamboo, herbs, grass and climbers, with a minimum tree crown cover of 30% (or equivalent stocking level), with the potential to reach a minimum canopy height at maturity in situ of 5 meters, and a minimum area of 1.0 ha.

Primary

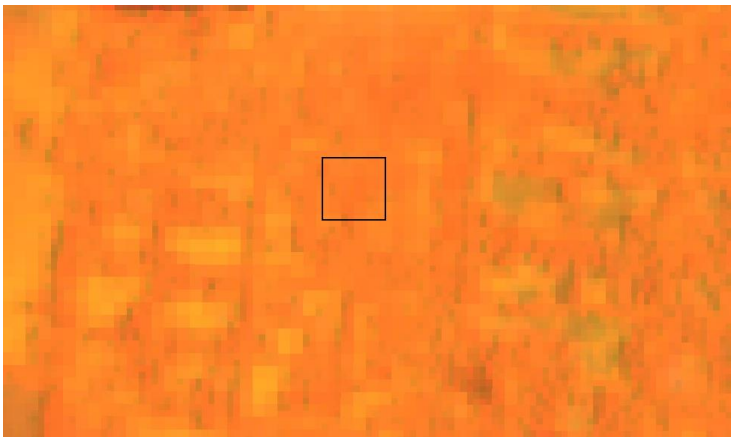
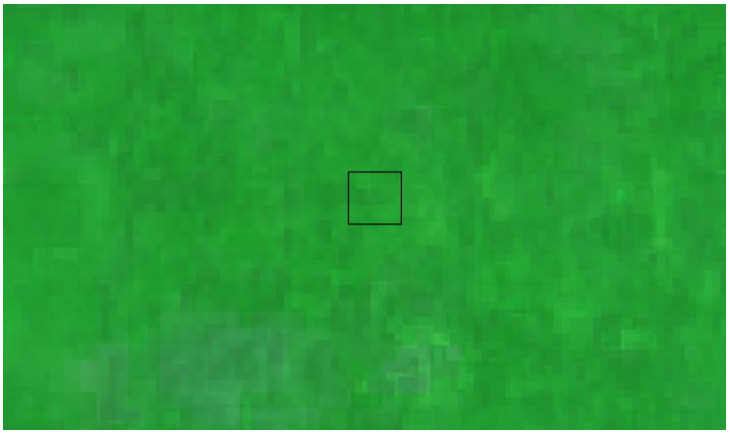
Definition	**Characteristic**
The definition of forest is based on nationally appropriate criteria chosen in line with the Marrakesh Accords (UNFCCC, 2001) and is described as followed: Land covered primarily by trees, but also often containing shrubs, palms, bamboo, herbs, grass and climbers.	1. Intermediate textures, associated to large and small tree crowns 2. Natural distribution of high emergent trees and lower canopy trees
Visualization	
Photo	**Google Earth/Bing**
	

[12] Under the Marrakesh Accord (UNFCCC, 2001), forest is defined as having a minimum area of land of 0.05-1 ha with tree crown cover (or equivalent stocking level) of more than 10-30% with the potential to reach a minimum height of 2-5 m at maturity in situ.

Sentinel	Landsat
	

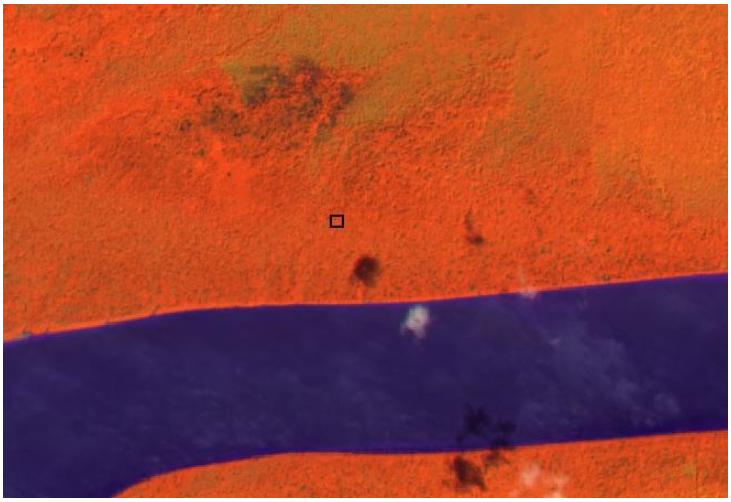
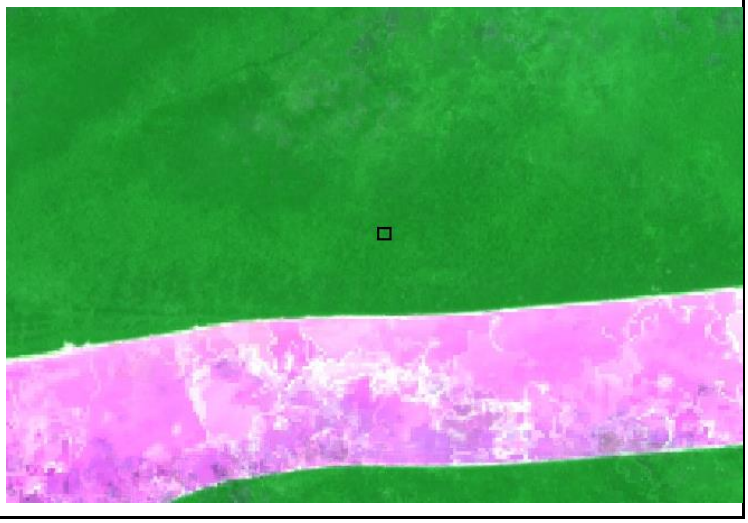
Secondary

Definition	Characteristic
Areas that **after the complete removal of forest** vegetation, are in advanced process of natural regeneration of shrub and/or tree or have been used for practicing forestry or permanent agriculture with the use of native or exotic species.	1. Includes abandoned areas, i.e. abandoned plantation, abandoned agriculture, abandoned mining (but close to forest) 2. Abandoned raised beds and drainage infrastructure visible
Visualization:	
Photo	**Google Earth**
	
Sentinel	**Landsat**

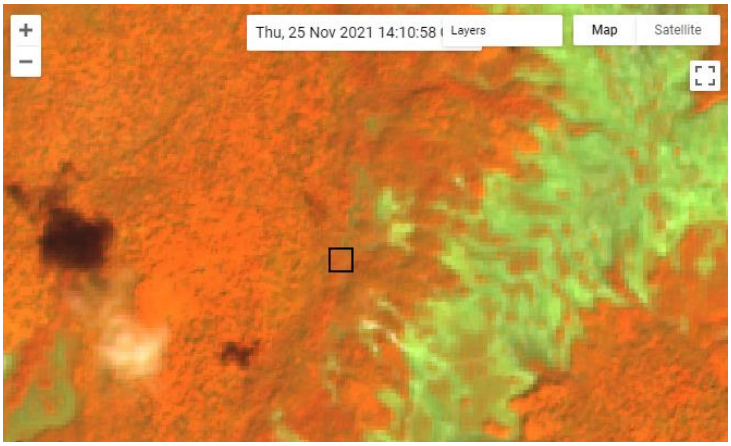
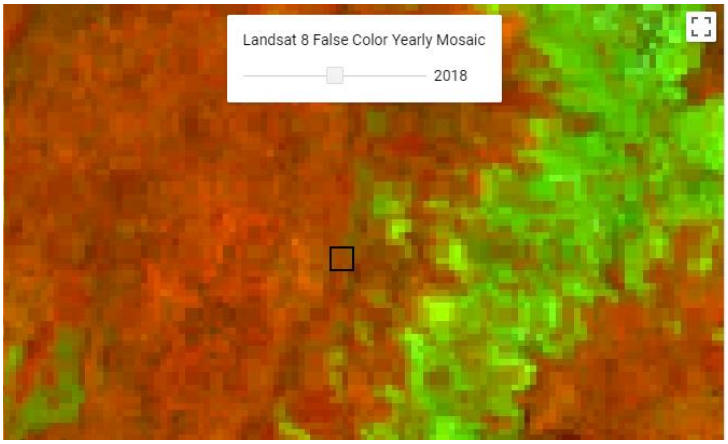
Mangrove

Definition	**Characteristic**
Mangroves are the characteristic littoral plant formations of tropical and subtropical sheltered coastlines. They have been variously described as 'coastal woodland', 'tidal forest' and 'mangrove forest'. Generally mangroves are trees and bushes growing below the high-water level inundated with saline water.	Generally, the vegetation of mangrove forests are also classified as "true mangrove" or "mangrove associates." Tomilson (2016) defined "true mangroves" as plant species that 1. *Occur only in mangrove forests and are not found in terrestrial communities* 2. *Play a major role in the structure of the mangrove community, sometimes forming pure stands* 3. *Have morphological specialisations to the mangrove environment* 4. *Have some mechanism for salt exclusion*
Visualization	
Photo	**Google Earth**

	
Sentinel	**Landsat**
	

Savannah forest

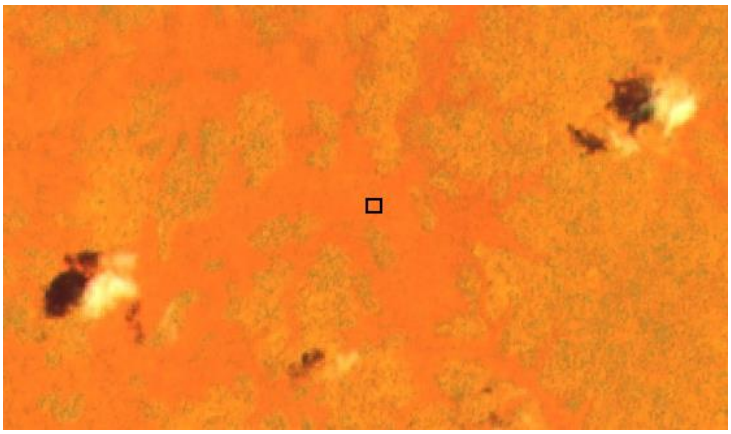
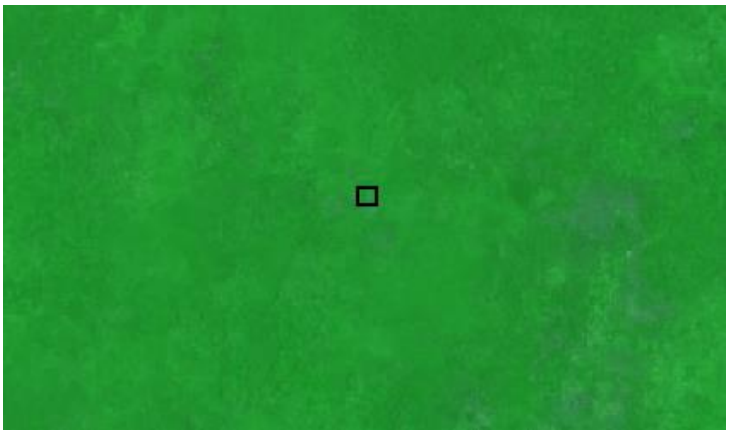
Definition This type of forest shows two storeys, the upper storey is closed, fairly dense and regular and reaches up to 25—30 m, as the tallest trees rise above the general level with broad round crowns without becoming emergents. The lower storey consists in general of many slender trees with very narrow crowns which give the forest a staky appearance. A herb	**Characteristic** Typical in the herb stratum are seedlings of Myrcia sylvatica (kleinbladige gujave) and Inga heterophylla (kleinbladig swietiboontje).

stratum is sometimes practically absent, in other cases it is dense and usually dominated by Bromelia alta L. B. Smith (bosananas).	
Visualization	
Photo	**Google/ Bing Image**
	
Sentinel	**Landsat**
	

Swamp forest

Definition	**Characteristic**
These forests are marked by very wet conditions all year round. The shorter the inundation period the more it resembles the rainforest. It varies from open woodland to single or more storeys 10- 20 meter high forest and can be found in permanently inundated terrain	1. Palms and epiphytes are rare 2. This forest does not have big trees and is poor in species

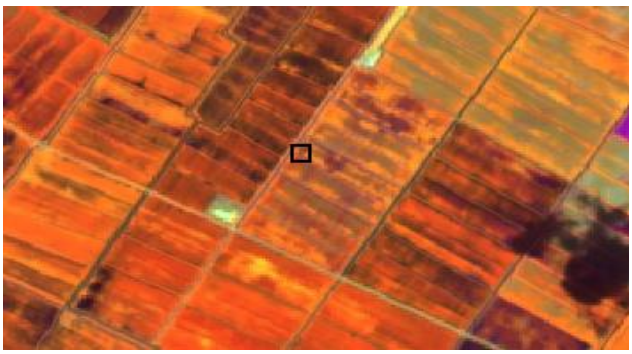
Visualization

Photo	**Photo**
	
Sentinel	**Landsat**
	

Cropland

Land used for cultivation of crops. Cropped land, including rice fields, and agroforestry systems where the vegetation structure falls below the thresholds used for the Forest Land category.

