Government of Guyana

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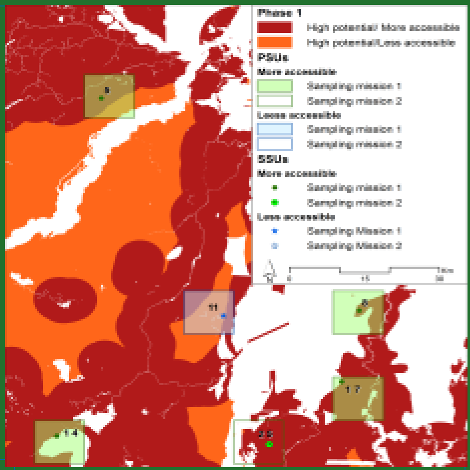
The Reference Level for Guyana's REDD+ Program



Contents

ACRONYMS

AD	Activity Data
A/R	Afforestation/reforestation
AFOLU	Agriculture, Forestry, and Other Land Use
BAU	Business as Usual
CO_2	Carbon dioxide
COP	Conference of Parties
EF	Emission Factor
EPA	Environmental Protection Agency
EVN	Economic Value to the Nation
FCMS	Forest Carbon Monitoring System
FCPF	Forest Carbon Partnership Facility
FPA	Forest Producers Association
GHG	Greenhouse Gas
GFC	Guyana Forestry Commission
GGDMA	Guyana Gold & Diamond Miners Association
GGMC	Guyana Geology & Mines Commission
GIM	Geospatial Information Management Unit
GoG	Government of Guyana
GoN	Government of Norway
GPG	Good Practice Guidance
GRIF	Guyana REDD+ Investment Fund
HFLD	High-forest, low deforestation
IPCC	Intergovernmental Panel on Climate Change
LCDS	Low Carbon Development Strategy
LULUCF	Land use, land-use change, and forestry
MNRE	Ministry of Natural Resources & the Environment
MoU	Memorandum of Understanding
MRV	Monitoring, reporting, and verification
NAREI	National Agricultural Research & Extension Institute
OCC	Office of Climate Change
REDD+	Reducing emissions from deforestation and forest degradation, and the role of conservation of forest carbon stocks, sustainable management of forests and enhancement of carbon stocks
RL	Reference Level
REL	Reference Emissions Level
UG	University of Guyana
UNFCCC	United Nations Framework Convention on Climate Change

EXECUTIVE SUMMARY

This document presents Guyana's submission of its reference level (RL) for deforestation, and forest degradation due to timber harvesting practices for results-based payments for REDD+ under the UNFCCC. In this document, and accompanying technical reports, Guyana has submitted detailed information on its historic emissions and projected emissions that are:

- transparent, with full documentation and highly sufficient for reviewers to assess the extent to which good practice requirements have been met;
- complete, whereby all relevant emissions categories are estimated and reported;
- consistent, whereby the methodologies used over the historic period are the same and use the same implementers so the differences from year to year are real and not an artifact of change in methodology; and
- accurate and with low uncertainty so that results are neither under or over-estimated.

The long term historical deforestation in Guyana has been very low over the whole country – and is one of the lowest in the world. Guyana has presented a rationale for why the forest RL should take into account national circumstances as the likely future emissions are not well captured by historical ones. The key reason for this is that Guyana's ongoing development is creating new economic and social incentives which can significantly impact rates of forest cover. By contrast, standing forest has historically not generated any economic value to the nation. Therefore, a programme of REDD+ based on prevailing good practice methods must generate sufficient economic incentives to reflect the global benefits provided by Guyana's efforts in maintaining standing forests, and create new economic alternatives to deforestation that will limit any future increase in emissions.

The RL for Guyana, developed at the National scale, is based on the detailed and robust analysis of historic emissions from deforestation from all causes and from degradation due to timber harvesting, and includes the following:

- The key drivers of deforestation, including conversion to agriculture, mineral extraction, and infrastructure expansion (mining and logging roads);
- Degradation from timber production, representing a source of emissions;
- Forest are defined as having a minimum area of land of 1 ha with tree crown cover (or equivalent stocking level) of more than 30% with the potential to reach a minimum height of 5 m at maturity in situ;
- All five IPCC recognized carbon pools are included and the key GHG selected is CO_2;
- The historic period selected is from 2001 to 2012, a total of 12 years;
- The collection and analysis of activity data (AD) and field data on forest carbon stocks are consistent with good practice in that they neither over- nor under-estimate as far as can be judged; and
- And all data are at Tier 2 and 3 levels for the following reasons:
    - Wall-to-wall coverage of satellite imagery is used to obtain the AD related to conversion of forest lands to other uses and such data are combined and co-registered with other key spatial data

bases in a GIS such as roads, rivers, settlements, vegetation class, location of logging concessions, location of mining concessions, and topography.

- A comprehensive, peer-reviewed, field sampling system was designed and implemented to attain a required precision target of a 95% confidence interval of <+/-15% of the mean total carbon stock of forests.

Having established the historic emission for Guyana, with specific reference to the results summarized in Table 13(a), Table 7 and Section 5.3, Guyana has developed its Proposal for Reference Level for REDD+.

Guyana's proposal for Reference Level for REDD+ is based on the Combined Reference Level Approach, in which a global forest carbon emissions loss of 0.44%, as concluded by Baccini et. al. 2012 is used, along with Guyana's historic emissions level for the period 2001 to 2012, as established in this Proposal.

The use of the combined reference level is determined to be the most appropriate method for Guyana and one which allows for the broadly accepted objective within the UNFCCC negotiations to be fulfilled. This objective expresses general agreement that a REDD+ mechanism must provide genuine incentives for forest conservation in low deforestation countries, as well as ensure global additionality.

This approach involves two main steps, and is summarized below:

- **Setting the Reference Level:**
  Using a global percent of forest carbon emissions of 0.44%, as the global level, and
  - establishing the historic annual average emissions percent level for Guyana (2001-2012) by dividing this average annual emissions by the total carbon stock of Guyana, resulting with 11,667,734 tCO_2 of emissions divided by 19,517,832,109 tCO_2 C stock= 0.06%,
  - deriving the Combined Average of the global and historic annual average emissions percent by: 0.44% + 0.06% divided by 2 = 0.25%.

- **Computing Annual REDD+ Performance based on Reference Level:**
  - Annual Reported Emissions percent (computed by dividing the annual reported forest carbon emissions loss by the total forest carbon stock of Guyana) that is concluded following measurement and verification, inclusive of establishment of accuracy levels, is then subtracted from the Combined Average of 0.25%.

Using an average C stock of forests of 300 t C ha^{-1}, Guyana's Proposed Reference Level for its REDD+ Programme is 48,794,580 t CO_2.

One of the key considerations in Guyana's Proposal for Reference Level for REDD+ is the integration of a financial incentives baseline and sliding scale mechanism within the payment computation. This will provide Guyana's commitment to ensuring that its REDD+ programme aims at assuring environmental integrity whilst advancing a low carbon pathway. One example of this model is currently in use in the bilateral agreement between Guyana and Norway. Further, key consideration is also extended in ensuring congruence with existing internationally accepted methods, such as those established for the FCPF Carbon Fund which allows for 0.1% of total carbon stock, as adjustments to emissions over the historic level.

1.0 BACKGROUND

In accordance with decision 12/CP.17 paragraph 13[1], Guyana has deemed it appropriate to submit and is submitting on a voluntary basis for consideration by the UNFCCC its initial proposal for developing the forest reference level (RL). There are two main components of the RL: (a) establishment of Guyana's historical emissions profile from the forestry sector and (b) the development of the proposed reference level. Here we include an overview of the data and methodologies used to estimate the historical emissions profile as well as details of how national circumstances are considered for developing a RL. The information presented is intended to be transparent, complete, consistent with UNFCCC guidance, accurate and guided by the most recent IPCC guidance and guidelines. We request the Secretariat to make this information available on the UNFCCC REDD web platform and hereby request a technical assessment of Guyana's initial proposal.

2.0 THE GUYANA CONTEXT

In global assessment reports, the Guiana Shield has been identified as one of the largest remaining blocks of primary tropical forest on earth, and has the potential to play an important role in mitigating climate change. The region has been reported to contain both the highest percentage of forest cover (over 90% is intact tropical forest) and the lowest human population density of any major tropical forested area.

Historical deforestation in Guyana has been very low (0.02% to 0.079% yr^{-1} over the past 22 years), but this trend may change in the future as deforestation increases to meet growing demands for agriculture, timber, minerals, and human settlements. Guyana is therefore considered to be a high forest cover low emission/deforestation rate (HFLE/D) country, with forests covering approximately 85% of the country (forest area of 18.5 million hectares) and containing an estimated 19.5billion tons (or Gt) of CO_2 in live and dead biomass pools. In addition to being one of Guyana's most valuable natural assets, these forests are suitable for logging and agriculture, and are underlain with significant mineral deposits. Mining has been the primary driver of deforestation in Guyana[2], accounting for approximately 60% of all deforestation between 1990 and 2009 and more than 90% of deforestation between 2009 and 2012. Other drivers include forestry infrastructure, agriculture, and other infrastructure.

3.0 APPLICATION OF UNFCCC MODALITIES TO GUYANA'S RL

Within the context of the United Nations Framework Convention on Climate Change (UNFCCC or Convention), REDD+ REL/RLs serve two purposes[3]. First, RLs establish a business-as-usual (BAU) baseline against which actual emissions are compared, whereby emission reductions are estimated as the difference between RLs and actual emissions. In this sense, RLs depict what the emissions scenario would be in the absence of REDD+ implementation, and thus provides the basis for measuring its success. Second, RLs are needed to determine

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[1] Decision by the Subsidiary Body on Scientific and Technical Advice of the United Nations Framework Convention on Climate Change (UNFCCC SBSTA).

[2] Decision 4, CP.15 paragraph 1(a) requests developing country Parties to identify drivers of deforestation and forest degradation resulting in emissions.

[3] Meridian Institute. 2011. "Modalities for REDD+ Reference Levels: Technical and Procedural Issues." Prepared for the Government of Norway, by Arild Angelsen, Doug Boucher, Sandra Brown, Valérie Merckx, Charlotte Streck, and Daniel Zarin. Available at: http://www.REDD-OAR.org.

the eligibility of UNFCCC Parties for international, results-based support for REDD+, and to calculate that support on the basis of measured, reported, and verified emission reductions.

The creation of forest RLs as benchmarks for assessing performance are guided by modalities contained in UNFCCC Conference of Parties (COP) decisions, most notably decision 12/CP.17 and its Annex. These modalities state that when establishing forest RLs, Parties should do so transparently taking into account historic data and adjusting for national circumstances in accordance with relevant decisions of the COP[4]. Forest RLs can be developed sub-nationally as an interim measure while transitioning to a national scale, but Guyana has chosen from the outset to develop its RL at a national scale. A step-wise approach is allowed that enables Parties to improve the forest RL by incorporating better data, improved methodologies and, where appropriate, additional pools. Forest RLs are expressed in units of tons of CO_2 equivalent per year and must maintain consistency with a country's greenhouse gas inventory (according to 12/CP.17, Paragraph 8). In response to the guidelines for submissions of information on RLs provided in decision 12/CP.17, a summary of Guyana's decisions on these modalities is given in Table 1.

Table 1. UNFCCC modalities relevant for Guyana's national RL.

Reference to Guideline	Description	Guyana's Proposal
Decision 12/CP.17 Paragraph 10	Allows for a step-wise approach	• RL is at national scale, and includes all drivers of deforestation, forest degradation due to selective logging only, but not removals or C stock enhancements at this stage.
Decision 12/CP.17 Annex, paragraph (c)	Pools and gases included	• Pools: (activity specific) - Aboveground and belowground biomass - Dead wood - Litter - Soil carbon - Wood products (timber harvesting only) • Gases: - Include CO_2 - Include N_2O and CH_4, converted to CO_2e, for biomass burning due to wildfires
Decision 12/CP.17 Annex, paragraph (c)	Activities included	• Include deforestation caused by agriculture, mining, forestry infrastructure, and other infrastructure • Include forest degradation from timber harvesting only • Include sustainable management of forests (SMF) in timber concessions

[4] Decision 4/CP.15, paragraph 7.

Decision 12/CP.17 Annex, paragraph (d)	Definition of forest used is same as that used in national GHG inventory	• Minimum tree cover: 30% • Minimum height: 5 m • Minimum area: 1 ha[5]
Decision 12/CP.17 Annex	The information should be guided by the most recent IPCC guidance and guidelines,	• All data are gathered using best practices and integrated to estimate emissions using IPCC 2003 and 2006 guidelines[6]
Decision 12/CP.17 II. Paragraph 9	To submit information and rationale on the development of forest RLs/RELs, including details of national circumstances and on how the national circumstances were considered	• Being a high forest cover and low deforestation country, Guyana proposes to make adjustments to allow for national circumstances likely future emissions are not well captured by historical ones.