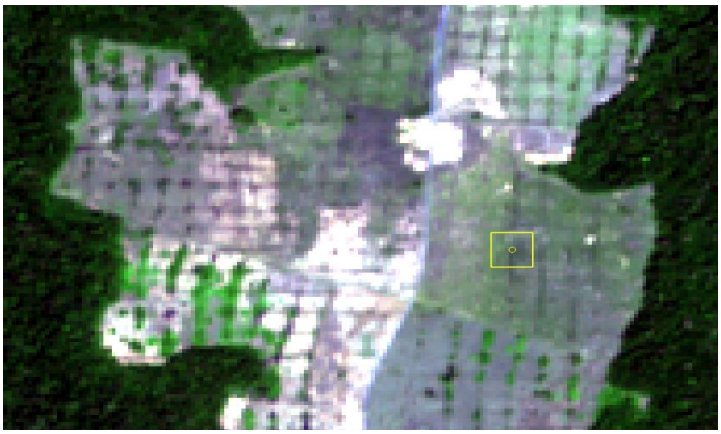
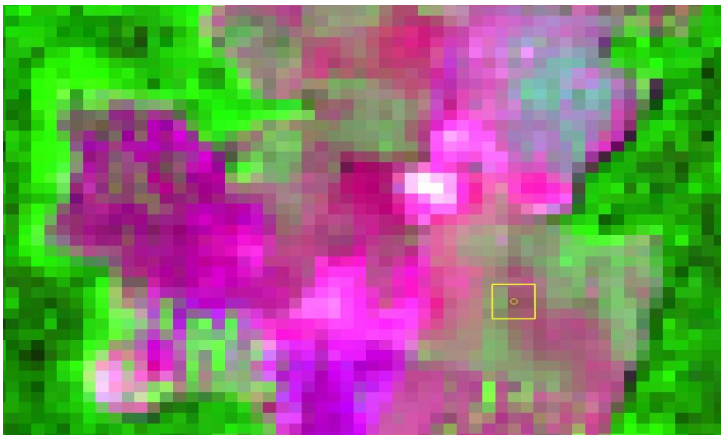
Annual

Definition	**Characteristic**
An annual plant definition is a plant that completes its entire life cycle in one year or one growing season.	Examples include Banana, watermelon, small scale agriculture. Rice plantation is also an annual crop, but due to the easy to detect patterns and the well-known locations (predominantly occurring in the district Nickerie), this crop is separately classified as “Annual-Rice”.
Visualization	
Photo	**Google Earth**
	
Sentinel	**Landsat**
	

Perennial

Definition	**Characteristic**
Perennial crops are typically considered as those that are more permanent, requiring a number of growth cycles before fruit is produced.	1. Examples include citrus, banana, podosiri. 2. Citrus and Podisiri plantations occur in the area of Tibiti and Alliance 3. Oil palm plantation are in Patamacca 4. West-Indian cherries are in district Commewijne

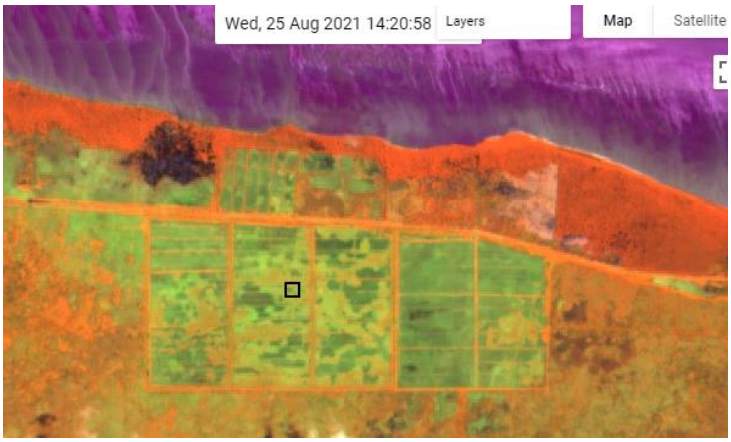
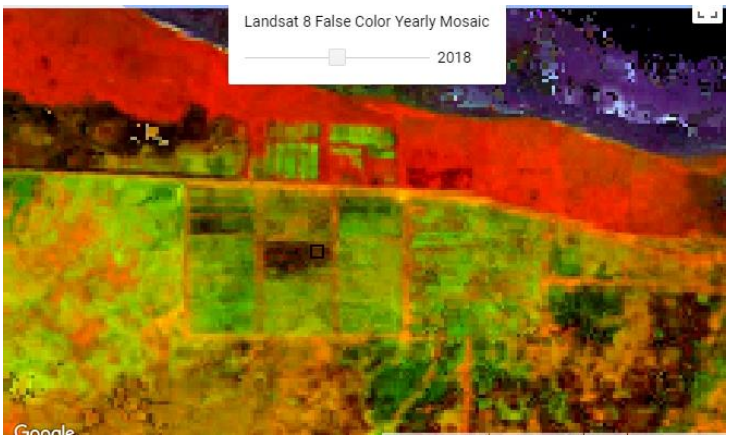
Visualization

Photo	**Google Earth**
	
Sentinel	**Landsat**
	

Abandoned

Definition	**Characteristic**
Land that was once used for agriculture activities but has already been abandoned and is now covered or saturated by water for all or part of the year.	1. Agricultural patterns clearly visible on the images 2. Saturated with water

Visualization

Photo	**Bing**
	
Sentinel	**Landsat**
	

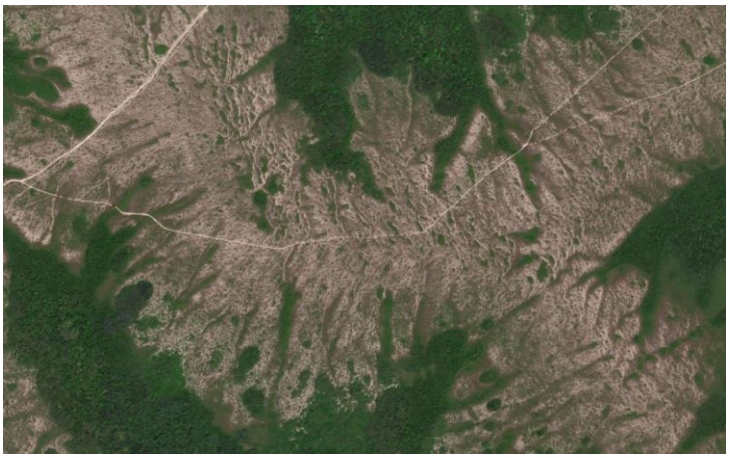
Grassland

Rangelands and pasture land that are not considered Cropland. It also includes systems with woody vegetation and other non-grass vegetation such as herbs and brushes that fall below the threshold values used in the Forest Land category. The category also includes all grassland from wild lands to recreational areas as well as agricultural and silvi-pastural systems, consistent with national definitions.

Open savannah

<table>
<tr><td>Definition
Open savanna is a mixed woodland grassland ecosystem characterized by trees that fall below the threshold values used in the Definition of Forest.

Note. only visible/open occurrences of typical savanna patterns are classified, which is not fully compatible with the morphological definition of "savanna".</td><td>Characteristic

1. Open tree canopy (i.e., scattered trees)</td></tr>
<tr><td colspan="2">Visualization</td></tr>
<tr><td>Photo</td><td>Google Earth</td></tr>
<tr><td>  </td><td>  </td></tr>
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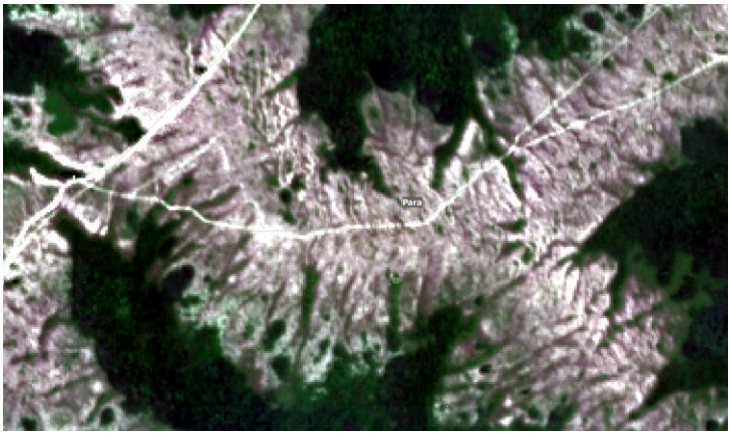
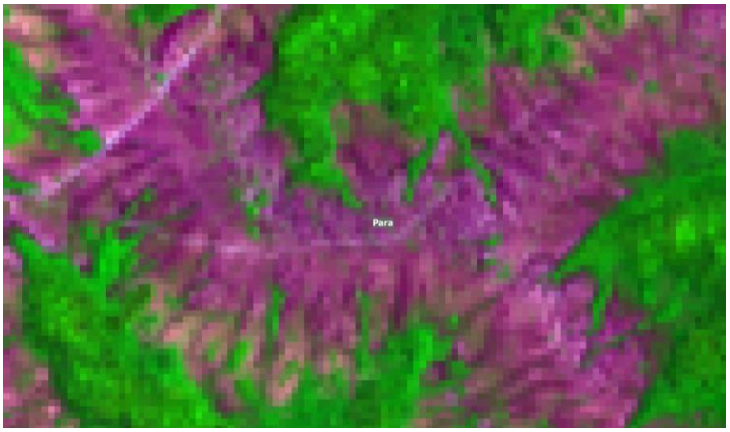
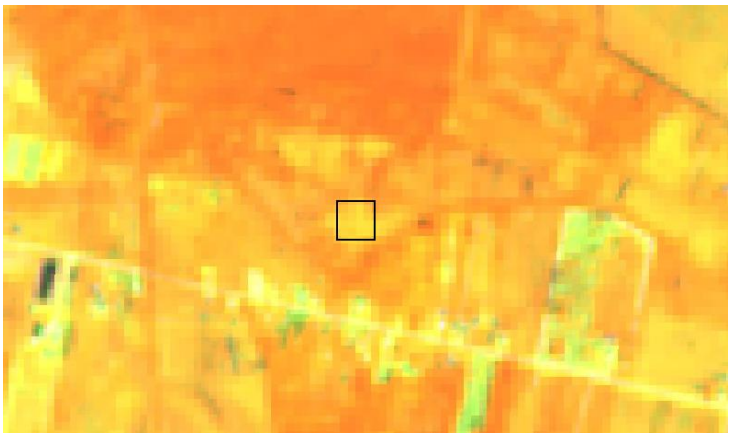
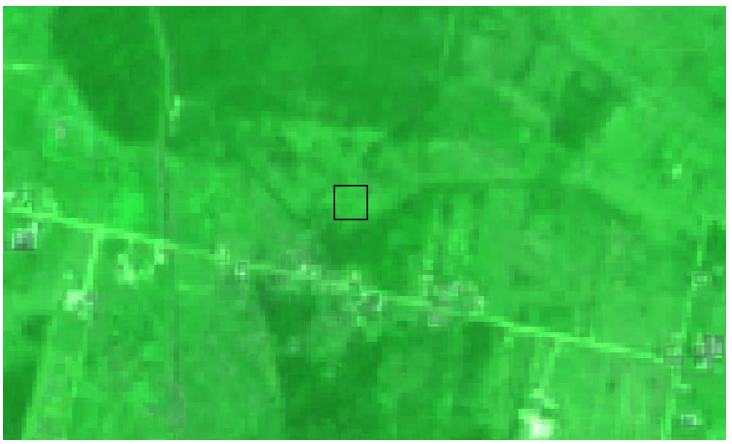
	

Rangelands/ meadows and Pasture

Definition Rangelands include natural grassland, savannas, many wetlands, some deserts, tundra, and certain forb and shrub communities. Pastures are those lands that are primarily used for the production of adapted, domesticated forage plants for livestock.	**Characteristic** 1. Larger extent than cropland 2. Smooth service 3. Mostly occurring at the borders of the built area in the districts Wanica and Para
Visualization	
Photo	**Google Earth**
	
Sentinel	**Landsat**

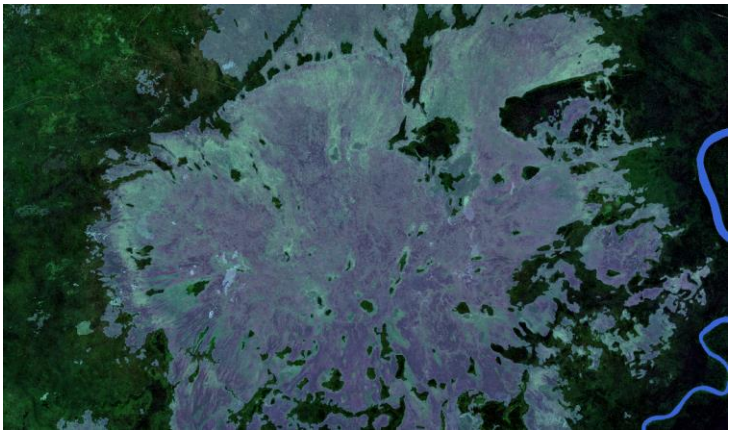
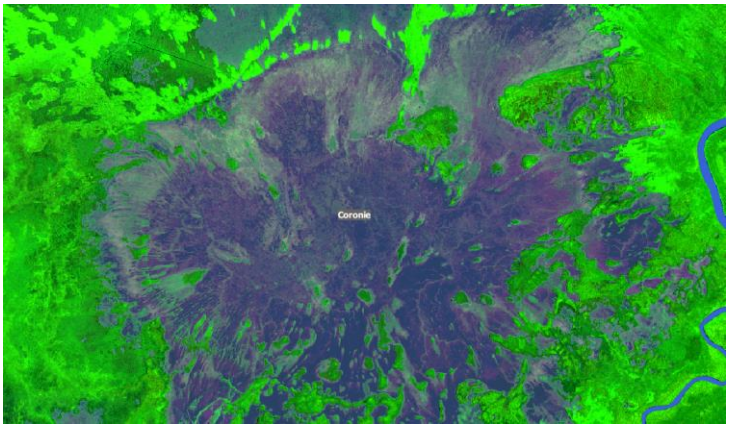
	

Wetland

Areas of peat extraction and land that is covered or saturated by water for all or part of the year (e.g., peatlands) and that does not fall into the Forest Land, Cropland, Grassland or Settlements categories. It includes reservoirs as a managed sub-division and natural rivers and lakes as unmanaged sub-divisions.

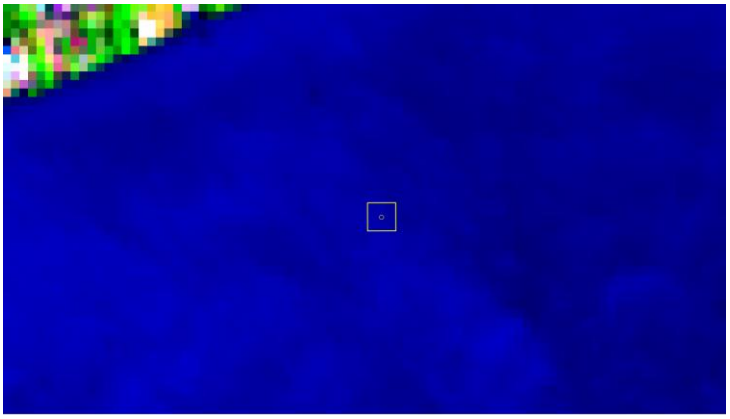
Open swamp

Definition Land that is covered or saturated by water for all or part of the year and is not covered with trees that fall under the definition of forest.	**Characteristic** Includes lagoons
Visualization	
Photo	**Google Earth**

	
Sentinel	**Landsat**
	

Water bodies

Definition Areas that are covered or saturated by water for all or part of the year, but also have grass/shrub vegetation on top of it.	**Characteristic** 1. Rivers/creeks 2. Flooded areas (and covered with grass/shrub) 3. Abandoned mining
Visualization	
Photo	**Google Earth**

	
Sentinel/Planet	**Landsat**
	

Settlements

All developed land, including mining, transportation infrastructure and human settlements of any size, unless they are already included under other categories.