Many of the critical elements of REDD+ and establishing a RL do not have strict guidance from the UNFCCC, leaving the analysis and final decision-making up to the country. At the Conference of Parties (COP) meeting in 2013, additional guidelines and procedures were discussed regarding technical assessment of RL submissions. Such additional guidance provides more clarity regarding how to proceed with submission of a Reference Level. The text that Guyana has followed closely was developed at the 2013 COP is available at http://unfccc.int/resource/docs/2011/cop17/eng/09a02.pdf#page=16

3.1 Rationale and Justification of Guyana's Decisions for the RL

Guyana's process of developing the Reference Level which is based on an ***agreed "Roadmap" to building a national MRV system***. The Roadmap was created in consultation with stakeholders and includes: a national implementation strategy, status of current activities and capacities, requirements for the MRV system, a capacity gap assessment, and a roadmap including an institutional framework for implementation. In March of 2014, a phase 2 Roadmap was developed that assess the achievement of the Phase 1 period, and identified next steps.[7]

3.1.1 Scope of Activities

Guyana has chosen to include emissions from deforestation and forest degradation in its RL but not removals from carbon stock enhancements at the initial stage. This recommendation is made given that more than 80% of Guyana is forested, and historically there have been few activities related to enhancing forest carbon stocks from which a reference level could be developed.

[5] Based on the Marrakech Accords.

[6] The two IPCC reports used are the IPCC 2003 Good Practice Guidance for the LULUCF sector (IPCC 2003 GPG) and the IPCC 2006 Guidelines for National GHG Inventories, Volume 4 AFOLU (IPCC 2006 AFOLU)

[7] Guyana Forestry Commission, "Terms of Reference for Developing Capacities for a national Monitoring, Reporting, and Verification System to support REDD+ participation of Guyana: September, 2014.

Deforestation

There are several drivers of deforestation, including conversion to agriculture, mineral extraction, infrastructure expansion, and Guyana intends to include deforestation as a REDD+ activity.

Forest Degradation

There are several sources of forest degradation in Guyana, each of which should be considered separately to determine whether potential emissions are significant to include in the RL, whether they can be included at reasonable cost, and whether it is likely that interventions can be implemented to reduce such emissions.

Potential causes of forest degradation in Guyana include:

1. Selective logging
2. Human-induced fires
3. Small scale land-use change (e.g., mining that does not qualify as a deforestation event)
4. Expanding shifting cultivation and/or shortened fallow periods

Selective Logging

Because the timber industry is active in Guyana and emissions from this form of degradation represents a proportion of emissions, degradation from selective logging is included in the RL.

Fires, Small-Scale Mining, and Shifting Cultivation

Emissions from other sources of forest degradation have not yet been quantified, though additional studies are being conducted on the impact of shifting cultivation. After preliminary data are evaluated, a method will be developed so that these sources of forest degradation can be included in the RL. Establishing a reliable and robust business-as-usual scenario for carbon impacts of degradation from human-induced fires is generally very difficult. However, data are available for estimating emissions caused by fires that resulted in complete deforestation (as opposed to forest degradation, see Section 4). Between 1990 and 2012, less than 2,200 ha of forest (~170 ha yr^{-1}) were deforested due to fire, resulting in estimated emissions of approximately 21,000 t CO_{2e} yr^{-1}, which represents<0.5% of total emissions from deforestation. Guyana therefore excludes degradation from fire in its RL due to the insignificance of fire as an emission source in Guyana.

Small scale mining that affects a smaller land area, often less than one hectare is classed as degradation. This practice is likely to result in fewer trees being cleared per unit area than medium or large scale mining. Therefore, the immediate impact of such activities would be classified as degradation due to the definition of a forest as having a minimum area of one hectare. However, small scale mining operations often coalesce, resulting in what appears to be a medium scale mine. Small-scale mining operations will be tracked using very high resolution satellite imagery in post 2010 work by GFC. Regeneration (gain) could occur over time on small clearings when abandoned but at this stage no assumptions as to what this value might be will be made given that it is conservative not to include it. Soil carbon emissions from small scale mining are unknown at this stage. Topsoil is washed during mining operations and is commonly scoured away downstream, or ends up ponding in puddles. Therefore it is assumed that emissions from soil in small scale mining are estimated using the same method for larger scale mining. Emissions from such sources may be more accurately addressed with increased understanding of soil carbon dynamics for this degradation activity and incorporated at a later stage.

3.1.2 Forest Definition

Guyana plans to implement REDD+ at the national scale, so it is appropriate to maintain one consistent forest definition rather than giving subnational jurisdictions the option to use a different definition. Guyana chose to use the thresholds of crown cover, height and area to develop a forest definition because this has been the overwhelming precedent set by the Clean Development Mechanism for Afforestation/Reforestation projects.

Guyana has chosen to define forest following the definition as outlined in the Marrakech Accords (UNFCCC 2001). Under this agreement 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. Guyana has elected to classify land as forest if it meets the following criteria:

- Tree cover of minimum 30%
- Minimum height of 5 m
- Minimum area of 1 ha

It was recommended that based on Guyana's forest characteristics, where there is largely undisturbed primary forest and the remaining being sustainably managed forests, where trees are predominantly 5 m in height, the minimum threshold for this variable is recommended to be 5m. From a monitoring perspective. The use of the upper limit (5m) would require the lowest transaction cost with no added value of going down to 2m.

Approximately 50% of Guyana's State Forest Estate is unallocated for commercial utilization. The remaining 50% is subject to sustainable utilization whereby extraction levels are strictly monitored based on approved guidelines. Additionally, in logging activities selective harvesting is practiced, and it is unlikely that the crown cover would diminish to below 30%. An assessment of Guyana's forest land showed that 85% of the forest land has a crown cover of 20% and greater. It is envisaged, that the majority of future planned land use development activities, may involve clearing of areas that are of 10% to 30% canopy cover. In order to adequately provide for this in Guyana's forest definition, an appropriate range for this variable is required to be taken into account. As such, it is recommended for Guyana to adopt a 30% crown cover threshold in the definition of forest. Guyana's national greenhouse gas inventory is being aligned to also utilize this definition.

Guyana's forest management system builds from one (1) hectare area size, to one block (100) hectare to compartments. In this context, the minimum monitoring unit for Guyana is therefore 1 ha. Guyana considered the relative sizes of the resolution of the imagery to be used in monitoring forest area change, (the minimum mapping unit, MMU), and the specified minimum area to be defined as forest. One (1) hectare was thought to be the most ideal size to allow for effective monitoring of forest area change. It is also intended that deforestation be assessed using medium/high resolution image on a routine (annual or biennial) basis. Detecting area change that is 0.05ha to 0.5ha becomes difficult, costly and possibly imprecise at this resolution. In considering the selection of a MMU, it is important to note that the MMU is closely connected with a country's forest definition. It is important to note that Remote Sensing data analyses become more difficult and more expensive with smaller MMU, as this requires an increase in mapping efforts, which usually results in a decrease in mapping accuracy. In keeping with Guyana's consideration of 1 ha for measurement of land area under its forest definition, the MMU should also be 1 ha. This is also appropriate as the optimal option, because it will allow for the consistency in application of the forest definition and the MMU.

3.1.3 Scale

Guyana has opted to develop its RL at the national scale rather than developing subnational RLs due to its relatively small size and relatively centralized government structure. The advantage of a national approach is that the integration of separate subnational RLs and MRV systems is not necessary. Therefore, the process of developing a RL is simplified and can happen more quickly than if common standards and agreements had to be developed for subnational jurisdictions to use.

3.1.4 Pools/Gases

Pools for Guyana were selected separately for each activity included in the RL (Table 2). The selection of pools was based on the expected magnitude of the change in stock in a given pool as a result of deforestation as well as the resources required to collect accurate and precise data. For degradation caused by timber harvesting, the soil carbon pool was not included because it has been shown that selective logging has no impact on soil carbon over a large concession because of the small area impacted[8]. Litter was also not included in degradation because like the soil pool the impact is very small due to the small area impacted by timber harvesting.

The selection of greenhouse gases for Guyana includes CO_2 only. The exception is the non-CO2 gases (nitrous oxide, N_2O, and methane, CH_4) that are included in the estimates of emissions from fire based on the IPCC 2006 AFOLU method and factors and converted to CO_2e.

Table 2. Carbon pools selected to include in the RL according to activity.

Activity	AG Biomass	BG Biomass	Dead Wood	Litter	Soil Carbon	Harvested Wood Products
Deforestation	x	x	x	x	X	
Degradation from Timber Harvesting	x	x	x			x

3.1.5 Historic Time Period

Guyana has established the time period for historic emissions to be from 2001 to 2012, a total of 12 years. This period was selected because robust and credible activity data are available for both deforestation and for degradation from timber harvest for this whole period. Furthermore, there were very few data on forest carbon stocks from which to build on and all carbon data used to estimate emission factors for Guyana's forests have been collected during the period late 2010 to early 2014, and extending these data to represent carbon stocks of pre 2000 forests is a weak assumption. We recognize that the MOU with Government of Norway established a benchmark period of 1990 to 2009, with subsequent monitoring through 2012. However, as REDD+ programmes are in development, with the funds received from Norway to date being used to build local capacity, to develop and implement a monitoring system, and generally prepare Guyana for a REDD+ mechanism, it is expected that programmes in development, will impact on reducing emissions, in the period following 2012.

[8]Johnson, D. W. and P. S. Curtis. 2001. Effects of forest management on soil C and N storage: meta analysis. Forest Ecology and Management 140:227-238

3.1.6 IPCC Guidance

The IPCC 2003 IPCC Good Practice Guidance for Land Use, Land-use Change, and Forestry (GPG-LULUCF) and the IPCC 2006 Guidelines for National Greenhouse Gas Inventories Agriculture, Forestry and Other Land use (AFOLU)[9] were developed for use in preparing a national greenhouse gas inventory. No guidance has been made with respect to preparing and reporting on REDD+ related activities although in 2011 the UNFCCC Conference of Parties agreed[10] that the Biennial Update Reports for non-Annex 1 Parties (i.e. developing countries) should be based on the 2003 GPG including the Tables in Annex 3.A.2.However, Decision 12/CP.17 Annex states that information used to develop a RL should be guided by the most recent IPCC guidance and guidelines; thus Guyana refers to both IPCC reports (GPG and AFOLU).

Key concepts that the IPCC recommends countries address with respect to estimating emissions and removals, and how Guyana applies these concepts in developing their RL are described below:

- **Good Practice**: Inventories consistent with good practice are those that contain neither over- nor under-estimates as far as can be judged, and in which uncertainties are reduced as far as practicable. These requirements are intended to ensure that estimates of emissions by sources and removals by sinks, even if uncertain, are bona fide estimates, in the sense of not containing any biases that could have been identified and eliminated. Good practice entails the following five principles: 1) transparency—that documentation is sufficient for reviewers to assess the extent to which good practice requirements have been met; 2) completeness—all relevant emissions and removal categories are estimated and reported; 3) consistency—differences in emissions and removals between years are real and not an artifact of changes in methodology or data; 4) comparability—so that inventory estimates can be compared among countries; and 5) accuracy—methods used are designed to produce neither under or over estimate. Guyana has applied good practice to all its data collection and analyses efforts by:
    - Building local capacity in all aspects of data collection and analyses
    - Developing and implementing a QA/QC plan, including steps for checking internal self-consistency, checking against other independent estimates, standard operating procedures (SOPs) for field data collection, data analysis, processing remote sensing imagery, and data archiving
    - Establishing and achieving accuracy targets for interpretation of remote sensing imagery used to estimate rates of forest loss (activity data--AD)
    - Establishing and achieving accuracy and precision targets for field data collection and analyses for estimating emission factors (EFs).
    - All documents and data bases are available for inspection

- **Tiers**: A system of tiers has been developed by the IPCC to represent different levels of methodological complexity. Tier 1 is the basic method, Tier 2 is intermediate and Tier 3 is the most demanding in terms of complexity and data requirements.

  The higher order Tier 3 include models and inventory measurement systems tailored to address national circumstances, repeated over time, and driven by high-resolution activity data and disaggregated at sub-national level. Such systems may include comprehensive field sampling repeated at regular time intervals

[9]Available at http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.html. And http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html
[10]See Annex III to Decision 2/CP.17.

and/or GIS-based systems of age, class/production data, soils data, and land-use and management activity data, integrating several types of monitoring. Parcels of land where a land-use change occurs can usually be tracked over time, at least statistically. All models should undergo quality checks, audits, and validations and be thoroughly documented. Guyana is operating at Tier 2 to 3 levels for the following reasons:

- Wall-to-wall coverage of satellite imagery is used to obtain the AD related to conversion of forest lands to other uses. For the period 1990 to 2010 Guyana used primarily Landsat imagery with a variety of other sensors. Post-2010 AD is based on practically wall to wall monitoring using high resolution RapidEye imagery.
- All AD are disaggregated by the strata used for the field sampling design for EF estimation (e.g. threat for land use change, accessibility), and by the drivers (e.g. mining, infrastructure, converted to cropland, converted to settlements,).
- All AD data are combined and co-registered with other key spatial data bases in a GIS such as roads, rivers, settlements, vegetation class, location of logging concessions, location of mining concessions, topography, etc.
- A comprehensive, peer-reviewed, field sampling system was designed to attain a required precision target (95% confidence interval of <+/-15% of the mean carbon stock of forests) and implemented. The location of each sample plot was selected statistically through a series of steps in a GIS[11].
- A field sampling plan has been designed for long-term, repeated measurements of the forest carbon stocks and ongoing monitoring of forest cover change.
- The allometric model of Chave et al.[12] was validated for use in Guyana forests.

3.1.7 Adjust for National Circumstances

According to Decision 12/CP.17 II. Paragraph 9, countries can submit information and rationale on the development of forest RLs, including details of national circumstances and if adjusted include details on how the national circumstances were considered. Being a country with high forest cover and low deforestation, Guyana proposes to make adjustments to allow for national circumstances to take into account:

- Likely future emissions are not well captured by historical ones.
- Mining is a major driver of deforestation and rising mineral prices could create incentives that significantly impact rates of forest cover change caused by this driver.
- Logging is a cause of forest degradation and changes in timber demand and prices could create incentives that significantly impact emissions caused by this driver.
- Need for broad participation by Parties and to assure equity across countries.

[11]Brown, S., K. Goslee, F. Casarim, N. L. Harris, and S. Petrova. 2014. Sampling Design and Implementation Plan for Guyana's REDD+ Forest Carbon Monitoring System (FCMS): Version 2. Submitted by Winrock International to the Guyana Forestry Commission.

[12]Chave, J, C. Andalo, S. Brown, M.A. Cairns, J.Q. Chambers, D. Eamus, H. Folster, F. Fromard, N. Higuchi, T. Kira, J.P. Lescure, B.W. Nelson, H. Ogawa, H. Puig, B. Riera, T. Yamakura. 2005. Tree allometry and improved estimation of carbon stocks and balance in tropical forests. Oecologia 145:87-99.

Adjusting the historic emissions will be based on the application of empirically-driven economic models to arrive at estimates of supply and demand for timber harvesting (degradation) and mineral production. The supply and demand system identifies critical factors affecting timber harvesting and mineral extraction activities in Guyana during the historical period, and that information is used to project future timber harvests and mineral extraction rates given predictions of the exogenous variables. The outputs of the models are then linked to the CO2 emission factors to project future emissions for the 10-yr future period of 2013-2023.

4.0 ESTABLISHMENT OF GUYANA'S NATIONAL FOREST MONITORING SYSTEM

UNFCCC decisions[13] requests developing country Parties to establish, according to national circumstances and capabilities, robust and transparent national forest monitoring systems (NFMS) and, if appropriate, sub-national systems as part of national monitoring systems that:

- Use a combination of remote sensing and ground-based forest carbon inventory approaches for estimating, as appropriate, anthropogenic forest-related GHG emissions by sources and removals by sinks, forest carbon stocks and forest area changes
- Provide estimates that are transparent, consistent, as far as possible accurate, and that reduce uncertainties, taking into account national capabilities and capacities
- Are transparent and their results are available and suitable for review as agreed by the COP

Guyana's NFMS (referred to within Guyana as the Monitoring, Reporting, and Verification System –MRVS), which is composed of the Forest Area Assessment System and the Forest Carbon Monitoring System(FCMS), has been developed for data and information collection, such as information on historical forest cover changes and emission factors, to inform the assessment of national forest RLs. In this way, the MRVS forms the link between historical assessments and current/future assessments, enabling consistency in the data and information to support the implementation of REDD+ activities. The MRVS details the methods required to quantify the changes in forest cover and changes in forest carbon stocks in Guyana, develop driver-specific emission factors by forest strata, and monitor emissions from land cover/land use change over time based on a variety of management activities.

The activity data and emission factors generated from the MRVS for key categories are combined to estimate total CO_2 emissions by source or driver under Guyana's REDD+ programme. Table 3 provides an overview of each key category addressed by Guyana, including the associated drivers and the pools included in each IPCC required category.

Table 3. Overview of the IPCC categories, drivers, and pools used to estimate emission factors for each key category.

IPCC Category	Driver(s) as defined in MRVS	Pools included		
		Biomass	Dead organic matter	Soil

[13] Decision 4/CP.15 paragraph 1d and Decision 1/CP.16 paragraph 71(c)

Forest Land Remaining Forest Land	Degradation caused by logging	AG & BG tree	Dead wood caused by logging	Not included
Forest Land Converted to Cropland	Agriculture	AG & BG tree, saplings	Standing and lying dead wood, litter	Based on conversion to permanent agriculture
Forest Land Converted to Settlements	Infrastructure including mining roads and forestry Infrastructure	AG & BG tree, saplings	Standing and lying dead wood, litter	Based on conversion to unpaved roads
Forest Land Converted to Other Land	Mining (bare soil)	AG & BG tree, saplings	Standing and lying dead wood, litter	Based on conversion to mining
Biomass Burning in Forest Lands	Fire-Biomass burning	AG, saplings	Standing and lying dead wood, litter	Not included

4.1 Estimating Activity Data

4.1.1 Deforestation

Activity data (AD) are developed by estimating the extent of forest change measured by area in the case of deforestation. In the case of degradation, where it can often be difficult to accurately relate changes in carbon to changes in area, activity data may employ units other than area.

Forest area change has been estimated for forests converted to other lands (deforestation) for all drivers, based on IPCC Approach 3. The Guyana Forestry Commission, with the services of Pöyry and Indufor, has completed an historical assessment of forest area change—from forest to non-forest—for six periods: 1990-2000, 2001-2005, 2006-September 2009, October 2009- September 2010, October 2010- December 2011, and January to December 2012. The analyses for these six periods were done by the same team of people using consistent methods. For the first four periods Landsat imagery was used, for the fifth period it was a combination of Landsat and Rapideye, and for the sixth reporting year wall-to-wall high resolution Rapideye imagery was used[14]. The use of higher resolution imagery in the most recent time frame allowed for higher accuracy of interpretation in this period and for a re-evaluation of the total forest area for the previous years. All remote sensing products have been assessed for accuracy (accuracy on forest area of >97%) and verified independently by a 3rd party and all steps certified by an external auditors.

For each of time period up to September 2010, 30 meter resolution satellite imagery was used to quantify deforestation resulting from various drivers including mining, agriculture, forestry infrastructure, road infrastructure, and fire. For the October 2010 to December 2011 period, 5 meter resolution RapidEye imagery was also used for half of Guyana's land area with the 30 m imagery, and full wall-to-wall coverage with RapidEye

[14] GFC and Indufor 2013, Guyana REDD+ Monitoring Reporting & Verification System (MRVS); Year 3 Interim Measures Report 01 January 2012 – 31 December 2012.

for 2012. GFC will conduct future monitoring of deforestation with medium/high resolution imagery and a product that gives similar quality and detail in functionality.

One driver of forest degradation, selective logging, is included in the MRVS at present, whilst work is ongoing to collate data for the other drivers of forest degradation. These activity data were estimated from two sources: (1) the areas cleared for forestry infrastructure (roads and log decks) from the analysis of remote sensing imagery and (2) the volume of timber removed during commercial logging and the length of skid trails, based on records available from GFC. The MRVS does not currently address other lands converted to forest (reforestation), though this may be included in the future. Activities used to determine forest area and area change and the findings are described in complete detail in reports by GFC and Pöyry (2011) and GFC and Indufor (2012, 2013)[15].

4.1.2 Degradation

The additional activity data for selective logging were obtained from records from the GFC. The GFC reports on volume of timber extracted, by the primary product class (Table 4) from its concessions and the length of the skid trails planned to extract the timber to the logging decks[16]. All timber data are converted to cubic meters over bark using a variety of factors, and summed to give a total timber production for each year.

Table 4. Primary product classes tracked by GFC and their conversion factors to obtain true volume under-bark in cubic meters. All volumes were converted to over-bark by multiplying under-bark by 1.12 (from IPCC 2006AFOLU).

[15] GFC and Indufor 2013, Guyana REDD+ Monitoring Reporting & Verification System (MRVS); Year 3 Interim Measures Report 01 January 2012 – 31 December 2012. Available from the GFC. Indufor, 2012. Guyana Forestry Commission Guyana REDD+ Monitoring Reporting & Verification System (MRVS) Interim Measures Report, 01 October 2010 – 31 December 2011. Joint report between Indufor and the Guyana Forestry Commission. Pöyry Management Consulting Ltd (Pöyry).2011.Guyana Forestry Commission REDD+ Measurement Reporting Verification System (MRVS) Interim Measures report. Joint report between Pöyry and the Guyana Forestry Commission (GFC).

[16] See section 9.7 in GFC and Indufor 2013, cited above in footnote 12, for more details.

Product		Description
Logs 1000 m^3/yr	Production	Log is a main product produced and is not a subset of any category. This volume that is declared is the hoppus volume that discounts a part of the log to provide for the taper factor. To determine the true volume of logs, it is recommended to multiply this by 1.278%.
Sawnwood 1000 m^3/yr*	Production	This category of production is a stand along category and is in addition to Logs. That is, it is not a sub set of the Logs category. This is the case since, Guyana's Forest Act allows for forest concessionaires to declare harvested timber in logs as well as Primary Lumber which is largely Chainsawn Lumber or Portable Mill produced lumber. To derive a total harvested volume quantity, this has to be ADDED to Logs harvested. Note that the conversion rate of Logs to Lumber of 50% therefore, to derive this total of production, it would have taken twice as much of log volume.
Roundwood (Piles, Poles, Posts, Spars) 1000 m^3/yr	Production	This is a separate category. Not a subset of Logs or Primary Lumber. Needs to be added to Logs and Primary Lumber to generate a total of harvested timber.
Splitwood (Staves, Shingles 1000 m^3/yr)	Production	This is a separate category and only includes non factory manufactured splitwood. Not a subset of Logs or Primary Lumber. Needs to be added to Logs, Primary Lumber and Roundwood to generate a total of harvested timber.

4.2 Estimating emission factors

4.2.1 Deforestation

Field data have been collected to estimate forest carbon stocks and for use in estimating emission factors for all drivers of deforestation and for degradation resulting from selective logging. Carbon stocks are estimated for all pools (cf. Table 2 and 3), using country-specific data and conversion factors, and an allometric equation[17] verified through destructive sampling of four large trees, resulting in emission factors that meet IPCC's requirements for Tier 3.

Stratification of Guyana's forest lands is a key step for developing a cost effective sampling plan and increasing the accuracy and precision of the resulting emission factors for deforestation. Estimating GHG emissions across Guyana as a whole is not possible without consideration of how carbon stocks are distributed across the country with respect to specific drivers or agents of forest land cover/use change and other physiognomic features of the landscape (i.e., forest type, elevation, soils composition, etc.). Often forest carbon stocks vary based on forest type, and because Guyana has diverse forests, initial attempts at stratification incorporated forest type. However, estimates of carbon stocks for different forest types based on measurements collected from preliminary plots were

[17]Chave, J, C. Andalo, S. Brown, M.A. Cairns, J.Q. Chambers, D. Eamus, H. Folster, F. Fromard, N. Higuchi, T. Kira, J.P. Lescure, B.W. Nelson, H. Ogawa, H. Puig, B. Riera, T. Yamakura. 2005. Tree allometry and improved estimation of carbon stocks and balance in tropical forests. Oecologia 145:87-99.

not significantly different across the multiple forest types in Guyana[18]. Differences in drivers of forest cover change, however, do result in differences in changes in carbon stocks and thus emission factors. In addition, different land-use histories as a result of accessibility such as proximity to roads and population centers can also lead to different forest carbon stocks and resulting emission factors.

A key first step in estimating emissions factors for deforestation was to use a stratified sampling design applied to the forests of Guyana. A stratified sampling design allows for maximum flexibility in designing a sampling protocol within each stratum that is tailored to the desired level of precision—for Guyana the target is a 95% confidence interval of ±<15% of mean--as well as the time and resources available to collect the data. Stratification criteria for the FCMS include both *ecological considerations* that affect how much carbon is contained within in a given area of land as well as *human pressure considerations* related to how the land is being used (and how it will be used in the future). For example, it is desirable to group all lands of similar carbon stocks together that are under similarly high pressure of future deforestation into one stratum, and other lands that are of similar carbon stocks but under little to no pressure into a separate stratum. In this way, resources can be optimized so that sampling intensity is greater (thus precision is higher) in the areas most likely to undergo change in the future.

An overarching spatial analysis framework, operating in a Geographical Information System (GIS) was used to create a Potential for Future Change (PFC) stratification system that developed a relationship between the historical deforestation pattern and the spatially represented factors of deforestation. This method of stratification aims to understand which forest change factors, or combinations of factors, contribute most significantly to the historical pattern of deforestation. Humans tend to deforest areas that are close to roads and settlements (accessible for clearing), clearly demarcating some areas as having high potential for future change and others low potential. Two recent historical periods, 2000-2005 and 2005-2009, were considered for defining the pattern of forest change. The PFC spatial analysis framework and the specific techniques are discussed in the spatial techniques report[19].This PFC framework resulted in the identification of three strata based on their potential for future change—high (HPfC), medium (MPfC), and low (LPfC) potential for change (Figure 1).

In addition to stratifying by potential for change, the forests were also stratified by accessibility. A large portion of Guyana's forestland is not easily accessible and the purpose of the sampling stratification is to overcome some operational constraints while maintaining robust sampling results. Therefore, the factor of accessibility was introduced in the sampling stratification methodology to provide a forest carbon sampling framework that allows for efficient collection of data. The accessibility strata were also included, because, given the long history of logging in Guyana, our initial working assumption was that areas near roads would have been disturbed and have lower carbon stocks than those areas far from roads. The more accessible (MA) stratum is defined as 5 km straight-line distance from both sides of roads for a total of 10 km, a distance which allows a field team of 4 or 5 people to travel to the sampling point and return to the road within one day. The less accessible (LA) stratum is defined as all forestland outside the 5 km road buffer were likely little disturbed (Figure 1).

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[18] Section 3.7.5 in Brown, S., K. Goslee, F. Casarim, N. L. Harris, and S. Petrova. 2014. Sampling Design and Implementation Plan for Guyana's REDD+ Forest Carbon Monitoring System (FCMS): Version 2. Submitted by Winrock International to the Guyana Forestry Commission.

[19] Petrova S., K. Goslee, N. Harris, and S. Brown. 2013 Spatial Analysis for Forest Carbon Stratification and Sample Design for Guyana's FCMS: Version 2. Submitted by Winrock International to the Guyana Forestry Commission.