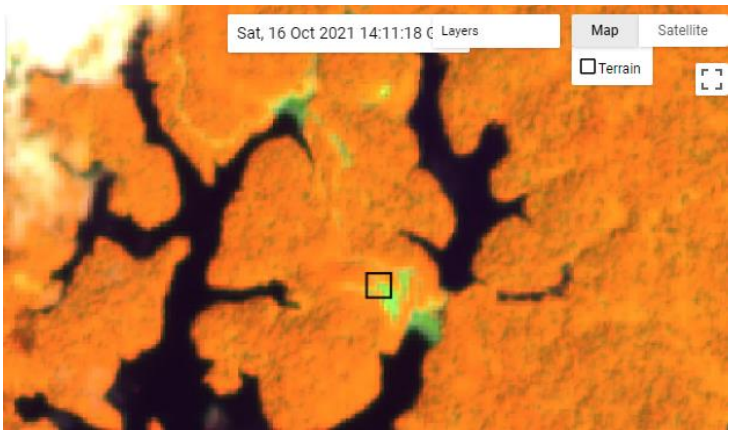
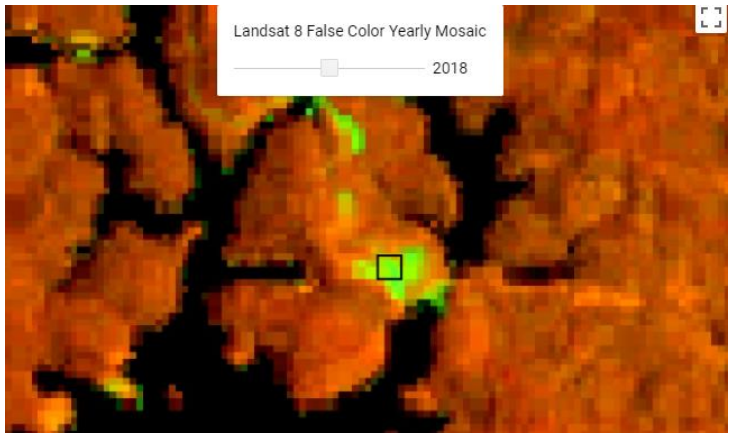
Built area

Definition High concentration of houses, buildings, streets and other public facilities.	**Characteristic** 1. Predominantly in the coastal area
Visualization	

Photo	Google Earth
	
Sentinel	**Landsat**
	

Infrastructure

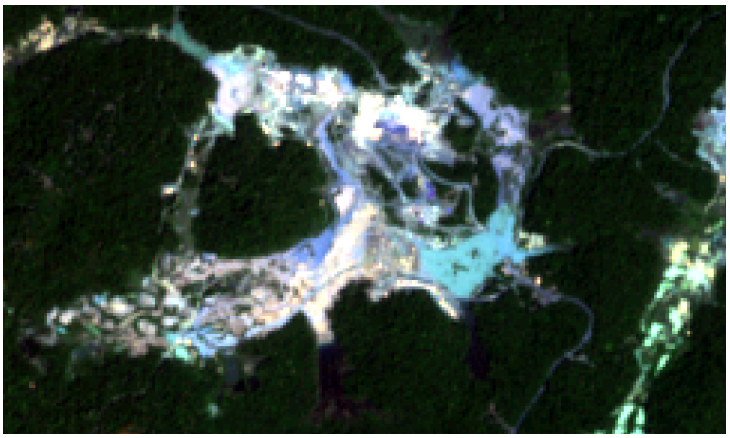
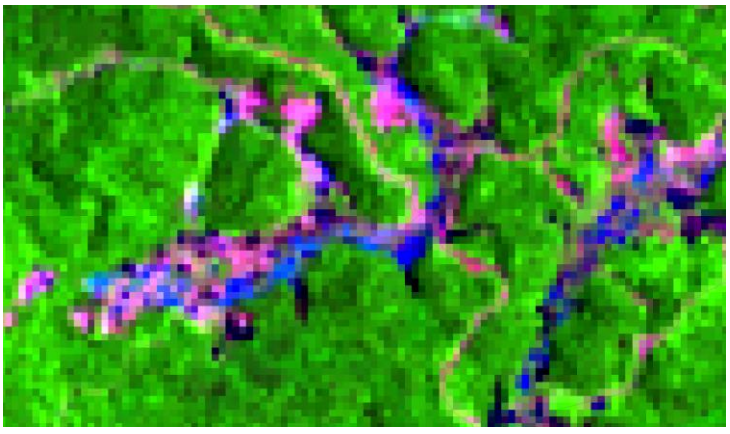
Definition All developed land, including transportation infrastructure and human settlements of any size, unless they are already included under other categories. This should be consistent with national definitions.	**Characteristic** 1. Road, Airport, Airstrip, Port, Dam, Dike and Log yards 2. Ancillary data can help in the identification
Visualization	
Photo	**Bing**

Sentinel	Landsat
	

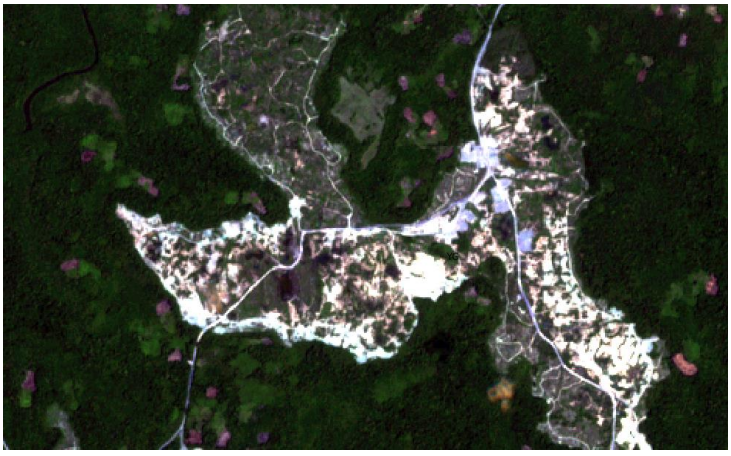
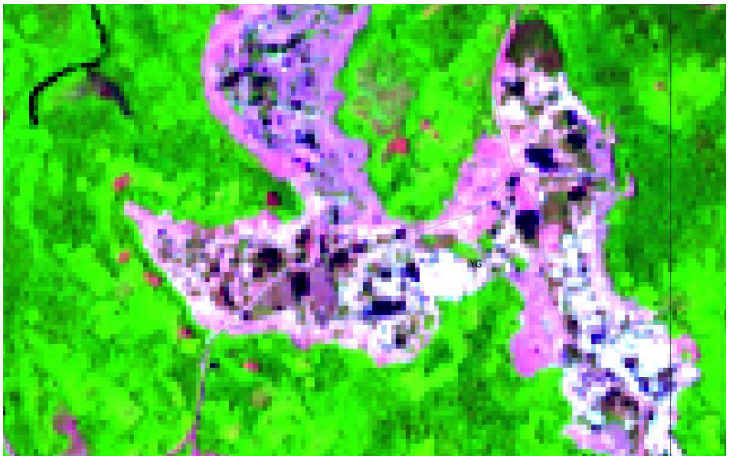
Mining

The process of extracting useful minerals from the surface of the Earth consists of exploration and exploitation activities.

Gold

	Definition The process of extracting gold from the surface of the earth consists of exploration and exploitation activities in areas > 1ha.	**Characteristic** 1. Found across streams 2. typically elongated areas, dozens of hectares in size, with multiple small digs (water ponds). 3. Predominantly occurring in the districts Brokopondo and Sipaliwini, in proximity to rivers/creeks
	Visualization	
	Photo	**Google Earth**
		
	Sentinel	**Landsat**
		

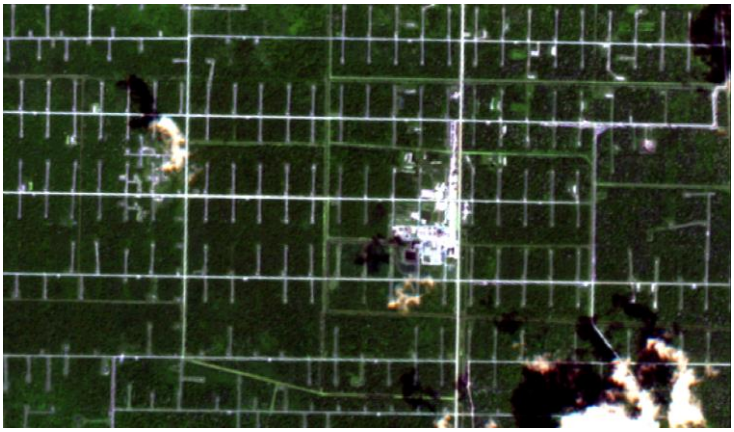
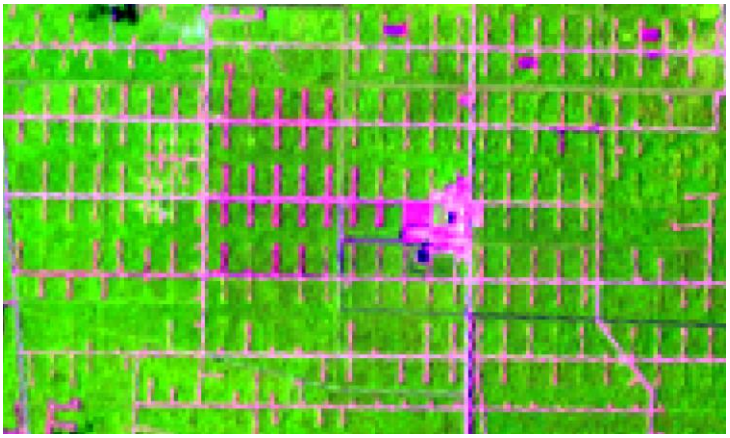
Bauxite

Definition	**Characteristic**
Quarries of bauxite are hundreds of hectares in size. As is the case with gold mines, they are often left open and damaged, with no rehabilitation.	1. Found in the districts Marowijne and Wanica 2. Mined-out areas are left abandoned
Visualization	
Photo	**Google Earth**
	
Sentinel	**Landsat**
	

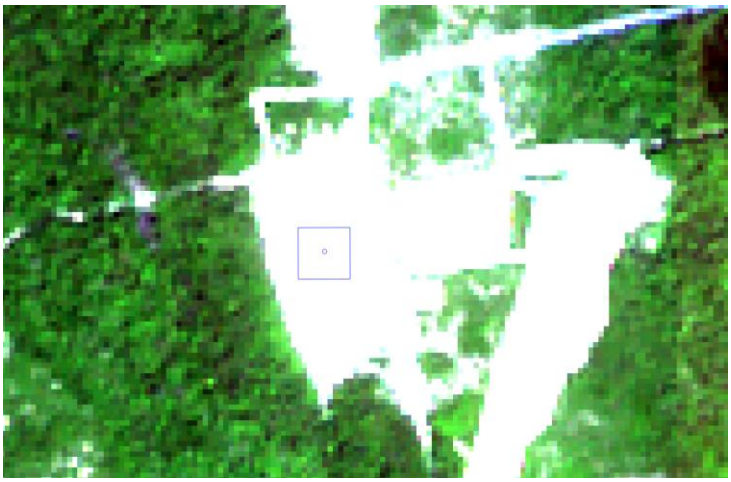
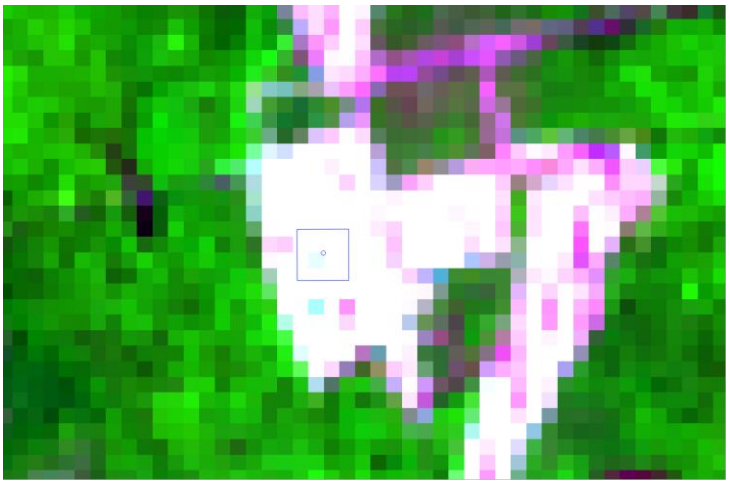
Oil

Definition	**Characteristic**
Land where petroleum mining is occurring. The plots are divided and a system of roads is paved between them.	1. Predominantly occurring in Saramacca

Visualization

Photo	**Google Earth**
	
Sentinel	**Landsat**
	

Building material

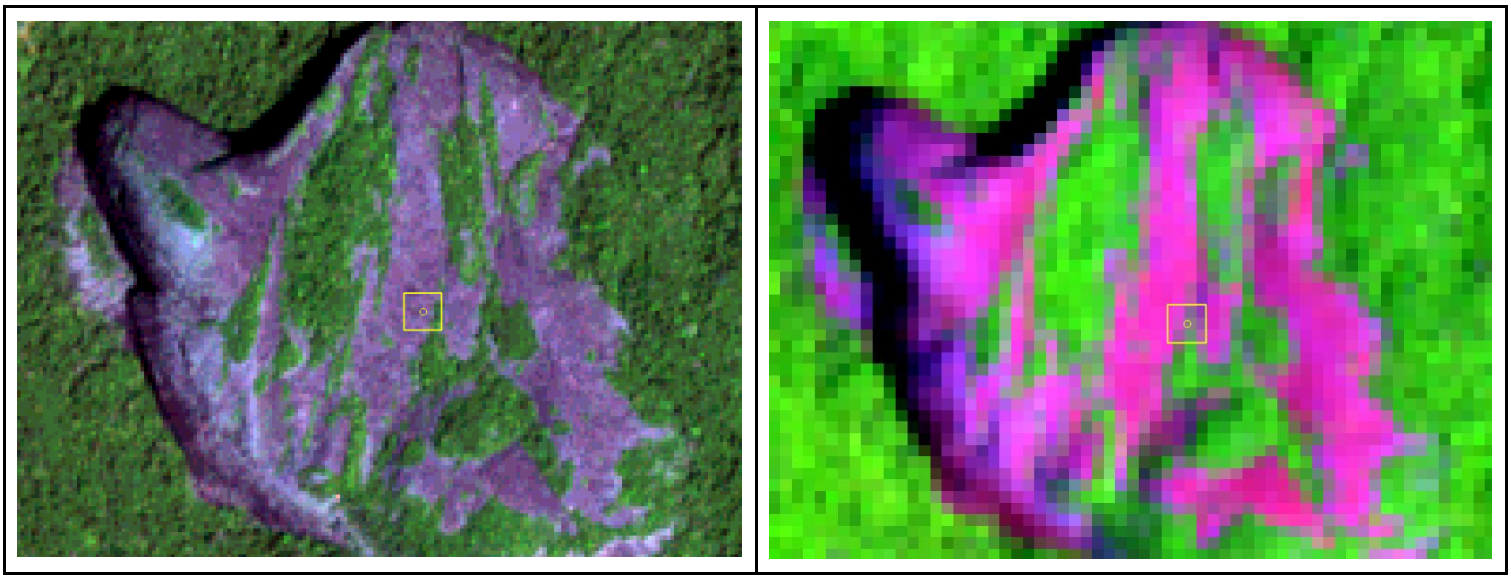
Definition	**Characteristic**
Extraction of building material used for construction.	1. Usually detectable based on the water pits, with the use of the mining concession data 2. Sand, shells and other types of ore as construction material are mined 3. Occurs mostly in the coastal area, on top of sand ridges and the savannah
Visualization	
Photo	**Google Earth**
	
Sentinel	**Landsat**
	

Otherland

Bare soil, rock, ice, and all land areas that do not fall into any of the other five categories. It allows the total of identified land areas to match the national area, where data are available. If data are available, countries are encouraged to classify unmanaged lands by the above land-use categories (e.g., into Unmanaged Forest Land, Unmanaged Grassland, and Unmanaged Wetlands). This will improve transparency and enhance the ability to track land-use conversions from specific types of unmanaged lands into the categories above.