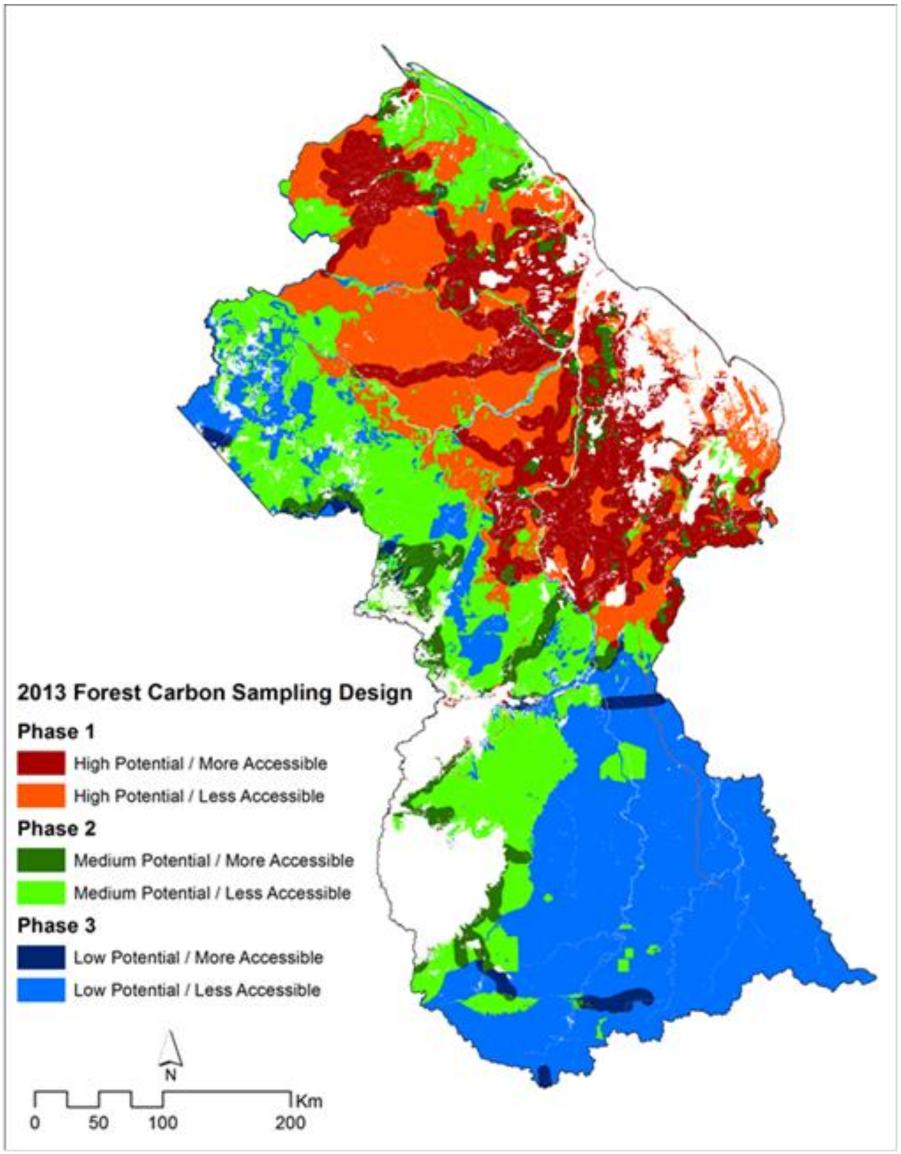


Figure 1.Stratification of Guyana's forest area by deforestation threat, or potential for future change.

The number of sampling plots and the design of the plots was determined by a preliminary sampling process that randomly located plots across various forest types identified in the Guyana vegetation map, and across a latitude and longitude gradient. Different sampling methods were tested aiming at the optimum design, balancing data collection with precision, robustness, efficiency and scientific integrity. Single plots and cluster plots (a cluster of four plots) were tested during preliminary data collection. Results from the preliminary field work, indicated that cluster plots were most appropriate because when compared to single plots, results showed improvement in precision across plots, reduction of variability within plots, and reduction in travel time in sampling for reaching the precision target. The results also showed that there were no significant differences in carbon stocks among the main forest types and that stratification by forest type was not necessary[20].

Sampling Design

For Guyana's carbon stock assessment, a stratified two-stage list sampling design with clustered plots was used. In this approach, the country is divided into 10 km x 10 km blocks (primary sampling units-PSUs). The PSUs within each stratum are selected using stratified two-stage list sampling design for carbon measurement—referred to as Stage 1(Figure 2). Secondary sampling units (SSUs) designed as L-shaped cluster of four subplots are established within each PSU and carbon measurements are obtained (Figure 3). Stage 2 is the random selection of SSUs within the PSUs. This design allows for the selection of a subset of primary sampling units (PSUs) in which clustered plots (SSUs) can be established. This allows field crews to achieve higher sample sizes at relatively low cost. This approach provides an efficient inventory that is well distributed across the landscape[21]. To implement a stratified approach each stratum should be considered separately and the number of PSUs to be sampled varied by stratum.

Based on the preliminary field data of carbon stock measurements, it was estimated that 35 SSU cluster plots in the HPfC stratum should be measured to attain the selected precision target (95% confidence interval of <15% of the mean). However, a total of 36 PSU/SSUs were pre-selected for the MA and 26 for the LA in case the carbon stocks were more variable than originally estimated in the preliminary sampling. These steps were repeated for the MPfC MA and LA strata. No PSUs/SSUs have been selected for the LPfC stratum at this time because this area is under low threat for forest cover change and it is of low priority until that time when significant deforestation (>100 ha) activities are found to occur by the remote sensing monitoring. Further details are given in Brown et al. 2014. (cf footnote 19).

[20]Brown, S., K. Goslee, F. Casarim, N. L. Harris, and S. Petrova. 2014. Sampling Design and Implementation Plan for Guyana's REDD+ Forest Carbon Monitoring System (FCMS): Version 2. Submitted by Winrock International to the Guyana Forestry Commission.

[21]Tomppo, E. and M. Katila. 2008. Comparing alternative sampling designs for national and regional forest monitoring. Appendix 4 in Tomppo, E. and K. Andersson, Technical review of FAO's approach and methods for national forest monitoring and assessment (NFMA), NFMA Working Paper No. 38, Rome, 2008.

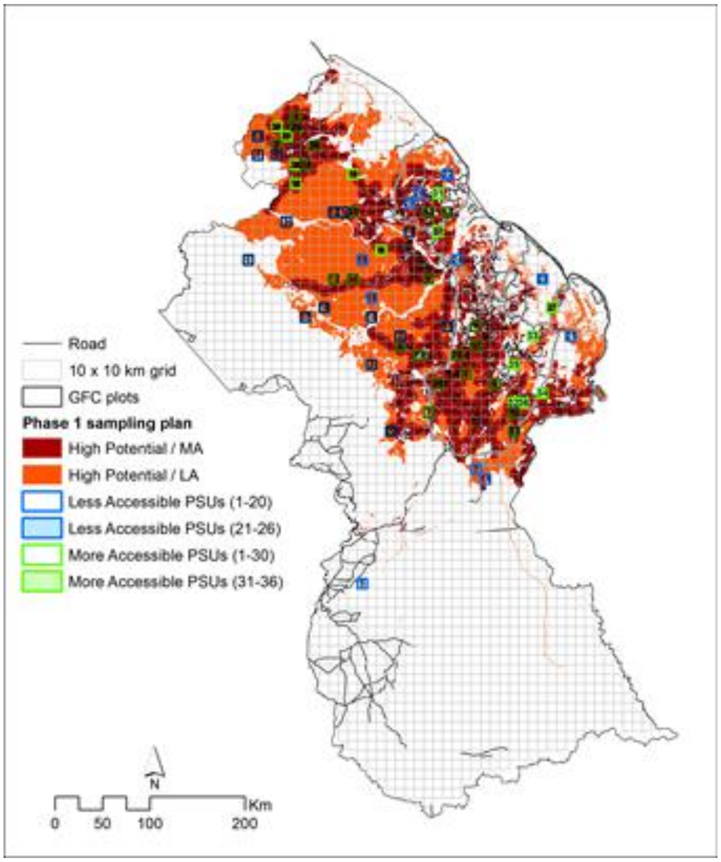


Figure 2. Example of the stratified two-stage list sampling design with clustered plots for the High Potential for Change More Accessible (MA) and Less Accessible (LA) strata.

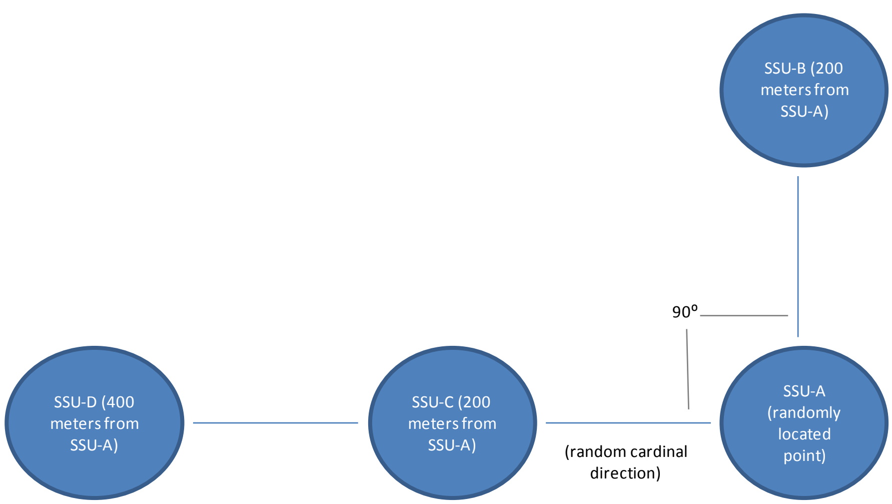


Figure 3. Layout of the four subplots that comprises a Secondary Sampling Unit (SSU) cluster plot. Each subplot consists of 4 nested plots ranging in size of 2 m radius

for saplings, 6 m radius for trees 5-25 cm DBH, 14 m radius for trees 25-50 cm DBH, and 20 m radius for trees >50 cm DBH.

The area of each stratum and number of cluster sample plots actually measured is given in Table 5. Based on this stratification system, data collection efforts were divided into three phases: the HPfC stratum first (Phase 1), followed by the MPfC stratum (Phase 2), and then the low priority LPfC (Phase 3) (Figure 1). To date all field work has been completed for Phase 1 and 2.

Table 5(a).Area of each sampling strata

Forest Carbon Sampling strata		Area (ha)	Number of sample plots
High potential for change	More accessible	3,165,731	26
HPfC	Less accessible	3,096,270	16
Medium potential for change	More accessible	960,633	11
MPfC	Less accessible	4,267,988	13
Low potential for change	More accessible	262,014	--
LPfC	Less accessible	5,872,574	--

Table 5(b). Total Forest Carbon Stock in Guyana's Forest

Forest Carbon Sampling strata		Area (ha)*	C stock per stratum t C/ha	Total stock tC
High potential for change	More accessible	3,165,731	259.8	822,456,914
HPfC	Less accessible	3,096,270	351	1,086,790,770
Medium potential for change	More accessible	960,633	300	288,189,900
MPfC	Less accessible	4,267,988	300	1,280,396,400
Low potential for change	More accessible	262,014	300	78,604,200
LPfC	Less accessible	5,872,574	300	1,761,772,200
TOTAL		**17,625,210**		**5,318,210,384**

**Total area of forest in deforestation mapping utilizes updated RapidEye Imagery accounting for the slightly increased total forest area that that recorded in the forest carbon stratification map which utilizes Landsat imagery.*

A complete description of the methods used for data collection is available in Brown et al. (2014) and the field data used to estimate emission factors are described in Goslee et al (2014)[22].

4.2.2 Degradation

Emissions due to degradation from selective logging were estimated through the development of emission factors related to the volume of timber extracted (in m^3 over bark). Sampling was conducted on active concessions across Guyana to determine the loss of carbon stocks through harvesting and collateral damage in the gaps and skid trails. Losses were assessed with data collected from "logging plots" and skid trails.

The carbon emissions from logging in Guyana can vary as a function of different logging intensities and practices, defined by stand re-entry, extraction rates, and reduced impact logging practices. These differences are captured in the types of concessions, classed as large, medium, and small scale concessions. The main difference between these different concessions is related to the amount of timber extracted per hectare and the re-entry period.

The goal of this component was to develop emission factors relating total biomass carbon damaged, and thus carbon emissions, to the volume of timber extracted and based on the method in Pearson et al[23]. This method allows for the estimation of the total emissions generated by selective logging for different concession sizes across the entirety of Guyana, and was implemented by:

1. Measuring, on a sample of logging gaps (183 plots across four large scale commercial concessions), the extracted volume and carbon in the timber tree and the incidental carbon damage to surrounding trees;
2. Estimating the carbon impact caused by construction of skid trails. (Although selective logging clears forest for roads and decks, their emissions will be estimated under the deforestation component.)

Estimating the total impact of selective logging on carbon stocks involves quantifying a number of different components:

- Volume and biomass removed in the commercial tree felled – emission;
- Dead wood created as a result of tree felling – emission;
- Damage from logging infrastructure – emission;
- Carbon stored in long term wood products from extracted timber – removal;

Carbon loss or change in live and dead biomass between the "before-logging" and "after-logging" scenario is a result of the felling of the timber tree, extraction of timber volume, the damage caused to residual trees from the logging activities, and the extraction of trees due to construction of skid trails. This is expressed in equation forms as follows

$$\textit{\textbf{Emissions, t C/yr}} = \underbrace{[Vol \times WD \times CF \times (1-C_{LTP})]}_{(1)} + \underbrace{[Vol \times LDF]}_{(2)} + \underbrace{[Vol \times LIF]}_{(3)} \qquad \text{(Eq.1)}$$

[22]Goslee, K., S. Brown, and F. Casarim, 2014. Forest Carbon Monitoring System: Emission Factors and their Uncertainties, Version 2. Submitted by Winrock International to the Guyana Forestry Commission.

[23] Pearson, TRH, S Brown, and FM Casarim. 2014. Carbon emissions from tropical forest degradation caused by logging. Environ, Res. Lett 9 034017 (11 pp) doi:10.1088/1748-9326/9/3/034017

Where:

Vol = volume timber over bark extracted (m^3yr^{-1})

WD = wood density ($t\ m^{-3}$)

CF = carbon fraction, the proportion of biomass that is carbon - 0.5 (IPCC 2003 GPG and 2006 AFOLU)

C_{LTP} = proportion of extracted carbon in long term products still in use after 100 yr (dimensionless)

LDF = logging damage factor—dead biomass left behind in gap from felled tree and collateral damage ($t\ C\ m^{-3}$)

LIF = logging infrastructure factor—dead biomass caused by construction of skid trails ($t\ C\ m^{-3}$)

The proportion of carbon in wood stored at long-term products is given as:

$$C_{LTP,i} = (1 - WW_i) * (1 - SLF_i) * (1 - OF_i)$$

Where:

i	wood product classes of sawnwood, woodbase panels and other industrial roundwood
WW_i	Fraction of biomass effectively emitted to the atmosphere during production of wood product i (wood waste)
SLF_i	Fraction of wood products that will be emitted to the atmosphere within 5 years of production of product i
OF_i	Fraction of wood products that will be emitted to the atmosphere between 5 and 100 years after production of product i

The values of the fractions used to estimate C_{LTP}in this analysis are[24]:

Product class	WW	SLF	OF 100yr
Sawnwood	0.50	0.20	0.84
Woodbase panels	0.50	0.10	0.94
Other industrial roundwood	0.50	0.30	0.99

Field measurements are collected from logging plots to quantify components (1) and (2) in Eq. 1 above. To quantify the biomass carbon that is damaged and dead as a result of constructing the skid trails (component (3) in above equation), measurements of the average width of skid trails and the forest carbon stocks damaged during the construction of trails are made.

Because of the need to collect data at plots located exactly where a tree has been felled, it is not possible to establish completely random plots across Guyana. Rather, plots are located at sites of recently felled trees in

[24] From Winjum, J. K., S. Brown, and B. Schlamadinger. 1998. Forest harvests and wood products: sources and sinks of atmospheric carbon dioxide. Forest Science 44:272-284.

concessions, and the volume and biomass removed in commercial logs is determined. In addition, for the measurement of damage that results from tree felling, it is not possible to establish a set plot size. Instead, one or more felled trees that create one gap define a "logging plot", and it is necessary to identify and measure all of the surrounding trees damaged during the felling in a given gap. In this way, it is possible to calculate carbon emissions per unit of volume extracted in commercial trees[25].

5.0 HISTORICAL EMISSIONS

5.1 Deforestation

5.1.1 Activity Data

It is clear that most of the past deforestation has occurred in the HPfC stratum where about 75.5 thousand ha have been cleared between 2001 to 2012 compared to 7.5 thousand ha in the MPfC stratum, and only 1.1 thousand ha in the LPfC stratum during the same time period (Table 6). Moreover, annual amounts of clearing have generally been increasing over the same time period.

For the HPfC stratum about twice as much deforestation occurred in the MA stratum than in the LA (50 thousand ha vs 25 thousand ha). However, in the MPfC stratum, more than twice as much deforestation occurred in the LA area than in the MA area, and this is likely due to the much larger area of inaccessible forest in this stratum.

The period selected for developing the historic emissions is 2001 to 2012.

[25] Further details of all field measurements and analyses are given in are given in SOPs 17-22 in Casarim FM, K Goslee, S Petrova, S Brown, H Sukhdeo, and C Bhojedat. 2014 Standard Operating Procedures for the Forest Carbon Monitoring System of Guyana. Winrock International; and Casarim F., K. Goslee, and S. Brown, 2014. User Manual for Calculating Emission Factors with Guyana's Selective Logging Tool. Submitted by Winrock International to the Guyana Forestry Commission.

Table 6. Historical activity data for deforestation by driver and stratum

Stratum	Driver	Area of forest change (ha)				
		2001-2005	2006-2009	2009-2010	2011	2012
Number of years		5	4.8	1	1.25	1
HPfC-MA	Forestry infrastructure	6,426	2,950	255	184	163
	Agriculture	947	68	15	31	257
	Mining (medium and large scale)	12,310	6,814	3,836	4,005	6,283
	Mining infrastructure	1,630	777	312	331	485
	Infrastructure	1,937	105	9	128	21
	Fire-Biomass burning	89	-	-	-	141
HPfC-LA	Forestry infrastructure	690	299	36	25	65.37
	Agriculture	1,776	1,729	498	20	167
	Mining (medium and large scale)	3,263	2,600	3,764	3,560	4,522
	Mining infrastructure	99	186	193	525	729
	Infrastructure	45	-	-	154	28
	Fire-Biomass burning	47	-	-	-	-
Total across drivers		29,259	15,528	8,917	8,963	12,863
Annual Average		5,852	3,235	8,917	7,171	12,863
MPfC-MA	Forestry infrastructure	117	310	3	11	7
	Agriculture	83	-	-	1	0
	Mining (medium and large scale)	979	222	98	73	149
	Mining infrastructure	-	50	5	8	12
	Infrastructure	90	57	8	26	27
	Fire-Biomass burning	-	-	32	6	37
MPfC-LA	Forestry infrastructure	98	39	-	14	4.08
	Agriculture	21	0	-	-	14
	Mining (medium and large scale)	1,073	962	859	403	961
	Mining infrastructure	24	20	26	113	188
	Infrastructure	-	33	45	60	30
	Fire-Biomass burning	99	-	-	-	5
Total across drivers		2,585	1,693	1,075	715	1,434
Annual Average		517	353	1,075	572	1,434
LPfC-MA	Forestry infrastructure	-	1	-	0	1
	Agriculture	0	-	-	-	-
	Mining (medium and large scale)	57	9	-	6	2
	Mining infrastructure	-	-	-	-	-
	Infrastructure	0	-	-	-	2
	Fire-Biomass burning	-	-	-	-	-
LPfC-LA	Forestry infrastructure	-	-	-	1	0
	Agriculture	25	-	-	-	-
	Mining (medium and large scale)	253	196	275	138	101
	Mining infrastructure	-	7	-	10	16
	Infrastructure	-	-	2	4	19
	Fire-Biomass burning	-	-	-	-	-
Total across drivers		335	212	276	158	141
Annual Average		67	44	276	126	141

5.1.2 Emission Factors

The carbon stock of Guyana's forests is high in comparison to many other tropical forests around the world, averaging about 300 t C/ha (Table 7), with more than 74% in the aboveground biomass. As expected forests in the MA stratum of the HPfC had the lowest stock, and the LA stratum forests of the HPfC contained the highest stock. There was not statistical difference in forests C stocks between the MA (300.3 t C/ha) and LA (299.9 t C/ha) of the MPfC stratum, thus the two were combined (Table 7). No field data have been collected for the LPfC stratum and thus the C stocks for the MPfC stratum will be used for this area at this time.

The total C stock of Guyana forests, excluding soil, is 5.32 billion t C (product of area and C stock by stratum). The vast majority of carbon resides in the tree pool (above- and belowground biomass) and the soil carbon pool (Table 7). The carbon stock of all the other biomass pools represents 6-8% of the total biomass pool.

The targeted 95% confidence interval was <+/-15% of the mean total carbon stock, excluding soil. The target was achieved in all strata.

Table 7. Carbon stocks in the selected pools in Guyana's forests in the high (HPfC) and medium (MPfC) potential for change forests. MA=more accessible stratum and LA=less accessible stratum. The values in parentheses are the 95% Confidence Interval expressed as a percent of the mean

Carbon Pool	HPfC		MPfC
	MA	LA	MA&LA
	Carbon Stocks (t C ha^{-1})		
Aboveground Tree	193.6	267.6	231.1
Belowground Tree	45.5	62.9	54.3
Saplings	4.2	4.1	3.5
Litter	3.3	5.6	3.2
Dead Wood	13.1	10.8	7.9
Total (without soil)	259.8 (7.8%)	351.0 (10.1%)	300.0 (12.1%)
Soil Carbon (top 30 cm)	99.3 (21.6%)	80.3 (17.4%)	96.5 (21%)

The emission factors for deforestation were calculated as:

$$EF_{deforestaton} = \{C_{AGB} + C_{BGB} + C_{LIT} + C_{DW} + C_{sap} + [C_{soil} - (C_{soil} \times F_{LU} \times F_{MG} \times F_I)]\} \times \frac{44}{12} \quad \text{(Eq.2)}$$

Where:

$EF_{deforestation}$ = gross emission factor for deforestation; t C ha^{-1}

C_{AGB} = Carbon stock in aboveground biomass pool; t C ha^{-1}

C_{BGB} = Carbon stock in belowground biomass pool; t C ha^{-1}

C_{LIT} = Carbon stock in litter pool; t C ha^{-1}

C_{DW}	= Carbon stock in dead wood pool; t C ha^{-1}
C_{sap}	= Carbon stock in saplings; t C ha^{-1}
C_{soil}	= Carbon stock in soil organic carbon pool (to 30 cm); t C ha^{-1}
F_{LU}	= stock change factor for land-use systems for a particular land-use, dimensionless
F_{MG}	= stock change factor for management regime, dimensionless
F_I	= stock change factor for input of organic matter, dimensionless

The values of F_{LU}, F_{MG}, and $F_I$used for different activities in Guyana are as follows[26]:

Converted to	F_{LU}	F_{MG}	F_I
Permanent agriculture	0.48	1.00	1.00
Unpaved roads	0.82	1.00	0.92
Mining	0.82	1.00	0.92

The change in carbon stocks in the top 30 cm of soil was calculated as the difference between the soil carbon stock before conversion and the soil carbon stock 20 years after conversion (time it takes to reach new steady state), where the soil carbon stock after conversion was estimated based on land use, management and input factors as given in above table. All mining and logging roads are unpaved and the same factors were used for both types of roads. For simplicity in accounting, we assume the full emission of soil carbon in the year of clearing, rather than spreading the emission over 20 years as suggested by IPCC 2006 (AFOLU).

The emission factors resulting from the application of Equation 2 are based on the assumption that all of the biomass carbon is emitted in the year of the event—commonly referred to as committed emissions. The emission factor for fire is calculated using equation 2.27 in the IPCC 2006 AFOLU report.

The variation in emission factors (Table 8) is based on differences in total C stocks of the forest strata and on the different soil factors.

[26] From Table 5.5 in IPCC 2006 AFOLU, Vol. 4, Ch. 5.

Table 8. Emission factors for deforestation by driver and stratum

Stratum	Drivers	t CO_2 ha^{-1}
HPfC -MA	Forestry infrastructure	1,042
	Agriculture	1,142
	Mining (medium and large scale)	1,042
	Mining infrastructure	1,042
	Infrastructure	1,042
	Fire-Biomass burning	775
HPfC-LA	Forestry infrastructure	1,359
	Agriculture	1,440
	Mining (medium and large scale)	1,359
	Mining infrastructure	1,359
	Infrastructure	1,359
	Fire-Biomass burning	1,043

Stratum	Drivers	t CO_2 ha^{-1}
Medium Potential for Change (ALL)	Forestry infrastructure	1,187
	Agriculture	1,284
	Mining (medium and large scale)	1,187
	Mining infrastructure	1,187
	Infrastructure	1,187
	Fire-Biomass burning	889

5.1.3 Historical Emissions

The activity data and emission factors for deforestation were combined to provide estimates of the historical emissions for the period 2001-2012 (Table 9). The total emissions from deforestation between 2001-2012 were **97.1 million t CO_2**. The average annual CO_2 emissions from deforestation over the whole period were **8.09 million t CO_2 yr^{-1}**. To provide estimates of annual emissions for each year, the total emission for 2006-2009 were divided by 4 yr instead of the 4.8 yr covered by the remote sensing data and the emissions for 2010-2011 were divided by 1 yr instead of 1.25 yr covered by the remote sensing data, resulting in a total emission period of 12 yr.

About 90% of the total emissions were from deforestation in the HPfC stratum, with 9% occurring in the MPfC and only 1% in the LPfC strata. Emissions from medium and large scale mining and mining infrastructure accounted for 76% of the total emissions, followed by forestry infrastructure (13%) and agriculture (8%); emissions from fire are insignificant at <0.3%.

Table 9. Total emissions for historical period 2001-2012, by driver and stratum.