Rock and bare soil

<table>
<tr><td>Definition
Rocks are land that is shaped by a solid aggregate of one or more minerals.
Bare soil is a natural area without forest cover, most of the time areas along rivers or creeks, such as beaches</td><td>Characteristic
1. Rocks have a bright brownish color on satellite images, where elevation data can be used as ancillary
2. Bare soil mostly occurs near/at the borders of rivers/water bodies</td></tr>
<tr><td colspan="2">Visualization</td></tr>
<tr><td>Photo</td><td>Google Earth</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Sentinel</td><td>Landsat</td></tr>
</table>



Sampling scheme design

As presented in the 2006 IPCC guidelines, data on land use are often obtained from sample surveys. One common example is the National Forest inventory that uses this kind of sampling survey to collect information on carbon stocks. Sampling means observing a fraction of the entire population: the sample. With the Land use Assessment Application land use and land use changes are assessed on a sample of the national territory and results are extrapolated to the rest of the country area.

Sampling scheme design includes defining the sample plot size and layout and choosing a sampling method for the spatial distribution of plots across the monitoring area. These parameters (table 1) are aligned with the national definition of forest as well as the existing scheme for the national forest inventory[13] (NFI).

Table 1. Parameters for the sampling scheme design

Sampling method	Sample creation	Plot size	Total plots
Systematic	Every 2.5 km	1 ha	≃ 26000

A systematic sampling method is used, where a grid of equally distributed sample plots is created to cover the monitoring area. These plots are permanent; points cannot be removed, but can be added through a statistical method called “intensification”.

To match the national definition of a minimum area to qualify as a forest, a 1ha plot of 100m x 100m is selected. For the spatial distribution of the plots, a sampling design is used that overlaps

[13] NFI field manual

the national NFI grid. The NFI sampling design used in the pilot project is based on a principal 20 x 20km systematic grid of permanent Sampling Units (SU) covering the entire country. For LULC monitoring, this grid is intensified to 2.5 x 2.5 km.

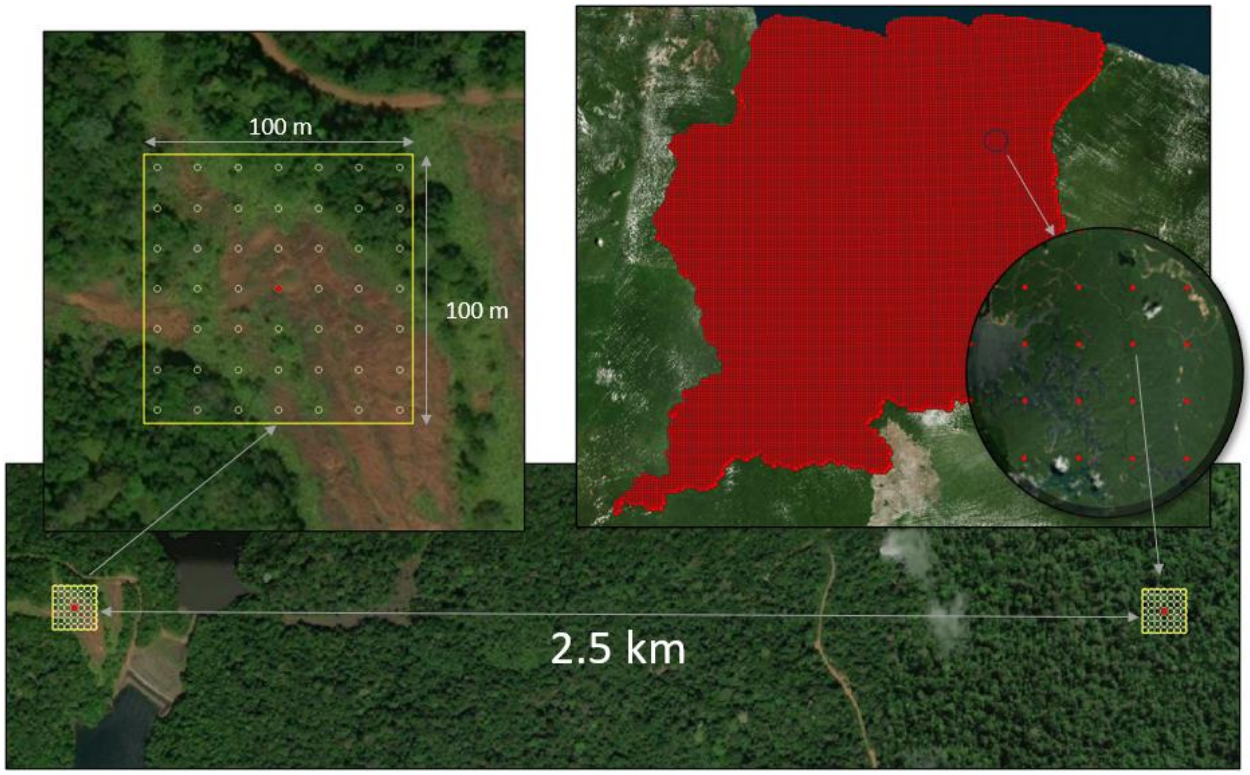


Figure 5. Sampling design for the systematic sampling approach

Sample interpretation keys

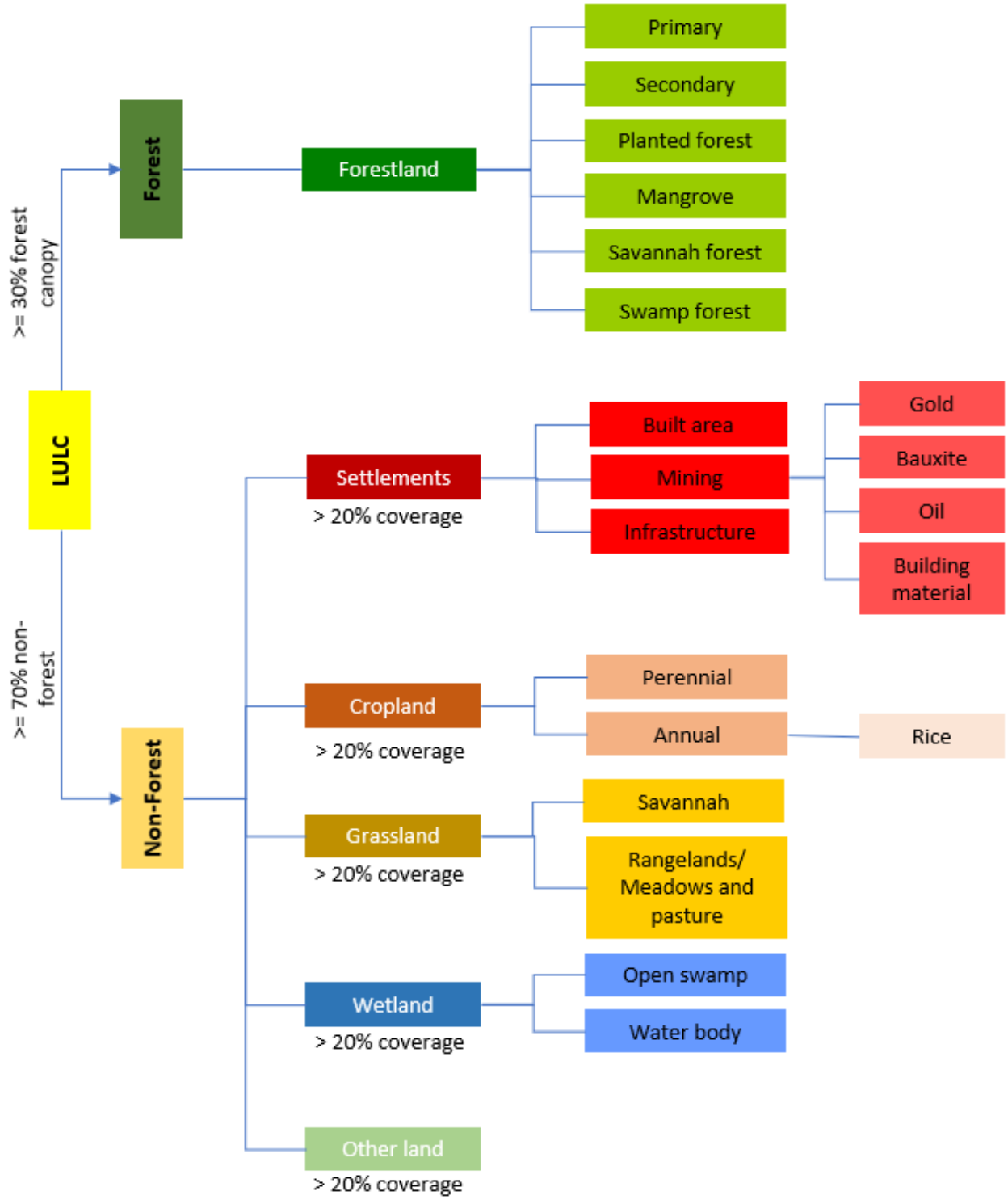


Figure 6. Sample interpretation key

For the classification system, it is important to consider important classification keys before assigning a class to an activity. The main steps in class assignment are:

a. Description/ characterization of the classes based on satellite images and field experience;
c. The context of the area your sample point falls in;
d. Percentage of classes in sample plot and
e. Hierarchical level for classification.

In the next paragraph, the interpretation keys are elaborated.

Land use changes
Landuse | Landuse Changes

Goldmining

Goldmining accounts for more than 60% of all deforestation and is easy to detect based on the characteristics. Water ponds are clearly visible, the goldmining also takes place close to creeks. Using the LandTrendr, a clear drop in spectral value is also visible due to the total loss of vegetation in 2017. In example below, the goldmining covered more than 70% of the plot in 2017 and is assigned as a land use change from forestland to settlements.

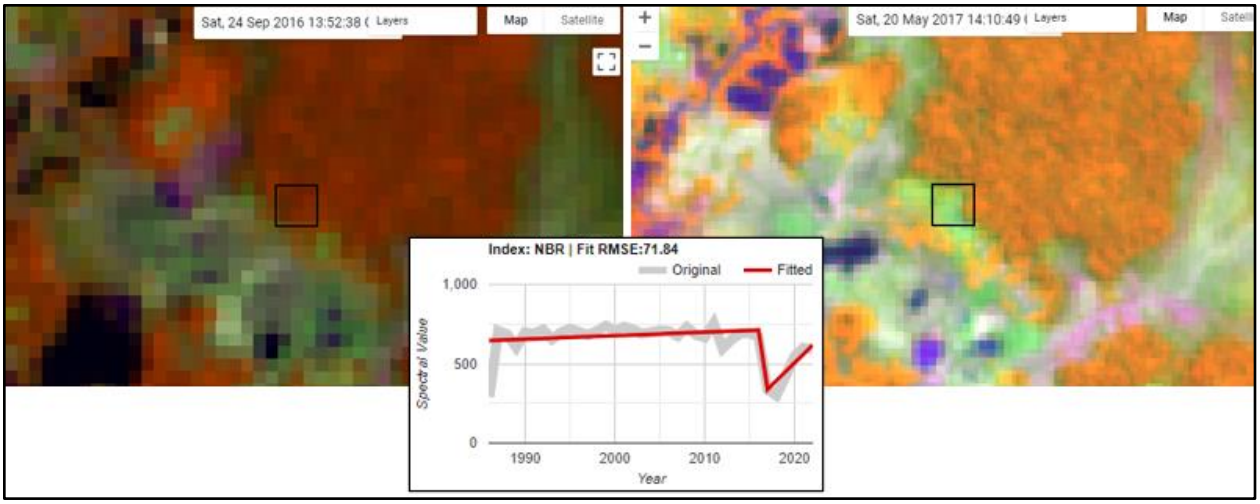


Figure 7. 1 year time-series of goldmining expansion

Agriculture

Annual crops has the biggest extent in the district Nickerie, where rice is cultivated. Looking at the zoomed-in picture on the top right position, a mix a of agriculture and infrastructure can be captured. With infrastructure < 20% and by looking at the context of the plot, this plot falls in a large agricultural area. Using information given above, this plot is classified as annual crops- rice.

Figure 8. Annual crop-rice

Grassland

Conversions from forestland to grassland, occurs by activities as burning (expansion of the savannah area) and pasture. In example below, forestland is converted to Savannah, caused by fires. Fire Information for Resource Management System (FIRMS) data is also used as ancillary data to confirm fires activities.