Stratum	Drivers	Emissions (t CO_2)				
		2001-2005	2006-2009	2009-2010	2010-2011	2012
Number of years		5	4.8	1	1.25	1
HPfC-MA	Forestry infrastructure	6,695,548	3,074,194	265,675	191,303	170,168
	Agriculture	1,081,277	77,404	17,173	35,248	293,654
	Mining (medium and large)	12,827,064	7,100,024	3,996,875	4,173,189	6,546,647
	Mining infrastructure	1,698,452	809,206	325,515	344,839	505,368
	Infrastructure	2,018,657	109,086	9,160	133,610	22,038
	Fire-Biomass burning	68,698	-	-	-	
HPfC-LA	Forestry infrastructure	937,592	406,748	49,098	34,273	88,867
	Agriculture	2,558,320	2,490,724	716,580	29,236	240,979
	Mining (medium and large)	4,435,916	3,534,430	5,116,731	4,839,022	6,147,347
	Mining infrastructure	135,047	252,822	262,369	714,141	991,025
	Infrastructure	60,917	-	-	209,702	38,649
	Fire-Biomass burning	48,709	-	-	-	-
HPfC TOTAL		32,566,197	17,854,639	10,759,178	10,704,562	15,044,742
MPfC-MA&LA	Forestry infrastructure	255,182	413,694	3,357	28,900	12,901
	Agriculture	133,928	13	0	1,798	18,720
	Mining (medium & large)	2,436,338	1,405,499	1,135,599	564,663	1,316,720
	Mining infrastructure	28,651	83,760	36,838	144,074	237,824
	Infrastructure	106,481	106,866	62,386	102,391	66,910
	Fire-Biomass burning	88,292	0	28,551	4,996	37,684
MPfC TOTAL		3,048,871	2,009,832	1,266,732	846,821	1,690,758
LPfC-MA&LA	Forestry infrastructure	0	1,590	0	1,242	878
	Agriculture	32,535	0	0	0	0
	Mining (medium & large)	366,907	242,215	325,889	170,481	122,196
	Mining infrastructure	0	7,952	0	11,275	19,417
	Infrastructure	344	0	1,804	4,451	25,096
	Fire-Biomass burning	0	0	0	0	0
LPfC TOTAL		399,787	251,758	327,693	187,449	167,587
ALL	Forestry infrastructure	7,888,322	3,896,227	318,131	255,718	272,815
	Agriculture	3,806,060	2,568,142	733,753	66,282	553,353
	Mining (medium & large)	20,066,226	12,282,167	10,575,095	9,747,355	14,132,909
	Mining infrastructure	1,862,151	1,153,740	624,723	1,214,329	1,753,633
	Infrastructure	2,186,400	215,953	73,351	450,153	152,693
	Fire-Biomass burning	205,698	0	28,551	4,996	37,684
TOTAL		**36,014,856**	**20,116,229**	**12,353,603**	**11,738,832**	**16,903,087**
ALL	Forestry infrastructure	1,577,664	974,057	318,131	255,718	272,815
	Agriculture	761,212	642,035	733,753	66,282	553,353
	Mining (medium & large)	4,013,245	3,070,542	10,575,095	9,747,355	14,132,909
	Mining infrastructure	372,430	288,435	624,723	1,214,329	1,753,633
	Infrastructure	437,280	53,988	73,351	450,153	152,693
	Fire-Biomass burning	41,140	0	28,551	4,996	37,684
ANNUAL TOTAL		**7,202,971**	**5,029,057**	**12,353,603**	**11,738,832**	**16,903,087**

Average annual emissions have increased over the period 2001-2012 at a rate of approximately 0.96 million t CO_2 per year (the slope of the line in Fig. 4). The upward trend is statistically significant but is limited and is driven by the large increase in mining activity after the unprecedented increase in the price of gold following the global financial crisis. No significant upward pressure was exerted by other drivers, for example by agriculture or large scale infrastructure development – despite the existence of opportunities to permit these drivers.

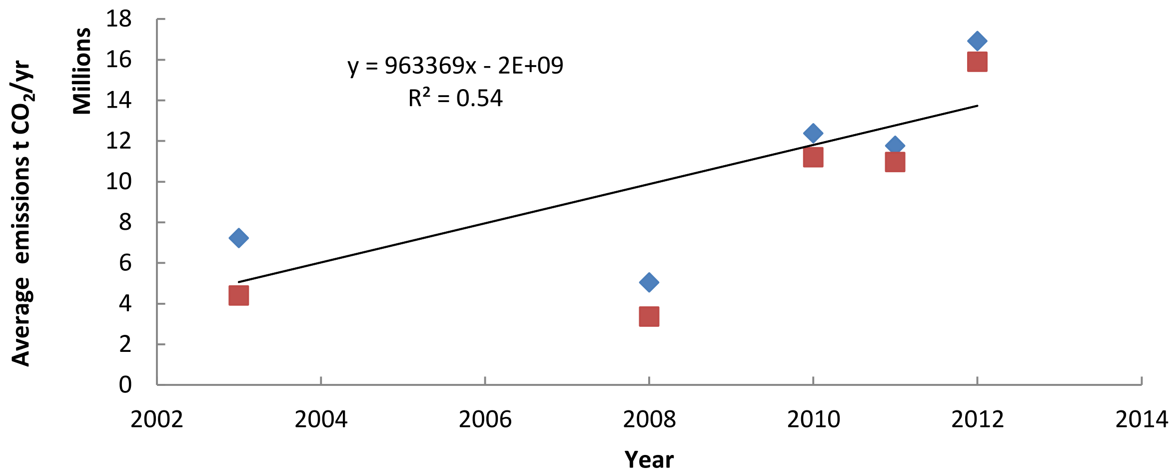


Figure 4. Average annual CO_2 emissions for the period 2001-2012 caused by deforestation. The midpoint of 2001-2005 was assumed to be 2003, and the midpoint of 2006-2009 was assumed to be 2008. The blue symbols =total emissions; red symbols =emissions from mining & mining infrastructure.

5.1.4 Uncertainty in deforestation emissions

The remote sensing products produced by Pöyry, Indufor and GFC team were verified and their accuracy assessed [27] Based on the verification of the remote sensing products, the estimated accuracy was >97% or a conservative uncertainty of 3%.

The uncertainty of the total emissions for deforestation is **a 95% confidence interval of ±9.6%**.This is based on application of the error propagation equation in Ch.5 of the IPCC GPG (2003) applied to each stratum (see the Uncertainty tab and Total Emissions tab in the Excel file:Final historic emission tool). At this stage the uncertainty in soil emissions is not included but the total uncertainty with inclusion of soil is not expected to be too different because the emissions from soil are <3% of the total.

[27] GFC and Indufor 2013, Guyana REDD+ Monitoring Reporting & Verification System (MRVS); Year 3 Interim Measures Report 01 January 2012 – 31 December 2012.

5.2 Degradation

5.2.1 Activity Data

As mentioned above, selective logging is the only driver of degradation that is included in the assessment of historical emissions. Robust activity data are available from 2001 to 2012. Selective logging, unlike deforestation, has a number of different data sources used to estimate emission factors and activity data.

These activity data include the volume of wood products and the length of skid trails (Table 10).

Table 10. Activity data for timber harvesting used for developing historic emissions. The volume of logs is reported in Hoppus volume underbark that has been converted to true volume overbark[28].

Product	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Logs 1000 m^3/yr	311.9	297.5	236.2	366.0	323.9	394.0	330.4	275.3	266.2	320.1	294.6	277.5
Sawnwood 1000 m^3/yr*	29.5	31.0	38.2	36.1	57.8	67.4	74.4	67.0	73.1	77.6	76.1	75.6
Roundwood (Piles, Poles, Posts, Spars) 1000 m^3/yr	19.3	14.6	14.7	18.0	19.6	17.2	20.9	18.7	19.4	17.7	14.8	16.6
Splitwood (Staves, Shingles 1000 m^3/yr)	2.0	1.4	3.1	3.0	3.2	3.4	1.1	0.7	0.96	2.3	0.01	0.01
Total true volume overbark logs m^3/yr	536,377	513,190	443,591	628,262	618,626	738,004	664,069	565,861	567,575	654,298	608,730	585,108

The length of skid trails was estimated based on two factors: for 2003 a factor of 4.31 km of skid trails per 1,000 m^3 of timber extracted and for 2009 a factor of 3.78 km per 1,000m^3 extracted. The 2003 factor was used for the period 2001 to 2008 and the 2009 factor was used for the period 2009-2012. For each year the appropriate factor was multiplied by the total timber over-bark harvested, resulting in the total length of skid trails constructed.

5.2.2 Emission Factors

To estimate carbon impact from readily available indicators, factors were created linking extracted volume with non-merchantable biomass of the felled tree (top and stump), collateral damage, and damage from skid trails left as dead wood in the forest.A total of 183 logging plots were installed across four large scale commercial forest concessions operating on a 25 year cutting cycle. The summary of results is given in Table 11.

[28] True volume = 1.278*Hoppus volume; and volume overbark = 1.12*true volume underbark (from IPCC AFOLU 2006). See the Excel Historic Emissions tool for more details.

Table 11. Extracted volume and estimated emission factors from selective logging on large concessions based on field data from 183 logging plots. LDF=logging damage factor and LIF=logging infrastructure factor

	Extracted Volume (m3 gap^{-1})	Average wood density (t C m^{-3})	Top & stump of Felled Tree (t C m^{-3})	Collateral Damage per Vol. Extracted (t C m^{-3})	LDF Total Carbon Damage per Vol. Extracted (t C m^{-3})	LIF Carbon Damage from Skid Trail (t C/km)
Mean	3.47	0.40	0.57	0.48	1.05	46.87
Std.Dev	2.19	0.03	0.30	0.56	0.68	8.08
95% CI	0.32	0.00	0.04	0.08	0.10	1.91
Uncertainty (CI as % of mean)	9.2%	1.0%	7.5%	16.9%	9.4%	4.1%

Based on the Eq. 1 and factors given in section 4.2.2 above and the mix of product classes (Table 10), the amount of wood carbon going into products with a life of >100 yr (C_{LTP}) is estimated to be < 0.5% of the total production of timber.

The data in Table 11 were used to estimate emission factors for selective logging to be used with the activity data on annual timber harvested and length of skid trails constructed (Table 12)

Table 12. Emission factors for selective logging. LDF=logging damage factor, LIF=logging infrastructure damage from skid trails, and C_{LTP} = carbon fraction of wood going into long term products

Driver	Emission Factors	
	Unit	t CO2
LDF	per m3	3.85
Wood density	per m3	1.47
LIF	per km	171.84
C_{LTP}**		
Sawnwood	Fraction	0.06
Woodbase panels		0.01
Other products		0.00

5.2.3 Historical Emissions

Combing the activity data in Table 10 with the emission factors in Table 12 results in an estimated total emissions from logging during the historical period of **42.9 million t CO_2**. The annual average emissions are **3.57 million t CO_2** and vary between 2.68 and 4.47 million t (Figure 5). More than 63.3% of the emissions are due to the logging damage factor (LDF), 8.7% are due to the construction of skid trails, and the remaining 28% from the logs.

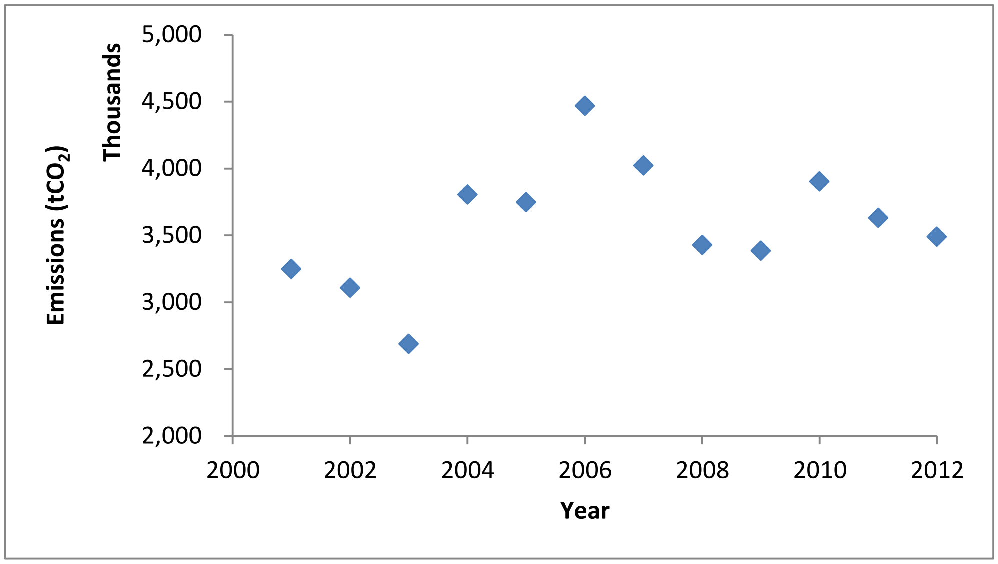


Figure 5. Annual emissions from selective logging between 2001 to 2012

5.2.4 Uncertainty in degradation emissions

The uncertainty in the timber production data is assumed to be zero as these data are well tracked by the GFC and monitored at four main levels: forest concession monitoring, monitoring through the transportation network, monitoring of sawmills and lumberyards, and monitoring ports of export.

The uncertainty of the total emissions for logging is a **95% confidence interval of ±6.1%**. This is based on application of the error propagation equation in Ch.5 of the IPCC GPG (2003) and includes the uncertainty of the LDF (95% CI of ±9.4% of the mean), the uncertainty in mean wood density of species logged (95% CI of ±1.0% of the mean, and the uncertainty in the measurements of the width and C stock of damaged trees for skid trails (95% CI of ±14.2% of the mean). Details of all calculations are given in the Uncertainty Tab of the Excel fileFinal historic emission tool). As the amount of carbon stored in long lived wood products is insignificant, its contribution to the uncertainty is not included.