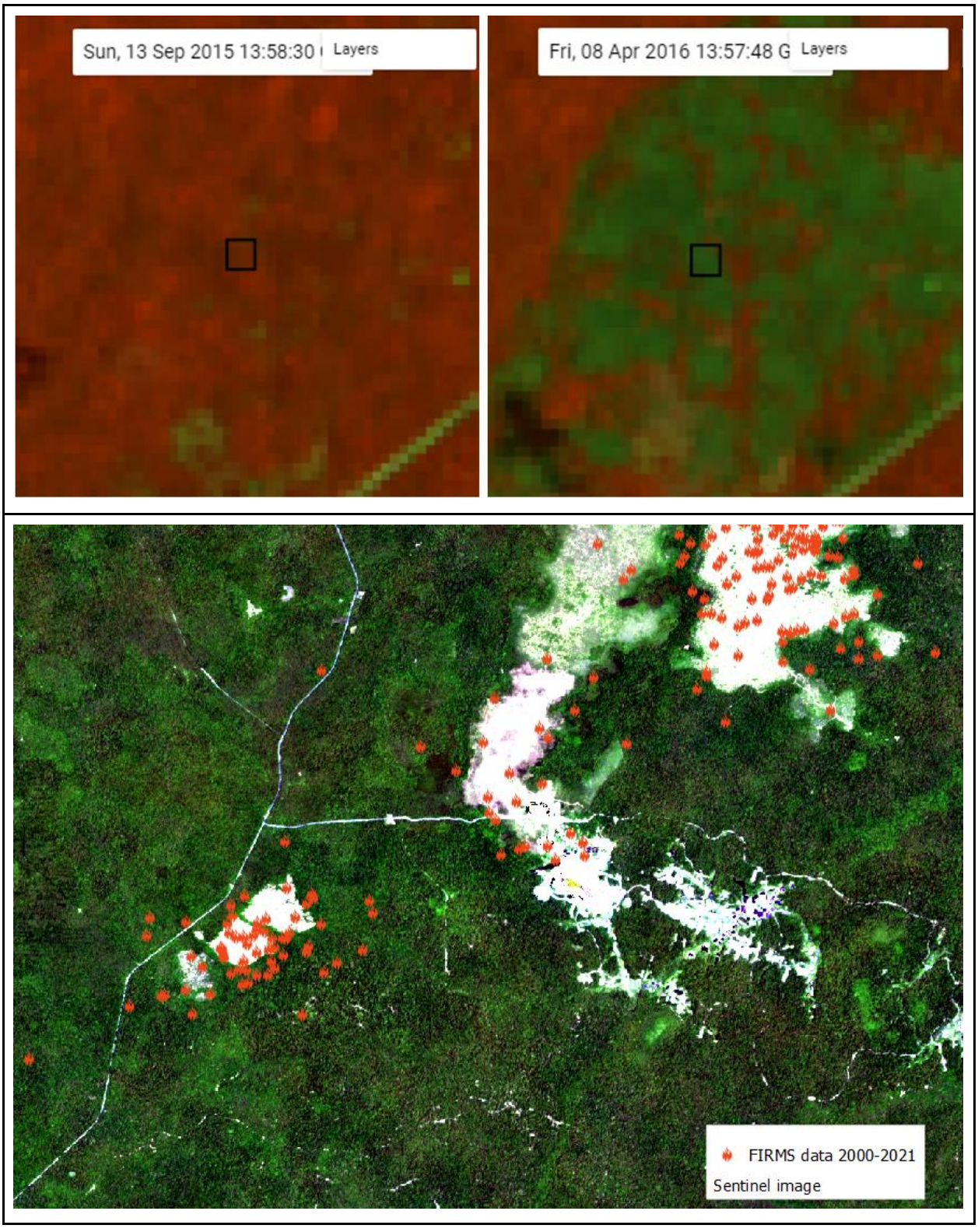


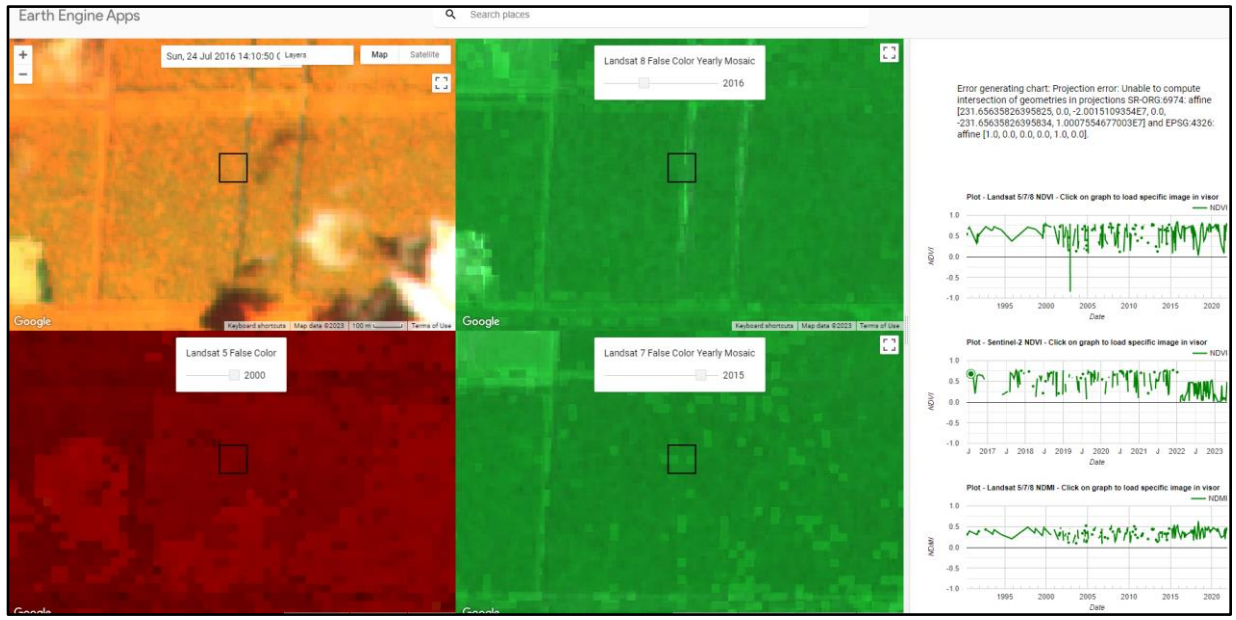
Figure 9. Fire Information for Resource Management System (FIRMS) data

Disturbances

Infrastructure

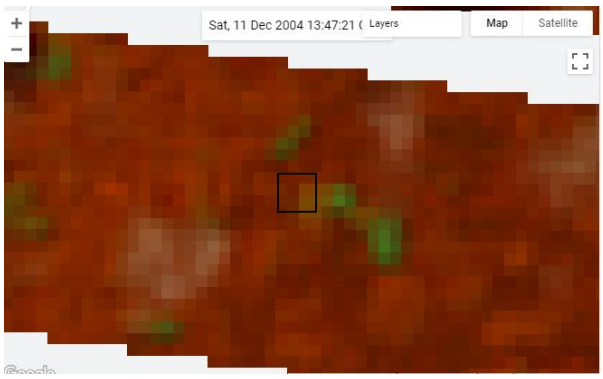
Using the Google Earth Engine app within the LUA app, timeseries of Landsat and Sentinel 2 images are visualized. With the timeseries, the year of Landuse change/ disturbance can be analyzed.

Characteristics	Classification
- >= 30% canopy coverage - Infrastructure development in 2016	Secondary Forest, with disturbance of infrastructure in 2016

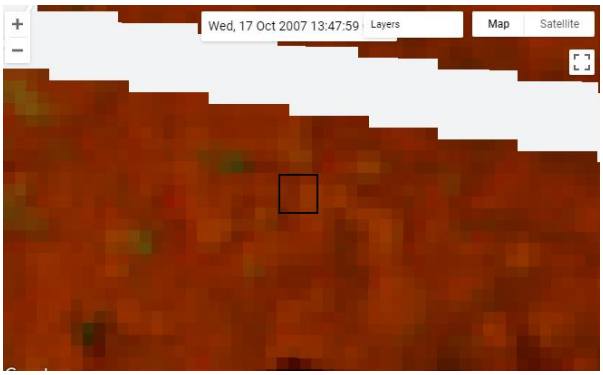


Shifting cultivation

Shifting cultivation is detected as a combination of small deforested patches (mostly < 1ha) embedded in an area with fallow land at different stages of regeneration. Within these rotational agricultural systems done by traditional practices, no heavy machinery is used and is done by slash and burn techniques. Within the shifting cultivation area, more on the north of Suriname, there may be some deforested patches greater than 1 ha, but these are distinguished as permanent agriculture.



Disturbance of shifting cultivation in 2004



Early stages of regeneration in 2007

Phase 3: Validation

The end products are validated LULC datasets of Suriname, estimates of LULC class areas, and associated error matrices to guide the use.

3.1. Data quality control

A quality control (or check) is a clearly specified task that scrutinizes all, or a sample, of the items issuing better during, or even at the end of the process in order to ensure that the final product is of satisfactory quality. The validation involves review, inspection or quantitative measurement, against well-defined pass/fail criteria (Kapnias, D. et al.,2008).

The quality control activity is conducted after the data collection phase in the LUA app. During this phase, a **reassessment of 21%** of all the sample plots (5624 out of 26193 samples) is done. These plots are randomly selected and randomly assigned to an interpreter.

Reassessment of the points are done during a 1-week workshop, where the interpreters came together to collaboratively re-assign LULC classification to samples.

3.2. Data analyses and results

Results include numerical estimates of land use proportions across the country as well as changes through time. Results are communicated, in a manner that corresponds with the data use plan and engagement strategy. The results can be used by the target audience to inform key decisions related to land use planning.

Transition validation using a matrix

Land Use transitions are validated using the transition matrix, which gives an overview of possible land use transitions.

Table 2. Classes Transition Matrix

Classes Transition Matrix		Forest land						Cropland				Grassland		Wetlands		Settlements						Other land	
		Primary	Secondary	Mangrove	Planted forest	Savannah forest	Swamp forest	Annual	Annual - Rice	Perennial	Abandoned	Savanah	Rangelands and Pasture	Open Swamp	Water body	Built area	Infrastructure	Mining - Oil	Mining - Gold	Mining - Bauxite	Mining - Building material	Rock	Baresoil
Forest land	Primary	Ok	No	No	Yes*	No	No	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
	Secondary	No	Ok	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
	Mangrove	No	No	Ok	No	No	No	No	No	No	No	No	No	No	Yes	Yes*	Yes*	Yes	No	No	No	No	No
	Planted forest	No	No	No	Ok	No	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No	No	No
	Savannah forest	No	No	No	No	Ok	No	Yes	No	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No
	Swamp forest	No	No	No	No	No	Ok	No	Yes	No	Yes	No	No	No	No	No	No	Yes	No	No	No	No	No
Cropland	Annual	No	Yes	No	No	No	No	Ok	No	Yes	Yes	No	Yes	No	Yes	Yes	No	No	No	No	No	No	No
	Annual - Rice	No	No	No	No	No	No	No	Ok	No	Yes	No	No	No	Yes	No	No	No	No	No	No	No	No
	Perennial	No	No	No	No	No	No	No	No	Ok	Yes	No	Yes	No	No	No	No	No	No	No	No	No	No
	Abandoned	No	Yes	No	No	No	No	Yes	Yes	Yes	Ok	Yes	Yes	No	No	Yes	No	No	No	No	No	No	No
Grassland	Savanah	No	Yes	No	No	No	No	No	No	No	No	Ok	No	No	No	Yes	Yes	No	No	No	Yes	No	No
	Rangelands and Pasture	No	Yes	No	No	No	No	Yes	No	Yes	No	No	Ok	No	Yes	Yes	Yes	No	No	No	Yes	No	No
Wetlands	Open Swamp	No	No	No	No	No	No	No	No	No	No	No	No	Ok	No	No	No	No	No	No	No	No	No
	Water body	No	No	No	No	No	No	No	No	No	No	No	No	No	Ok	No	No	No	No	No	No	No	No
Settlements	Built area	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Ok	No	No	No	No	No	No	No
	Infrastructure	No	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	Ok	No	No	No	No	No	No
	Mining - Oil	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes	No	No	Ok	No	No	No	No	No
	Mining - Gold	No	Yes	No	No	No	No	No	No	No	No	No	No	No	Yes	No	No	No	Ok	No	No	No	No
	Mining - Bauxite	No	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Ok	No	No	No
	Mining - Building material	No	Yes	No	No	No	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	Ok	No	No
Other lands	Rock	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Ok	No
	Bare soil	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Ok

Understanding national definitions is fundamental in determining possible land use changes as well as impossible transitions between land use changes. For this purpose, the transition matrix is used for quality control. This matrix is very important in conducting a year-by-year time series analyses, with the purpose of annual reporting of greenhouse gas emissions and removals.

Disturbances

Disturbances are punctual events that affect the land, in particular some of the carbon pools present on these lands. According to the IPCC, there are two types of disturbances; 1. Natural disturbances that happen without any human intervention, for example hurricanes or storms, 2. Anthropogenic disturbances that are created by some specific management practices can be controlled or not, for example fires.

Disturbances can be seen, while doing the classification of the plot. Based on previous classification activities, knowledge is built on the occurring national disturbances.

Table 3. Disturbances matrix

	Disturbances	Fires	Mining	Shifting Cultivation	Infrastructure	Windbreaks (Natural)	Floods
Forest land	Primary	Yes	Yes	Yes	Yes	Yes	Yes
	Secondary	Yes	Yes	Yes	Yes	Yes	Yes
	Mangrove	No	Yes	No	No	Yes	Yes
	Planted forest	No	No	No	No	Yes	Yes
	Savannah forest	Yes	Yes	No	No	Yes	Yes
	Swamp forest	No	No	No	No	Yes	Yes
Cropland	Annual	Yes	No	No	No	No	Yes
	Annual - Rice	Yes	No	No	No	No	Yes
	Perennial	No	No	No	No	Yes	Yes
	Abandoned	Yes	No	No	No	No	Yes
Grassland	Savanah	Yes	No	No	No	No	Yes
	Rangelands and Pasture	Yes	No	No	No	No	Yes
Wetlands	Open Swamp	No	No	No	No	No	No
	Water body	No	No	No	No	No	No
Settlements	Built area	No	No	No	No	No	Yes
	Infrastructure	No	Yes	No	No	No	Yes
	Mining - Oil	No	No	No	No	No	Yes
	Mining - Gold	No	No	No	No	No	Yes
	Mining - Bauxite	No	No	No	No	No	Yes
	Mining - Building material	No	No	No	No	No	Yes
Other lands	Rock	No	No	No	No	No	No
	Bare soil	No	No	No	No	No	Yes

Disturbances are identified as:

1. Shifting cultivation: Close to rivers, rotational cultivated areas are commonly smaller than 1 ha, slash and burn activities can be confirmed with FIRMS fire data.
2. Fires: Due to agricultural practices in Suriname, all forest areas that present shifting cultivation, present biomass burning. Therefore, it is assumed that the surface affected by Shifting cultivation has fires.
3. Mining: Mining areas < 1ha, are seen as disturbances caused by mining
4. Infrastructure: Infrastructure developments < 1ha, are seen as disturbances caused by infrastructure
5. Windbreaks: these are naturally occurring storms, usually causing disruptions smaller than 1 ha.
6. Flooding: Abandoned areas that are flooded or parts that are flooded during rainy seasons and or areas that are underwater all year round

Annex II. Land use, land use change matrices

2001	Pr. For	Sc. For	Man	Sav. For	Sw. For	Pl. For	Ab. CL	Ann. CL	Rice	Per. CL	Sav. GL	Rng. Past.	Op. Sw.	Water	Built Area	Infrastr.	Min. Baux.	Min. Gold.	Min. Build.	Min. Oil.	Rock	Bare soil
Pr. For	14,685,070.51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,249.69	-	-	-	-
Sc. For	-	206,198.34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Man	-	-	64,983.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sav. For	-	-	-	23,119.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sw. For	-	-	-	-	456,760.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pl. For	-	-	-	-	-	12,496.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ab. CL	-	-	-	-	-	-	24,368.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ann. CL	-	-	-	-	-	-	-	43,114.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice	-	-	-	-	-	-	-	-	58,110.44	-	-	-	-	-	-	-	-	-	-	-	-	-
Per. CL	-	-	-	-	-	-	-	-	-	6,248.43	-	-	-	-	-	-	-	-	-	-	-	-
Sav. GL	-	-	-	-	-	-	-	-	-	-	94,351.36	-	-	-	-	-	-	-	-	-	-	-
Rng. Past.	-	-	-	-	-	-	-	-	-	-	-	16,245.93	-	-	-	-	-	-	-	-	-	-
Op. Sw.	-	-	-	-	-	-	-	-	-	-	-	-	338,665.14	-	-	-	-	-	-	-	-	-
Water	-	-	-	-	-	-	-	-	-	-	-	-	-	274,306.27	-	-	-	-	-	-	-	-
Built Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37,490.61	-	-	-	-	-	-	-
Infrastr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,124.22	-	-	-	-	-	-
Min. Baux.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-	-	-	-
Min. Gold.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7,498.12	-	-	-	-
Min. Build.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,249.69	-	-	-
Min. Oil.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	624.84	-	-
Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,873.28	-
Bare soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,499.37

2002	Pr. For	Sc. For	Man	Sav. For	Sw. For	Pl. For	Ab. CL	Ann. CL	Rice	Per. CL	Sav. GL	Rng. Past.	Op. Sw.	Water	Built Area	Infrastr.	Min. Baux.	Min. Gold.	Min. Build.	Min. Oil.	Rock	Bare soil
Pr. For	14,684,445.67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	624.84	-	-	-	-
Sc. For	-	206,198.34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Man	-	-	64,983.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sav. For	-	-	-	23,119.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sw. For	-	-	-	-	456,760.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pl. For	-	-	-	-	-	12,496.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ab. CL	-	-	-	-	-	-	24,368.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ann. CL	-	-	-	-	-	-	-	43,114.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice	-	-	-	-	-	-	-	-	58,110.44	-	-	-	-	-	-	-	-	-	-	-	-	-
Per. CL	-	-	-	-	-	-	-	-	-	6,248.43	-	-	-	-	-	-	-	-	-	-	-	-
Sav. GL	-	-	-	-	-	-	-	-	-	-	94,351.36	-	-	-	-	-	-	-	-	-	-	-
Rng. Past.	-	-	-	-	-	-	-	-	-	-	-	16,245.93	-	-	-	-	-	-	-	-	-	-
Op. Sw.	-	-	-	-	-	-	-	-	-	-	-	-	338,665.14	-	-	-	-	-	-	-	-	-
Water	-	-	-	-	-	-	-	-	-	-	-	-	-	274,306.27	-	-	-	-	-	-	-	-
Built Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37,490.61	-	-	-	-	-	-	-
Infrastr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,124.22	-	-	-	-	-	-
Min. Baux.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-	-	-	-
Min. Gold.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8,747.81	-	-	-	-
Min. Build.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,249.69	-	-	-
Min. Oil.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	624.84	-	-
Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,873.28	-
Bare soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,499.37

2003	Pr. For	Sc. For	Man	Sav. For	Sw. For	Pl. For	Ab. CL	Ann. CL	Rice	Per. CL	Sav. GL	Rng. Past.	Op. Sw.	Water	Built Area	Infrastr.	Min. Baux.	Min. Gold.	Min. Build.	Min. Oil.	Rock	Bare soil
Pr. For	14,681,321.45	-	-	-	-	-	-	-	-	-	624.84	624.84	-	-	-	-	-	1,874.53	-	-	-	-
Sc. For	-	205,573.49	-	-	-	-	-	-	-	-	-	-	-	-	624.84	-	-	-	-	-	-	-
Man	-	-	64,983.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sav. For	-	-	-	23,119.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sw. For	-	-	-	-	456,760.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pl. For	-	-	-	-	-	12,496.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ab. CL	-	-	-	-	-	-	24,368.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ann. CL	-	-	-	-	-	-	-	43,114.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice	-	-	-	-	-	-	-	-	58,110.44	-	-	-	-	-	-	-	-	-	-	-	-	-
Per. CL	-	-	-	-	-	-	-	-	-	6,248.43	-	-	-	-	-	-	-	-	-	-	-	-
Sav. GL	-	-	-	-	-	-	-	-	-	-	94,351.36	-	-	-	-	-	-	-	-	-	-	-
Rng. Past.	-	-	-	-	-	-	-	-	-	-	-	16,245.93	-	-	-	-	-	-	-	-	-	-
Op. Sw.	-	-	-	-	-	-	-	-	-	-	-	-	338,665.14	-	-	-	-	-	-	-	-	-
Water	-	-	-	-	-	-	-	-	-	-	-	-	-	274,306.27	-	-	-	-	-	-	-	-
Built Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37,490.61	-	-	-	-	-	-	-
Infrastr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,124.22	-	-	-	-	-	-
Min. Baux.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-	-	-	-
Min. Gold.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9,372.95	-	-	-	-
Min. Build.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,249.69	-	-	-
Min. Oil.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	624.84	-	-
Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,873.28	-
Bare soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,499.37

2004	Pr. For	Sc. For	Man	Sav. For	Sw For	Pl. For	Ab. CL	Ann. CL	Rice	Per. CL	Sav. GL	Rng. Past.	Op. Sw.	Water	Built Area	Infrastr.	Min. Baux.	Min. Gold.	Min. Build.	Min. Oil.	Rock	Bare soil
Pr. For	14,676,822.08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,499.37	-	-	-	-
Sc. For	-	205,573.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Man	-	-	64,983.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sav. For	-	-	-	23,119.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sw For	-	-	-	-	456,760.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pl. For	-	-	-	-	-	12,496.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ab. CL	-	-	-	-	-	-	24,368.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ann. CL	-	-	-	-	-	-	-	43,114.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice	-	-	-	-	-	-	-	-	58,110.44	-	-	-	-	-	-	-	-	-	-	-	-	-
Per. CL	-	-	-	-	-	-	-	-	-	6,246.43	-	-	-	-	-	-	-	-	-	-	-	-
Sav. GL	-	-	-	-	-	-	-	-	-	-	94,976.20	-	-	-	-	-	-	-	-	-	-	-
Rng. Past.	-	-	-	-	-	-	-	-	-	-	-	16,870.77	-	-	-	-	-	-	-	-	-	-
Op. Sw.	-	-	-	-	-	-	-	-	-	-	-	-	338,665.14	-	-	-	-	-	-	-	-	-
Water	-	-	-	-	-	-	-	-	-	-	-	-	-	274,306.27	-	-	-	-	-	-	-	-
Built Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36,115.45	-	-	-	-	-	-	-
Infrastr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,124.22	-	-	-	-	-	-
Min. Baux.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-	-	-	-
Min. Gold.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11,247.18	-	-	-	-
Min. Build.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,249.69	-	-	-
Min. Oil.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	624.84	-	-
Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,873.28	-
Bare soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,499.37

2005	Pr. For	Sc. For	Man	Sav. For	Sw For	Pl. For	Ab. CL	Ann. CL	Rice	Per. CL	Sav. GL	Rng. Past.	Op. Sw.	Water	Built Area	Infrastr.	Min. Baux.	Min. Gold.	Min. Build.	Min. Oil.	Rock	Bare soil
Pr. For	14,677,572.39	-	-	-	-	-	-	624.84	-	-	-	-	-	-	-	-	-	624.84	-	-	-	-
Sc. For	-	205,573.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Man	-	-	64,983.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sav. For	-	-	-	23,119.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sw For	-	-	-	-	456,760.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pl. For	-	-	-	-	-	12,496.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ab. CL	-	-	-	-	-	-	24,368.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ann. CL	-	-	-	-	-	-	-	43,114.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice	-	-	-	-	-	-	-	-	58,110.44	-	-	-	-	-	-	-	-	-	-	-	-	-
Per. CL	-	-	-	-	-	-	-	-	-	6,246.43	-	-	-	-	-	-	-	-	-	-	-	-
Sav. GL	-	-	-	-	-	-	-	-	-	-	94,976.20	-	-	-	-	-	-	-	-	-	-	-
Rng. Past.	-	-	-	-	-	-	-	-	-	-	-	16,870.77	-	-	-	-	-	-	-	-	-	-
Op. Sw.	-	-	-	-	-	-	-	-	-	-	-	-	338,665.14	-	-	-	-	-	-	-	-	-
Water	-	-	-	-	-	-	-	-	-	-	-	-	-	274,306.27	-	-	-	-	-	-	-	-
Built Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36,115.45	-	-	-	-	-	-	-
Infrastr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,124.22	-	-	-	-	-	-
Min. Baux.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-	-	-	-
Min. Gold.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13,746.56	-	-	-	-
Min. Build.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,249.69	-	-	-
Min. Oil.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	624.84	-	-
Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,873.28	-
Bare soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,499.37

2006	Pr. For	Sc. For	Man	Sav. For	Sw. For	Pl. For	Ab. CL	Ann. CL	Rice	Per. CL	Sav. GL	Rng. Past.	Op. Sw.	Water	Built Area	Infrastr.	Min. Baux.	Min. Gold.	Min. Build.	Min. Oil.	Rock	Bare soil
Pr. For	14,676,947.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	624.84	-	-	-	-
Sc. For	-	205,573.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Man	-	-	64,983.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sav. For	-	-	-	23,119.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sw. For	-	-	-	-	456,760.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pl. For	-	-	-	-	-	12,496.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ab. CL	-	-	-	-	-	-	24,368.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ann. CL	-	-	-	-	-	-	-	43,739.04	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice	-	-	-	-	-	-	-	-	58,110.44	-	-	-	-	-	-	-	-	-	-	-	-	-
Per. CL	-	-	-	-	-	-	-	-	-	6,246.43	-	-	-	-	-	-	-	-	-	-	-	-
Sav. GL	-	-	-	-	-	-	-	-	-	-	94,351.36	-	-	-	-	-	-	624.84	-	-	-	-
Rng. Past.	-	-	-	-	-	-	-	-	-	-	-	16,870.77	-	-	-	-	-	-	-	-	-	-
Op. Sw.	-	-	-	-	-	-	-	-	-	-	-	-	338,665.14	-	-	-	-	-	-	-	-	-
Water	-	-	-	-	-	-	-	-	-	-	-	-	-	274,306.27	-	-	-	-	-	-	-	-
Built Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38,115.45	-	-	-	-	-	-	-
Infrastr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,124.22	-	-	-	-	-	-
Min. Baux.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-	-	-	-
Min. Gold.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14,371.40	-	-	-	-
Min. Build.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,249.69	-	-	-
Min. Oil.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	624.84	-	-
Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,873.28	-
Bare soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,499.37

2007	Pr. For	Sc. For	Man	Sav. For	Sw. For	Pl. For	Ab. CL	Ann. CL	Rice	Per. CL	Sav. GL	Rng. Past.	Op. Sw.	Water	Built Area	Infrastr.	Min. Baux.	Min. Gold.	Min. Build.	Min. Oil.	Rock	Bare soil
Pr. For	14,676,947.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sc. For	-	265,573.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Man	-	-	64,983.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sav. For	-	-	-	23,119.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sw.For	-	-	-	-	456,760.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pl. For	-	-	-	-	-	12,496.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ab. CL	-	-	-	-	-	-	24,368.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ann. CL	-	-	-	-	-	-	-	43,739.04	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice	-	-	-	-	-	-	-	-	58,110.44	-	-	-	-	-	-	-	-	-	-	-	-	-
Per. CL	-	-	-	-	-	-	-	-	-	6,248.43	-	-	-	-	-	-	-	-	-	-	-	-
Sav. GL	-	-	-	-	-	-	-	-	-	-	94,351.36	-	-	-	-	-	-	-	-	-	-	-
Rng. Past.	-	-	-	-	-	-	-	-	-	-	-	16,870.77	-	-	-	-	-	-	-	-	-	-
Op. Sw.	-	-	-	-	-	-	-	-	-	-	-	-	338,665.14	-	-	-	-	-	-	-	-	-
Water	-	-	-	-	-	-	-	-	-	-	-	-	-	274,306.27	-	-	-	-	-	-	-	-
Built Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38,115.45	-	-	-	-	-	-	-
Infrastr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,124.22	-	-	-	-	-	-
Min. Baux.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-	-	-	-
Min. Gold.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15,621.89	-	-	-	-
Min. Build.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,249.69	-	-	-
Min. Oil.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	624.84	-	-
Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,873.28	-
Bare soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,499.37

2008	Pr. For	Sc. For	Man	Sav. For	Sw. For	Pl. For	Ab. CL	Ann. CL	Rice	Per. CL	Sav. GL	Rng. Past.	Op. Sw.	Water	Built Area	Infrastr.	Min. Baux.	Min. Gold.	Min. Build.	Min. Oil.	Rock	Bare soil
Pr. For	14,674,448.18	-	-	-	-	-	-	624.84	-	-	-	-	-	-	-	-	-	1,874.53	-	-	-	-
Sc. For	-	265,573.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Man	-	-	64,983.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sav. For	-	-	-	23,119.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sw. For	-	-	-	-	456,760.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pl. For	-	-	-	-	-	12,496.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ab. CL	-	-	-	-	-	-	24,368.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ann. CL	-	-	-	-	-	-	-	43,739.04	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice	-	-	-	-	-	-	-	-	58,110.44	-	-	-	-	-	-	-	-	-	-	-	-	-
Per. CL	-	-	-	-	-	-	-	-	-	6,248.43	-	-	-	-	-	-	-	-	-	-	-	-
Sav. GL	-	-	-	-	-	-	-	-	-	-	94,351.36	-	-	-	-	-	-	-	-	-	-	-
Rng. Past.	-	-	-	-	-	-	-	-	-	-	-	16,870.77	-	-	-	-	-	-	-	-	-	-
Op. Sw.	-	-	-	-	-	-	-	-	-	-	-	-	338,665.14	-	-	-	-	-	-	-	-	-
Water	-	-	-	-	-	-	-	-	-	-	-	-	-	274,306.27	-	-	-	-	-	-	-	-
Built Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38,115.45	-	-	-	-	-	-	-
Infrastr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,124.22	-	-	-	-	-	-
Min. Baux.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-	-	-	-
Min. Gold.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15,621.89	-	-	-	-
Min. Build.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,249.69	-	-	-
Min. Oil.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	624.84	-	-
Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,873.28	-
Bare soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,499.37