5.3 Total Historic Emissions

Combining the historical emissions from deforestation with those from degradation from timber harvest gives a total emission estimate of **140.0 million t CO_2** for the period 2001-2012 (Table 13). Using the error propagation method proposed by IPCC (2003 GPG), the **95% CI is ±9.6 million t CO_2 or ±7% of the mean** (see Total Emissions Tab in the Excel File Final Historic emission tool for more details).

Table 13 (a). Total historic emissions from deforestation and timber harvesting between 2001 and 2012.

Drivers	2001-2012	
	t CO_2e	% of total
Forestry infrastructure	12,631,213	9%
Agriculture	7,727,589	6%
Mining (medium and large scale)	66,803,751	48%
Mining infrastructure	6,608,576	5%
Infrastructure	3,078,549	2%
Fire-Biomass burning	276,929	0%
Timber harvesting	42,886,201	31%
Total	**140,012,808**	**100%**
Annualized	**11,667,734**	

It is clear that mining, and associated roads, is the largest emission source during the period 2001 to 2012, accounting for 53% of the total emissions, followed by timber harvesting activities (if infrastructure created to allow for forestry operations, such as roads and decks are taken into account), accounting for another 40% of the total. Thus, mining and timber harvesting together account for 93% of the total emissions. Conversion to agriculture and other infrastructure account for about 8% of the total. Emissions from fire are insignificant, and indicate that emissions from degradation due to fire will be even less so as less biomass will be burned.

It should be noted that the total impact of timber harvesting is spread over a large area of utilization, that is, on an annual period approximately 2 million hectare. This results in a very low impact per hectare as compared to other Drivers, such as mining, which impacts more significantly on a given hectare that is utilized.

Table 13 (b). Average historic emissions per hectare from deforestation and timber harvesting between 2001 and 2012, based on area in utilization.

Drivers	2001-2012
	Average tCO_2e/ha based on area utilized
Forestry Infrastructure	904
Agriculture	1,367
Mining (medium and large scale) Mining infrastructure	1,110
Infrastructure	1,675
Fire-Biomass burning	544
Timber harvesting	22

The annual emissions appear to vary only slightly for the first 9 years, but this is an artefact of the way the deforestation data were collected—over about a 4 to 5 year period—thus the annual rate is averaged over the period in question (Figure 6). In the last 3 years there was a large increase in emissions, but at present there is no way to know if this occurred only in the last 3 years or was preceded by larger emissions in the previous year (e.g. 2008 and 2009).

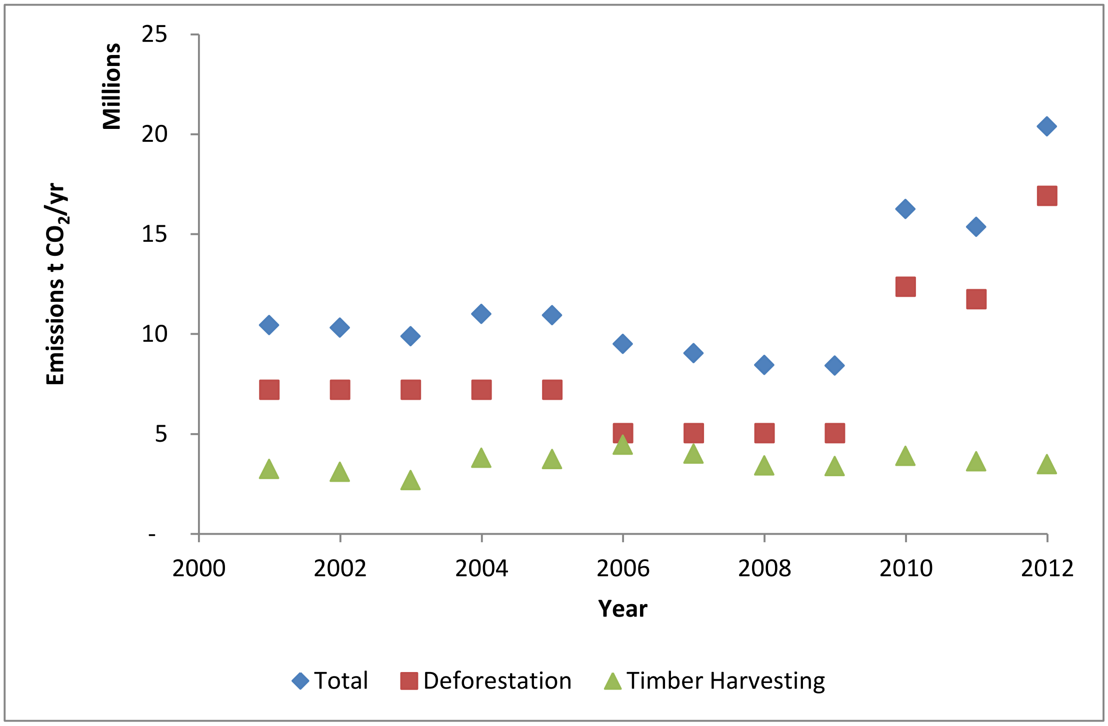


Figure 6. Annual emissions of CO_2 from deforestation and degradation during the historic period 2001-2012.

6.0 GUYANA'S PROPOSAL FOR REFERENCE LEVEL FOR REDD+

6.1 Background

In 2008, then Guyanese President Bharrat Jagdeo set out the broad parameters of what he described as Guyana's willingness to create a globally replicable model for REDD+. He stated that: "Avoiding a business-as-usual development model will require shifts in economic calculations to make the forests worth more alive than dead. Because of the global benefits from climate and other ecosystem services, those who benefit internationally need to contribute towards paying for these services".

Building from this, in late 2008, an independent study carried out for the Government of Guyana by McKinsey and Company estimated that, absent REDD+, the Economic Value to the Nation (EVN) of extractive activities in Guyana's forests could be in excess of US$580 million.

To start competing with the pressures on Guyana's forests, the Government proposed that an Interim REDD+ mechanism would be set up whereby Guyana would receive interim payments modelled on a potential future REDD+ mechanism under the UNFCCC. This Interim REDD+ mechanism would be tied to a global goal to halve deforestation by 2020 and eliminate net deforestation by 2030, and it would create significant new economic incentives which could support low/reduced impact from drivers of deforestation, while at the same time generating financing flows to invest in a new low carbon development trajectory for the entire country.

In November 2009, the Governments of Guyana and Norway agreed an interim payment-for-carbon partnership, which the Government of Guyana classifies as "payment for climate services". Norway pays Guyana US$5/t based on the reference level methodology described below. To date, Guyana has earned in excess of US$200 million under this partnership – although Norway has only paid US$150 million, to create opportunities for other partners to join. This in turn has funded Guyana's Low Carbon Development Strategy and is catalysing in excess of US$1billion in private sector investment, mostly for the energy sector.

Based on Guyana's experience with the Guyana-Norway partnership, this section describes Guyana's proposed UNFCCC reference level. It covers:

- The existing pressures on Guyana's forest resources and potential EVN to be created from extractive activities
- The Guyana-Norway partnership and the establishment of a small but significant EVN for REDD+
- How the EVN from REDD+ is enabling investment in Guyana's Low Carbon Development Strategy and non-extractive economic alternatives

Existing Pressures on Guyana's Forest Resources

Guyana's forests cover approximately 85% of the country, contain an estimated 19 billion ton of CO_2 in biomass, and cover an estimated 18.5 million hectares (Guyana Forestry Commission, 2013.) In addition to being one of Guyana's most valuable natural assets, these forests are suitable for logging and agriculture, and have significant mineral deposits.

Should Guyana choose to pursue a development pathway that would lead to increased deforestation from mining, logging and agriculture, there would be significant negative consequences for the world, as the critical ecosystem services that Guyana's forests currently provide both locally and globally – such as biodiversity, water regulation and carbon sequestration – would be lost. If an effectively designed and appropriately resourced Reducing Emissions from Deforestation and Degradation (REDD+) mechanism is agreed by the Parties to the UNFCCC, Guyana will be able to decide whether to place its forest under long-term protection by establishing an agreed level of forest based greenhouse gas emissions.

However, no trading markets exist for these environmental services – and as a consequence, individuals and companies in rainforest countries face powerful incentives to deforest. In turn, the Government is faced with political pressure to use the forest for economic and employment benefit. Reconciling this tension between protecting rainforests and pursuing economically rational development is the core challenge that must be addressed to make forests worth more alive than dead.

There has been increasing global recognition of the fact that protecting forests is essential to the fight against climate change – deforestation and forest degradation contribute a significant percent of global greenhouse gas emissions. As a consequence, the conditions under which long-term forest protection might align Guyana's interests with global needs to combat climate change have become clearer. If a properly designed and resourced Reduced Emissions from Deforestation and Degradation (REDD+) mechanism is agreed by the Parties to the United Nations Framework Convention on Climate Change (UNFCCC), Guyana will be able to decide whether to place its forest under long-term protection by establishing a voluntary cap on forest based greenhouse gas emissions.

Guyana faces many of the challenges and opportunities that must be addressed by all forested countries to reduce deforestation and forest degradation. The country has a strong track record in sustainable forestry practices, with national MRVS statistics demonstrating a very low rate of deforestation over the past 23 years. However, economic pressures to increase value from forest resources in Guyana are growing. The great majority of Guyana's forests are suitable for timber extraction, there are large sub-surface mineral deposits within the forest, and rising agricultural commodity prices increase the potential returns to alternative forms of land use, all increasing the opportunity cost of leaving the forest alone. These challenges will intensify as infrastructure links between Northern Brazil and Guyana advance, increasing development opportunities in the interior of Guyana. The best approach will require incentives to reward both the preservation of existing forests, and support to restoration of forests that have been removed. To not do so would result in economic leakages across borders in the Amazon region and elsewhere – deforestation activities would migrate from countries rewarded for slowing down deforestation to countries where deforestation was not previously taking place. The incentives therefore need to appeal to the broad spectrum of forest countries.

Guyana also faces potentially massive climate change adaptation costs given the need to protect low-lying areas from the risk of flooding (~90 percent of Guyana's population and all of its economic base lives on a narrow strip of coastal land that lies below sea level, rendering it vulnerable to sea-level rise and inland flooding). Moreover, its citizens expect continuously better social and economic services as the country develops. If long-term economic incentives to protect the forest are weak, future Governments may well find it necessary to meet these needs using revenues from unsustainable resource extraction. These pressures bring into sharp focus the need to create meaningful incentives for forest conservation, and make Guyana an important case study in the economics of deforestation.

Mining & Guyana's Forests

Mining is an important part of the Guyanese economy, contributing 10.6% to the nation's annual GDP in 2012[29]. Between 2007 and 2012 there was 14% growth of the total export value of mining[30].

Over the period 2010 to 2013, mining is estimated to have contributed 93% of total deforestation from Guyana. These emissions are due to deforestation that occurs as mines expand, as prospectors try to find new deposits, and as roads are built to ship materials into and out of new mining sites.

In the early 1990s, gold extraction began to increase. There are a number of important reason for this, one of which is the switch by the government to paying market rates. Another important reason, however, relates to economic and other reforms that took place during the late 1980s and early 1990s, including restructuring Guyana's foreign debt (in conjunction with the IMF), unifying the official exchange rate with the market exchange rate, and privatizing many companies and natural resources that had been nationalized during the post-colonial period. These reforms allowed new capital to flow into Guyana and it allowed foreign companies to become more active investors in the gold mining industry in Guyana (see Merrill, 1992).

Starting in the early 1990s, economic activity picked up in Guyana, due to economic reforms, but also partly due to the increase in gold mining that occurred during that period. In 1993, the Omai gold mine opened. This was one of the largest mines in the world and when operating at peak capacity during the early 2000s, it produced over 350,000 ounces of gold, which was 75% of the output of the entire country. The Omai mine ceased production in 2005. Gold output in other areas of Guyana had stagnated in the early 2000s, but rising world prices starting in the early 2000s lead to additional investments in Guyana and increasing outputs.

The gold mining sector has been playing an increasingly important role in the national development of Guyana, with production reaching unprecedented levels in 2012. The growth of the industry has resulted in significant job creation and stimulated economic activity in remote communities and across the country. Increased investment in the sector has resulted in innovative technology being utilized to effect more efficient recovery and production. With this in mind, progressive and continuous development and improvement in mining practices are seen as a phased undertaking to be executed through a strategic programme of work in the short to medium term.

Overall in 2012 gold and bauxite exports represented 50% and 10% respectively of total export revenues[31]. Gold export earnings were US$716.9 million, 38.7% higher than the 2011 level, reflecting favourable world prices and the higher volumes exported. The average export price per ounce of gold increased by 6.0% to US$1,575.4 per ounce from US$1,486.5 per ounce in 2011.

Declared gold production of 438,645 ounces was the highest recorded in the entire history of the gold industry (excluding one of the largest producers – Omai's production), and was 20.8% higher in 2012 than 2011. The bauxite industry recorded growth in value added of 12.5%, with production of 2,213,972 tonnes with the highest rate of increase achieved in the production of cement grade bauxite.

The mining industry is also one of the principal contributors for Foreign Direct Investment (FDI) in Guyana, with several large scale investments in the sector. The demonstrated level of investor confidence and anticipated

[29]Guyana Bureau of Statistics
[30]Guyana Bureau of Statistics
[31]Guyana Bureau of Statistics; Bank of Guyana

continued high price levels for gold on the world market augur well for the sector. The mining and quarrying industry recorded 14.8% growth in 2012 over 2011.