2009	Pr. For	Sc. For	Man	Sav. For	Sw. For	Pl. For	Ab. CL	Ann. CL	Rice	Per. CL	Sav. GL	Rng. Past.	Op. Sw.	Water	Built Area	Infrastr.	Min. Baux.	Min. Gold	Min. Build.	Min. Oil.	Rock	Bare soil
Pr. For	14,673,196.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,249.69	-	-	-	-
Sc. For	-	265,573.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Man	-	-	64,983.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sav. For	-	-	-	23,119.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sw. For	-	-	-	-	456,760.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pl. For	-	-	-	-	-	12,496.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ab. CL	-	-	-	-	-	-	24,368.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ann. CL	-	-	-	-	-	-	-	44,363.88	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice	-	-	-	-	-	-	-	-	58,110.44	-	-	-	-	-	-	-	-	-	-	-	-	-
Per. CL	-	-	-	-	-	-	-	-	-	6,248.43	-	-	-	-	-	-	-	-	-	-	-	-
Sav. GL	-	-	-	-	-	-	-	-	-	-	94,351.36	-	-	-	-	-	-	-	-	-	-	-
Rng. Past.	-	-	-	-	-	-	-	-	-	-	-	16,870.77	-	-	-	-	-	-	-	-	-	-
Op. Sw.	-	-	-	-	-	-	-	-	-	-	-	-	338,665.14	-	-	-	-	-	-	-	-	-
Water	-	-	-	-	-	-	-	-	-	-	-	-	-	274,306.27	-	-	-	-	-	-	-	-
Built Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38,115.45	-	-	-	-	-	-	-
Infrastr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,124.22	-	-	-	-	-	-
Min. Baux.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-	-	-	-
Min. Gold.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17,496.62	-	-	-	-
Min. Build.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,249.69	-	-	-
Min. Oil.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	624.84	-	-
Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,873.28	-
Bare soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,499.37

2010	Pr. For	Sc. For	Man	Sav. For	Sw. For	Pl. For	Ab. CL	Ann. CL	Rice	Per. CL	Sav. GL	Rng. Past.	Op. Sw.	Water	Built Area	Infrastr.	Min. Baux.	Min. Gold.	Min. Build.	Min. Oil.	Rock	Bare soil
Pr. For	14,670,074.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,124.22	-	-	-	-
Sc. For	-	205,573.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Man	-	-	64,983.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sav. For	-	-	-	23,119.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sw. For	-	-	-	-	456,760.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pl. For	-	-	-	-	-	12,496.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ab. CL	-	-	-	-	-	-	24,368.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ann. CL	-	-	-	-	-	-	-	44,363.88	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice	-	-	-	-	-	-	-	-	58,110.44	-	-	-	-	-	-	-	-	-	-	-	-	-
Per. CL	-	-	-	-	-	-	-	-	-	6,248.43	-	-	-	-	-	-	-	-	-	-	-	-
Sav. GL	-	-	-	-	-	-	-	-	-	-	94,351.36	-	-	-	-	-	-	-	-	-	-	-
Rng. Past.	-	-	-	-	-	-	-	-	-	-	-	16,870.77	-	-	-	-	-	-	-	-	-	-
Op. Sw.	-	-	-	-	-	-	-	-	-	-	-	-	338,665.14	-	-	-	-	-	-	-	-	-
Water	-	-	-	-	-	-	-	-	-	-	-	-	-	274,306.27	-	-	-	-	-	-	-	-
Built Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38,115.45	-	-	-	-	-	-	-
Infrastr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,124.22	-	-	-	-	-	-
Min. Baux.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-	-	-	-
Min. Gold.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18,745.30	-	-	-	-
Min. Build.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,249.69	-	-	-
Min. Oil.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	624.84	-	-
Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,873.28	-
Bare soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,499.37

2011	Pr. For	Sc. For	Man	Sav. For	Sw. For	Pl. For	Ab. CL	Ann. CL	Rice	Per. CL	Sav. GL	Rng. Past.	Op. Sw.	Water	Built Area	Infrastr.	Min. Baux.	Min. Gold.	Min. Build.	Min. Oil.	Rock	Bare soil
Pr. For	14,663,825.84	-	-	-	-	-	-	624.84	-	-	-	-	-	-	-	-	-	5,623.59	-	-	-	-
Sc. For	-	205,573.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Man	-	-	64,983.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sav. For	-	-	-	23,119.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sw. For	-	-	-	-	456,760.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pl. For	-	-	-	-	-	12,496.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ab. CL	-	-	-	-	-	-	24,368.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ann. CL	-	-	-	-	-	-	-	44,363.88	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice	-	-	-	-	-	-	-	-	58,110.44	-	-	-	-	-	-	-	-	-	-	-	-	-
Per. CL	-	-	-	-	-	-	-	-	-	6,248.43	-	-	-	-	-	-	-	-	-	-	-	-
Sav. GL	-	-	-	-	-	-	-	-	-	-	94,351.36	-	-	-	-	-	-	-	-	-	-	-
Rng. Past.	-	-	-	-	-	-	-	-	-	-	-	16,870.77	-	-	-	-	-	-	-	-	-	-
Op. Sw.	-	-	-	-	-	-	-	-	-	-	-	-	338,665.14	-	-	-	-	-	-	-	-	-
Water	-	-	-	-	-	-	-	-	-	-	-	-	-	274,306.27	-	-	-	-	-	-	-	-
Built Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38,115.45	-	-	-	-	-	-	-
Infrastr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,124.22	-	-	-	-	-	-
Min. Baux.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-	-	-	-
Min. Gold.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21,869.62	-	-	-	-
Min. Build.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,249.69	-	-	-
Min. Oil.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	624.84	-	-
Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,873.28	-
Bare soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,499.37

2012	Pr. For	Sc. For	Man	Sav. For	Sw. For	Pl. For	Ab. CL	Ann. CL	Rice	Per. CL	Sav. GL	Rng. Past.	Op. Sw.	Water	Built Area	Infrastr.	Min. Baux.	Min. Gold.	Min. Build.	Min. Oil.	Rock	Bare soil
Pr. For	14,659,451.93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4,373.90	-	-	-	-
Sc. For	-	205,573.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Man	-	-	64,983.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sav. For	-	-	-	23,119.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sw. For	-	-	-	-	456,760.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pl. For	-	-	-	-	-	12,496.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ab. CL	-	-	-	-	-	-	24,368.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ann. CL	-	-	-	-	-	-	-	44,988.73	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice	-	-	-	-	-	-	-	-	58,110.44	-	-	-	-	-	-	-	-	-	-	-	-	-
Per. CL	-	-	-	-	-	-	-	-	-	6,248.43	-	-	-	-	-	-	-	-	-	-	-	-
Sav. GL	-	-	-	-	-	-	-	-	-	-	94,351.36	-	-	-	-	-	-	-	-	-	-	-
Rng. Past.	-	-	-	-	-	-	-	-	-	-	-	16,870.77	-	-	-	-	-	-	-	-	-	-
Op. Sw.	-	-	-	-	-	-	-	-	-	-	-	-	338,665.14	-	-	-	-	-	-	-	-	-
Water	-	-	-	-	-	-	-	-	-	-	-	-	-	274,306.27	-	-	-	-	-	-	-	-
Built Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38,115.45	-	-	-	-	-	-	-
Infrastr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,124.22	-	-	-	-	-	-
Min. Baux.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-	-	-	-
Min. Gold.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27,493.11	-	-	-	-
Min. Build.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,249.69	-	-	-
Min. Oil.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	624.84	-	-
Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,873.28	-
Bare soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,499.37

2013	Pr. For	Sc. For	Man	Sav. For	Sw. For	Pl. For	Ab. CL	Ann. CL	Rice	Per. CL	Sav. GL	Rng. Past.	Op. Sw.	Water	Built Area	Infrastr.	Min. Baux.	Min. Gold.	Min. Build.	Min. Oil.	Rock	Bare soil
Pr. For	14,655,702.87	-	-	-	-	-	-	624.84	-	-	-	1,249.69	-	-	-	-	-	1,874.53	-	-	-	-
Sc. For	-	205,573.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Man	-	-	64,983.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sav. For	-	-	-	22,494.36	-	-	-	-	-	-	624.84	-	-	-	-	-	-	-	-	-	-	-
Sw. For	-	-	-	-	456,760.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pl. For	-	-	-	-	-	12,496.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ab. CL	-	-	-	-	-	-	24,368.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ann. CL	-	-	-	-	-	-	-	44,988.73	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice	-	-	-	-	-	-	-	-	58,110.44	-	-	-	-	-	-	-	-	-	-	-	-	-
Per. CL	-	-	-	-	-	-	-	-	-	6,248.43	-	-	-	-	-	-	-	-	-	-	-	-
Sav. GL	-	-	-	-	-	-	-	-	-	-	94,351.36	-	-	-	-	-	-	-	-	-	-	-
Rng. Past.	-	-	-	-	-	-	-	-	-	-	-	16,870.77	-	-	-	-	-	-	-	-	-	-
Op. Sw.	-	-	-	-	-	-	-	-	-	-	-	-	338,665.14	-	-	-	-	-	-	-	-	-
Water	-	-	-	-	-	-	-	-	-	-	-	-	-	274,306.27	-	-	-	-	-	-	-	-
Built Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36,115.45	-	-	-	-	-	-	-
Infrastr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,124.22	-	-	-	-	-	-
Min. Baux.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-	-	-	-
Min. Gold.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31,867.02	-	-	-	-
Min. Build.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,249.69	-	-	-
Min. Oil.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	624.84	-	-
Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,873.26	-
Bare soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,499.37

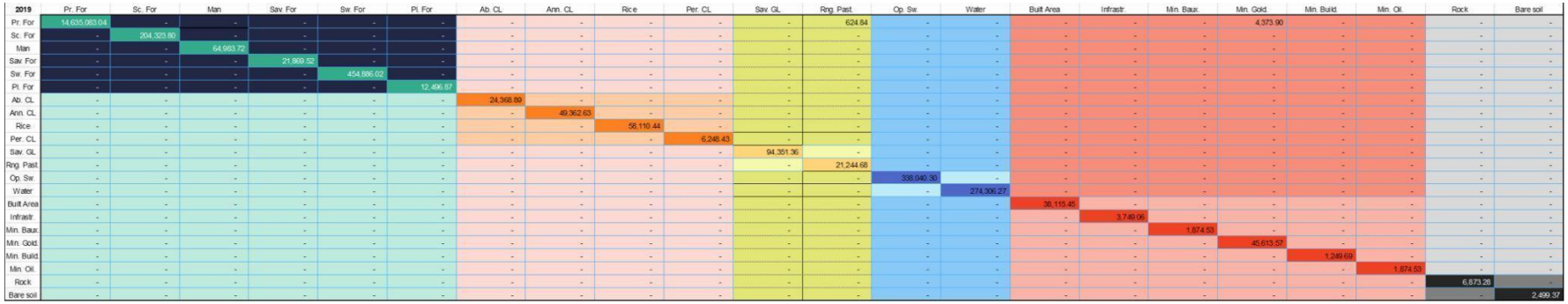
2014	Pr. For	Sc. For	Man	Sav. For	Sw. For	Pl. For	Ab. CL	Ann. CL	Rice	Per. CL	Sav. GL	Rng. Past.	Op. Sw.	Water	Built Area	Infrastr.	Min. Baux.	Min. Gold.	Min. Build.	Min. Oil.	Rock	Bare soil
Pr. For	14,652,578.66	-	-	-	-	-	-	624.84	-	-	-	-	-	-	-	-	-	2,499.37	-	-	-	-
Sc. For	-	205,573.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Man	-	-	64,983.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sav. For	-	-	-	22,494.36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sw. For	-	-	-	-	456,130.71	-	-	-	-	-	-	624.84	-	-	-	-	-	-	-	-	-	-
Pl. For	-	-	-	-	-	12,496.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ab. CL	-	-	-	-	-	-	24,368.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ann. CL	-	-	-	-	-	-	-	45,613.57	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice	-	-	-	-	-	-	-	-	58,110.44	-	-	-	-	-	-	-	-	-	-	-	-	-
Per. CL	-	-	-	-	-	-	-	-	-	6,248.43	-	-	-	-	-	-	-	-	-	-	-	-
Sav. GL	-	-	-	-	-	-	-	-	-	-	94,976.20	-	-	-	-	-	-	-	-	-	-	-
Rng. Past.	-	-	-	-	-	-	-	-	-	-	-	16,120.46	-	-	-	-	-	-	-	-	-	-
Op. Sw.	-	-	-	-	-	-	-	-	-	-	-	-	338,665.14	-	-	-	-	-	-	-	-	-
Water	-	-	-	-	-	-	-	-	-	-	-	-	-	274,306.27	-	-	-	-	-	-	-	-
Built Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36,115.45	-	-	-	-	-	-	-
Infrastr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,124.22	-	-	-	-	-	-
Min. Baux.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-	-	-	-
Min. Gold.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33,741.55	-	-	-	-
Min. Build.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,249.69	-	-	-
Min. Oil.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	624.84	-	-
Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,873.26	-
Bare soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,499.37

2015	Pr. For	Sc. For	Man	Sav. For	Sw. For	Pl. For	Ab. CL	Ann. CL	Rice	Per. CL	Sav. GL	Rng. Past.	Op. Sw.	Water	Built Area	Infrastr.	Min. Baux.	Min. Gold.	Min. Build.	Min. Oil.	Rock	Bare soil
Pr. For	14,649,454.44	-	-	-	-	-	-	-	-	-	-	624.84	-	-	-	-	-	2,499.37	-	-	-	-
Sc. For	-	204,948.65	-	-	-	-	-	624.84	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Man	-	-	64,983.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sav. For	-	-	-	22,494.36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sw. For	-	-	-	-	455,510.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	624.84	-	-
Pl. For	-	-	-	-	-	12,496.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ab. CL	-	-	-	-	-	-	24,368.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ann. CL	-	-	-	-	-	-	-	45,238.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice	-	-	-	-	-	-	-	-	58,110.44	-	-	-	-	-	-	-	-	-	-	-	-	-
Per. CL	-	-	-	-	-	-	-	-	-	6,248.43	-	-	-	-	-	-	-	-	-	-	-	-
Sav. GL	-	-	-	-	-	-	-	-	-	-	94,976.20	-	-	-	-	-	-	-	-	-	-	-
Rng. Past.	-	-	-	-	-	-	-	-	-	-	-	16,745.30	-	-	-	-	-	-	-	-	-	-
Op. Sw.	-	-	-	-	-	-	-	-	-	-	-	-	338,665.14	-	-	-	-	-	-	-	-	-
Water	-	-	-	-	-	-	-	-	-	-	-	-	-	274,306.27	-	-	-	-	-	-	-	-
Built Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36,115.45	-	-	-	-	-	-	-
Infrastr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,124.22	-	-	-	-	-	-
Min. Baux.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-	-	-	-
Min. Gold.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36,240.92	-	-	-	-
Min. Build.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,249.69	-	-	-
Min. Oil.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	624.84	-	-
Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,873.26	-
Bare soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,499.37

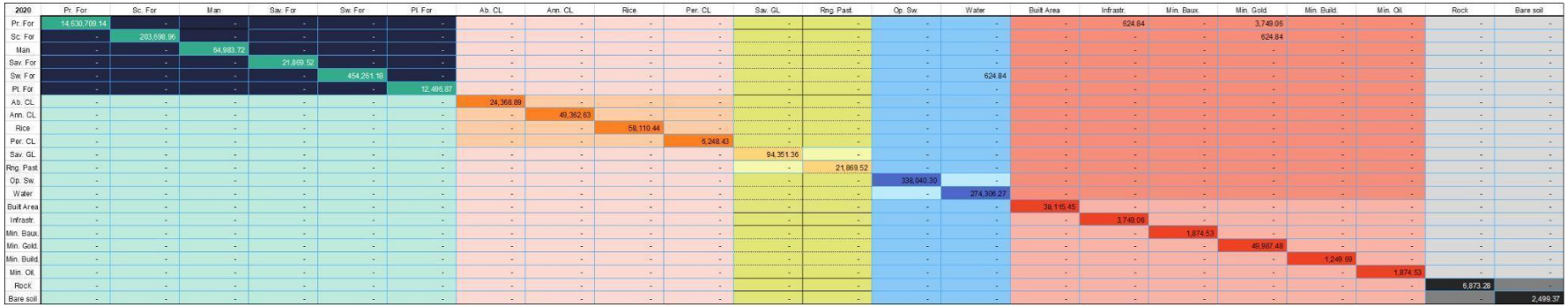
2016	Pr. For	Sc. For	Man	Sav. For	Sw. For	Pl. For	Ab. CL	Ann. CL	Rice	Per. CL	Sav. GL	Rng. Past.	Op. Sw.	Water	Built Area	Infrastr.	Min. Baux.	Min. Gold.	Min. Build.	Min. Oil.	Rock	Bare soil
Pr. For	14,643,206.00	-	-	-	-	-	-	1,249.69	-	-	-	1,249.69	-	-	-	-	-	3,749.06	-	-	-	-
Sc. For	-	204,948.65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Man	-	-	64,983.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sav. For	-	-	-	22,494.36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sw. For	-	-	-	-	455,510.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pl. For	-	-	-	-	-	12,496.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ab. CL	-	-	-	-	-	-	24,368.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ann. CL	-	-	-	-	-	-	-	46,863.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice	-	-	-	-	-	-	-	-	58,110.44	-	-	-	-	-	-	-	-	-	-	-	-	-
Per. CL	-	-	-	-	-	-	-	-	-	6,248.43	-	-	-	-	-	-	-	-	-	-	-	-
Sav. GL	-	-	-	-	-	-	-	-	-	-	94,351.36	-	-	-	-	624.84	-	-	-	-	-	-
Rng. Past.	-	-	-	-	-	-	-	-	-	-	-	19,370.15	-	-	-	-	-	-	-	-	-	-
Op. Sw.	-	-	-	-	-	-	-	-	-	-	-	-	338,040.30	-	-	-	-	-	-	624.84	-	-
Water	-	-	-	-	-	-	-	-	-	-	-	-	-	274,306.27	-	-	-	-	-	-	-	-
Built Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38,115.45	-	-	-	-	-	-	-
Infrastr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,124.22	-	-	-	-	-	-
Min. Baux.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-	-	-	-
Min. Gold.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38,740.29	-	-	-	-
Min. Build.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,249.69	-	-	-
Min. Oil.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,249.69	-	-
Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,873.26	-
Bare soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,499.37

2017	Pr. For	Sc. For	Man	Sav. For	Sw. For	Pl. For	Ab. CL	Ann. CL	Rice	Per. CL	Sav. GL	Rng. Past.	Op. Sw.	Water	Built Area	Infrastr.	Min. Baux.	Min. Gold.	Min. Build.	Min. Oil.	Rock	Bare soil
Pr. For	14,641,956.32	-	-	-	-	-	-	-	-	-	-	624.84	-	-	-	-	-	624.84	-	-	-	-
Sc. For	-	204,948.65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Man	-	-	64,983.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sav. For	-	-	-	22,494.36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sw. For	-	-	-	-	455,510.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pl. For	-	-	-	-	-	12,496.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ab. CL	-	-	-	-	-	-	24,368.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ann. CL	-	-	-	-	-	-	-	46,112.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice	-	-	-	-	-	-	-	-	58,110.44	-	-	-	-	-	-	-	-	-	-	-	-	-
Per. CL	-	-	-	-	-	-	-	-	-	6,248.43	-	-	-	-	-	-	-	-	-	-	-	-
Sav. GL	-	-	-	-	-	-	-	-	-	-	94,351.36	-	-	-	-	-	-	-	-	-	-	-
Rng. Past.	-	-	-	-	-	-	-	-	-	-	-	20,619.83	-	-	-	-	-	-	-	-	-	-
Op. Sw.	-	-	-	-	-	-	-	-	-	-	-	-	338,040.30	-	-	-	-	-	-	-	-	-
Water	-	-	-	-	-	-	-	-	-	-	-	-	-	274,306.27	-	-	-	-	-	-	-	-
Built Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38,115.45	-	-	-	-	-	-	-
Infrastr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,749.06	-	-	-	-	-	-
Min. Baux.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-	-	-	-
Min. Gold.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42,489.35	-	-	-	-
Min. Build.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,249.69	-	-	-
Min. Oil.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-
Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,873.26	-
Bare soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,499.37

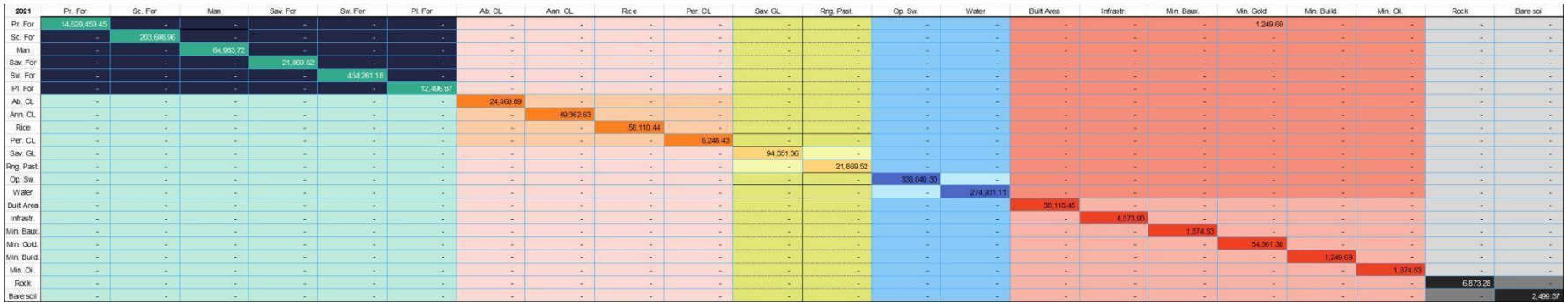
2018	Pr. For	Sc. For	Man	Sav. For	Sw. For	Pl. For	Ab. CL	Ann. CL	Rice	Per. CL	Sav. GL	Rng. Past.	Op. Sw.	Water	Built Area	Infrastr.	Min. Baux.	Min. Gold.	Min. Build.	Min. Oil.	Rock	Bare soil
Pr. For	14,640,081.79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-	-	-
Sc. For	-	204,323.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	624.84	-	-	-	-
Man	-	-	64,983.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sav. For	-	-	-	21,869.52	-	-	-	624.84	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sw. For	-	-	-	-	454,886.02	-	-	624.84	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pl. For	-	-	-	-	-	12,496.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ab. CL	-	-	-	-	-	-	24,368.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ann. CL	-	-	-	-	-	-	-	46,112.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice	-	-	-	-	-	-	-	-	58,110.44	-	-	-	-	-	-	-	-	-	-	-	-	-
Per. CL	-	-	-	-	-	-	-	-	-	6,248.43	-	-	-	-	-	-	-	-	-	-	-	-
Sav. GL	-	-	-	-	-	-	-	-	-	-	94,351.36	-	-	-	-	-	-	-	-	-	-	-
Rng. Past.	-	-	-	-	-	-	-	-	-	-	-	21,244.68	-	-	-	-	-	-	-	-	-	-
Op. Sw.	-	-	-	-	-	-	-	-	-	-	-	-	338,040.30	-	-	-	-	-	-	-	-	-
Water	-	-	-	-	-	-	-	-	-	-	-	-	-	274,306.27	-	-	-	-	-	-	-	-
Built Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38,115.45	-	-	-	-	-	-	-
Infrastr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,749.06	-	-	-	-	-	-
Min. Baux.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-	-	-	-
Min. Gold.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43,114.20	-	-	-	-
Min. Build.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,249.69	-	-	-
Min. Oil.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-
Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,873.26	-
Bare soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,499.37



2019	Pr. For	Sc. For	Man	Sav. For	Sw. For	Pl. For	Ab. CL	Ann. CL	Rice	Per. CL	Sav. GL	Rng. Past.	Op. Sw.	Water	Built Area	Infrastr.	Min. Baux.	Min. Gold.	Min. Build.	Min. Oil.	Rock	Bare soil
Pr. For	14,635,063.04	-	-	-	-	-	-	-	-	-	-	624.84	-	-	-	-	-	4,373.90	-	-	-	-
Sc. For	-	204,323.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Man	-	-	64,983.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sav. For	-	-	-	21,869.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sw. For	-	-	-	-	454,886.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pl. For	-	-	-	-	-	12,496.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ab. CL	-	-	-	-	-	-	24,368.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ann. CL	-	-	-	-	-	-	-	49,362.63	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice	-	-	-	-	-	-	-	-	58,110.44	-	-	-	-	-	-	-	-	-	-	-	-	-
Per. CL	-	-	-	-	-	-	-	-	-	6,248.43	-	-	-	-	-	-	-	-	-	-	-	-
Sav. GL	-	-	-	-	-	-	-	-	-	-	94,351.36	-	-	-	-	-	-	-	-	-	-	-
Rng. Past.	-	-	-	-	-	-	-	-	-	-	-	21,244.68	-	-	-	-	-	-	-	-	-	-
Op. Sw.	-	-	-	-	-	-	-	-	-	-	-	-	338,040.30	-	-	-	-	-	-	-	-	-
Water	-	-	-	-	-	-	-	-	-	-	-	-	-	274,306.27	-	-	-	-	-	-	-	-
Built Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38,115.45	-	-	-	-	-	-	-
Infrastr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,749.06	-	-	-	-	-	-
Min. Baux.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-	-	-	-
Min. Gold.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	45,613.57	-	-	-	-
Min. Build.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,249.69	-	-	-
Min. Oil.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-
Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,873.28	-
Bare soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,499.37



2020	Pr. For	Sc. For	Man	Sav. For	Sw. For	Pl. For	Ab. CL	Ann. CL	Rice	Per. CL	Sav. GL	Rng. Past.	Op. Sw.	Water	Built Area	Infrastr.	Min. Baux.	Min. Gold.	Min. Build.	Min. Oil.	Rock	Bare soil
Pr. For	14,630,709.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	624.84	-	3,749.06	-	-	-	-
Sc. For	-	203,698.96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	624.84	-	-	-	-
Man	-	-	64,983.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sav. For	-	-	-	21,869.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sw. For	-	-	-	-	454,261.18	-	-	-	-	-	-	-	-	624.84	-	-	-	-	-	-	-	-
Pl. For	-	-	-	-	-	12,496.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ab. CL	-	-	-	-	-	-	24,368.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ann. CL	-	-	-	-	-	-	-	49,362.63	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice	-	-	-	-	-	-	-	-	58,110.44	-	-	-	-	-	-	-	-	-	-	-	-	-
Per. CL	-	-	-	-	-	-	-	-	-	6,248.43	-	-	-	-	-	-	-	-	-	-	-	-
Sav. GL	-	-	-	-	-	-	-	-	-	-	94,351.36	-	-	-	-	-	-	-	-	-	-	-
Rng. Past.	-	-	-	-	-	-	-	-	-	-	-	21,869.52	-	-	-	-	-	-	-	-	-	-
Op. Sw.	-	-	-	-	-	-	-	-	-	-	-	-	338,040.30	-	-	-	-	-	-	-	-	-
Water	-	-	-	-	-	-	-	-	-	-	-	-	-	274,306.27	-	-	-	-	-	-	-	-
Built Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38,115.45	-	-	-	-	-	-	-
Infrastr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,749.06	-	-	-	-	-	-
Min. Baux.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-	-	-	-
Min. Gold.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	49,987.48	-	-	-	-
Min. Build.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,249.69	-	-	-
Min. Oil.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-
Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,873.28	-
Bare soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,499.37



2021	Pr. For	Sc. For	Man	Sav. For	Sw. For	Pl. For	Ab. CL	Ann. CL	Rice	Per. CL	Sav. GL	Rng. Past.	Op. Sw.	Water	Built Area	Infrastr.	Min. Baux.	Min. Gold.	Min. Build.	Min. Oil.	Rock	Bare soil
Pr. For	14,629,459.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,249.69	-	-	-	-
Sc. For	-	203,698.96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Man	-	-	64,983.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sav. For	-	-	-	21,869.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sw. For	-	-	-	-	454,261.18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pl. For	-	-	-	-	-	12,496.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ab. CL	-	-	-	-	-	-	24,368.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ann. CL	-	-	-	-	-	-	-	49,362.63	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice	-	-	-	-	-	-	-	-	58,110.44	-	-	-	-	-	-	-	-	-	-	-	-	-
Per. CL	-	-	-	-	-	-	-	-	-	6,248.43	-	-	-	-	-	-	-	-	-	-	-	-
Sav. GL	-	-	-	-	-	-	-	-	-	-	94,351.36	-	-	-	-	-	-	-	-	-	-	-
Rng. Past.	-	-	-	-	-	-	-	-	-	-	-	21,869.52	-	-	-	-	-	-	-	-	-	-
Op. Sw.	-	-	-	-	-	-	-	-	-	-	-	-	338,040.30	-	-	-	-	-	-	-	-	-
Water	-	-	-	-	-	-	-	-	-	-	-	-	-	274,931.11	-	-	-	-	-	-	-	-
Built Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38,115.45	-	-	-	-	-	-	-
Infrastr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4,373.90	-	-	-	-	-	-
Min. Baux.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-	-	-	-
Min. Gold.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	54,361.38	-	-	-	-
Min. Build.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,249.69	-	-	-
Min. Oil.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,874.53	-	-
Rock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,873.28	-
Bare soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,499.37