Guyana's capital account also reflected a surplus in 2012 and this was driven by significant growth in foreign direct investment (FDI), mainly investments in the mining and quarrying, among two other sectors, resulting in total FDI increasing for Guyana by 19% to US$293.7 million in 2012. Net domestic credit by the banking system expanded in 2012 with strong contributions from the mining sector of 51.5%.

In 2011, it was estimated that 13,800 people are directly employed for the small and medium scale mining of gold and diamonds, and 19,000 indirectly employed in mining support industries. For bauxite an estimated 2,070 are directly employed[32]. It was shown that up to 15% of Guyanese citizens are economically dependent on small-scale mining[33].

The mining sector has also contributed to the development of hinterland infrastructure. A large number of mining companies develop infrastructure for areas in which they operate and allow multiple use of these access ways, for not only mining operators but also for forestry activities, as well as other uses. This results in the opening up of previously inaccessible areas for commercial as well as community level utilization.

Logging & Guyana's Forests

The forest sector has been a strong contributor to Guyana's economy. Over the past 15 years, the forestry sector recorded 403,000m3 to 537,000m3 per annum in production of timber, plywood and fuelwood based products. Export value from forest products range between US$32M to US$62M over the past decade and include both primary timber exports and added value forest products. Total employment in the forestry sector is estimated at approximately 20,000 persons with the larger majority of these being in interior locations.

State forests administered by the Guyana Forestry Commission (GFC) account for about 12.6 million ha of which 54% had been allocated for timber harvesting. Access for commercial timber removal on State Forests is controlled by the GFC through the allocation of temporary concessions and permits as follows:

1. Timber Sales Agreement (TSA) covers concessions of more than 24,000 hectares and is allocated for a period of more than 20 years.
2. Wood Cutting License (WCL) is issued for 3 to 10 years, and covers forests of between 8,000 and 24,000 hectares.
3. State Forest Permissions (SFP) are given for two years and cover areas of less than 8,000 hectares. SFPs are generally issued to individual small-scale operators and community-based associations.
4. State Forest Exploratory Permits (SFEPs), which is the precursor stage to TSA and WCL.

There has over the past five years, been growing interest in forest concessions for timber harvesting and export of forest products. Whilst this sector has traditionally recorded low rates of deforestation, there continues to be economic and social pressures that may lead to increases to this rate as well as the forest degradation level.

[32] Guyana's Gold & Diamond Mining Sector (2005-2010)_May 2011_ GGMC
[33] Small Scale Mining - World Bank - 2010

Infrastructural Development & Guyana's Forests

The Amaila Falls Hydro Project is a fundamental component of Guyana's Low Carbon Development Strategy, and will significantly lower the Guyana's carbon footprint while reducing the country's long term energy costs and exposure to imported oil price volatility. It is expected to eliminate over 92% of the country's energy-related emissions, after the emissions associated with its construction are accounted for. The construction of a new 165MW hydroelectric facility creates an opportunity for Guyana to generate its own power from a clean, natural source. The plant, located where the Amaila and Kuribrong rivers meet, will deliver electricity to Guyana's capital, Georgetown, and its second largest town, Linden, by 270 km high voltage electric transmission line. Construction of the hydro facility and electrical interconnection is anticipated to begin as soon as all necessary approvals are granted and will take approximately four years to complete. There are three parts to the Project:

- *Hydropower Plant*- Construction of a dam where the Amaila and Kuribrong rivers meet will create a reservoir upstream of the dam. The project is expected to have the capacity to produce 165 MW of electricity by releasing impounded water through turbines specifically designed and built for the plan.
- *Transmission Lines*- Electricity will be delivered from the hydropower plant to Georgetown and Linden through a high-voltage 230-kV transmission line that will be built along with electric substations in Linden and Georgetown. The 270 km long transmission line will be supported on towers approximately 36 m tall and 300 m apart, carrying two circuits thus providing redundancy in the event of loss of one circuit.
- *Access Road*- In order to access the Project site, new roads will be constructed and some existing roads will be upgraded. A new road approximately 65 km long will be built connecting the project site to the existing Bartica-Potaro Road. Another new road approximately 20 km will be constructed from the existing Mabura Hills Highway to the Essequibo River. Other existing roads will be upgraded in order to provide access needed to move the equipment, supplies, and personnel to build the Project, as well as for future operation and maintenance of the plant and transmission lines. Construction of access roads began in 2010 and will be completed in advance of the construction of the Hydropower Facility.

Relevant assumptions on future changes in domestic policies have been considered in the development of the RL. Policies and plans for both the mining and forest sectors support existing programmes as outlined in this section and are being implemented in a phased manner. These programmes are intended to bring about a maintained low rate or a lowering of emissions where applicable. Plans for the future development for the main extractive sectors have been considered in the development of the RL.

Guyana' Low Carbon Development Strategy

On the 8th of June 2009, the Government of Guyana launched its Low Carbon Development Strategy (LCDS), which outlines Guyana's vision and national trajectory for promoting sustainable economic development, while striking a harmonious balance for combating climate change. Guyana's Low Carbon Development Strategy sets out a vision through which economic development and climate change mitigation will be enabled through the generation of payments for forest services in a mechanism of sustainable utilization and development. The result is intended to be the transformation of Guyana's economy whilst combating climate change. The Strategy has four key dimensions: (1) value of Guyana's forests (mitigation), (2) low carbon development opportunities, (3) adaptation plans, and (4) the involvement and socio-economic development of Guyanese. Through the implementation of the LCDS, Guyana would be able to protect its forest and simultaneously seek a development path that promotes the growth of low-carbon economic sectors and reduces deforestation and high-carbon economic activity.

Guyana's Proposal for Reference Level for REDD+ is a core aspect of the LCDS.

REDD+ Priorities for Guyana

It is expected that mining will continue to be the key driver of the economy, and that growth will be strong (although dependant on international commodity prices). An interest to pursue this sectoral expansion with foreign investor involvement has been expressed by the Ministry of Finance[34].

Accompanying projected developments in the sector is a programme of work that has already started and that will be further advanced in the next few years. These efforts are systemic interventions to improve the REDD+ model. A number of initiatives have been developed to reduce degradation from the mining sector. These are the implementation of the Ministry of Natural Resources and the Environment of Guyana (MNRE's) Strategic Framework 2013 - 2018 and the mandates of the committees that are implementing the recommendations of the Sustainable Land use Committee (SLUC).

As part of the new Ministry's planning processes, MNRE developed a Strategic Framework for the Natural Resources Sector for the period 2013-2018. The objectives of this process is to conduct a thorough review and analysis of the regulatory and institutional landscapes to help MNRE shape its strategy to address environmental and natural resource issues within the framework of Guyana's LCDS. This activity has informed the development of the Strategic Framework Document and Strategic Plan. The Strategic Framework makes a number of recommendations, including those that relate directly to the mining sector such as activities to improve reclamation of mined out areas, and initiatives to address impacts on deforestation and forest degradation from mining.

The SLUC was established in 2009 to provide recommendations to Cabinet through a cross-sectoral approach to manage land use conflicts and issues, including aspects of land use as they related to degradation from extractive activities. The recommendations from this committee aimed at addressing key mining issues under broad themes including: (1) Enhanced Land Reclamation, (2) Improved Infrastructure in Mining Districts, (3) Sustainable Land Management in the mining and forestry sector, (4) Strengthening of Land-Use Planning and Coordination and (5) Amendments to the Mining Act and Regulation among natural resource agencies.

Additionally, there are a number of activities in various stages of planning and implementation that will contribute to reduced degradation from extractive activities. These activities overlap to varying degrees with the higher level initiatives; they can be divided into four categories (1) Improving reclamation of mined areas (2) Improving compliance (3) Providing technical assistance and raising awareness and (4) Improving technologies.

In 2012, broad stakeholder discussions resulted in the establishment of the Land Reclamation Committee (LRC) to address specific recommendations/issues of the SLUC within the broader environmental management framework. Building on existing initiatives and recommendations, the LRC has the overarching objective of coordinating national level efforts for the reclamation of mined-out land and to provide guidance to the Government and the GGMC. The Committee comprises representative from the MNRE, EPA, GGMC, GFC, FPA, GGDMA, UG, OCC and NAREI.

[34] Budget 2012: Remaining on Course, United in Purpose, Prosperity for all, Budget Speech - Minister of Finance - Mar 2012

At the level of the GGMC, work has advanced in developing and implementing Codes of Practice on Mining. The codes include those relating to avoiding environmental degradation from mining. GGMC is currently revising the codes of practice[35], e.g. on the use of mercury and wastewater management. The draft codes of practices have been reviewed. The drafts have also been shared with the mining community, so that they understand future compliance requirements by the GGMC and the Guyana Gold and Diamond Miners Association.

There has been development at the operational end of mining. The improvement of technology and mining practices are very important to (1) shift miners away from the use of mercury and (2) to improve the recovery efficiency of mining operations. New technologies such as centrifuge systems can increase recovery rates in mines from 30% to 80% compared to traditional practices. This means that a mine need only be worked once, after which it can be closed and the forest restored.

The Mining School was established and incorporated in 2012. The School will offer miners short courses (between one and six months) once the draft curriculum has been approved. The curriculum has been developed in consultation with relevant stakeholders, including EPA and GGDMA and will be further developed through a project with support from the WWF. The School will focus on geology, mining methods, exploration technology, surveying and computer applications for mining operations and mineral explorations.

To facilitate the objective of having readily available and accurate spatial data to inform decision making, a dedicated group of persons from different Agencies were recruited to establish the Geospatial Information Management Unit (GIM). This Unit was convened to provide services and support to all Agencies under the purview of the Ministry of Natural Resources & the Environment. Additionally, the lessons learnt will be shared with other Government Agencies to create and maintain an online portal that can facilitate the collection, dissemination and integration of spatial data to improve decision making nationally. The Unit utilizes technology innovation, capacity building and training sessions, development of specific applications and decision support systems to achieve its objectives. The GIM comprises staff that have been seconded from the GFC as well as other natural resources management agencies. The physical office of the GIM is hosted by the GFC and shares data amongst the agencies based on agreed protocols.

The National Forest Plan 2011 embodies ideals for enhanced development and wider opportunities for the management of Guyana's forest estate. Programme areas of the Plan cover the Low Carbon Development Strategy (LCDS), increased value-added production, additional guidelines for sustainable forest management (including non-timber forest products), improvements in marketing strategies, meeting training and human resource capacity needs, ensuring community development is satisfied, and forest resources equitably shared; all of which are enshrined in the National Forest Policy Statement 2011.

One of the main programme areas of work of the forest sector is to improve added value activities locally. This will assist in creating a higher potential for carbon storage in long term wood products. This could also potentially reduce the pressure on forest resources as a higher value may result in reduced harvest levels.

Further, a key priority for the forest sector is the implementation of sustainable forest management methods of which Reduce Impact Logging (RIL) is a key aspect. RIL, among other advantages, is intended to lower collateral and incidental damage associated with logging including tree damage from tree felling and logging infrastructure impacts, such as skid trails. Reducing the incidental and collateral damage during tree felling by about 10% and

[35] (Ref. 320; 321;322;323;328;329; 330; 331;332) GGMC Codes of Practice

the damage from skid trails by about 35% (avoiding mid-size trees during skidding), could reduce the annual emissions by about 13.5% each year. This translates to a reduction of about 430 thousand t CO_2 per year and can target more predominantly the smaller concession category.

Reducing and even stopping illegal logging, although at low levels, is also a high priority for Guyana. In this regard, the continued implementation of the National Log Tracking System and chain of custody programme, both of which are aspects of Guyana's current negotiation process with the EU on a FLEGT VPA (Forest Law Enforcement Governance and Trade, Voluntary Partnership Agreement), will likely result in the finalization of a bilateral agreement that certified forest legality for exports of forest products.

6.2 Guyana's Combined Reference Level Proposal

Guyana is a country with high forest cover and low deforestation. However, as illustrated in the previous section, the economic and social incentives to allow significant increases in deforestation are strong and growing. The economic value they create can drive Guyana's poverty alleviation and economic development objectives – however, they could also lead to increased deforestation.

Therefore, Guyana proposes a reference level which enables Guyana to maintain very low levels of deforestation, while at the same time earning money from the global benefits provided by Guyana's forests – and using this money to invest in a new low carbon economy. Guyana proposes the use of the Combined Reference Level Approach that reports on percent of emissions per year. A simplified version of this has been used as part of the Guyana-Norway partnership from 2009-2015.

The "combined reference level" methodology provides incentives for all categories of forest countries, and ensures that emissions from deforestation and forest degradation are reduced cumulatively at a global level. The application of this method takes an advanced step to that which is applied in the Guyana Norway agreement by using a scientifically established historic carbon emissions level, country informed forest carbon stocks and storage ratios, and includes both deforestation and forest degradation impacts. Additionally, the global level to which the national reporting results are proposed to be compared to, is an emissions total rather than a deforestation rate previously utilized.

The use of the combined reference level, is determined to be the most appropriate method for Guyana because it allows for the broadly accepted objective within the UNFCCC negotiations to be fulfilled. This objective expresses general agreement that a REDD-mechanism must provide genuine incentives for forest conservation in low deforestation countries, as well as ensure global additionality. To maintain additionality, Strassburg et. al. (2009) proposed a 'combined incentives' mechanism which maintains the sum of national references levels equal to the global reference level through a flexible combination of higher reference levels for countries with historically low deforestation rates and lower reference levels for countries with historically high deforestation rates.

As stated in the Eliasch Review, which was produced for the Government of the United Kingdom: "The combined [reference level] has the potential to be sufficiently comprehensive to attract countries at all stages of the deforestation process over both the short and long term. Countries with high historical rates of deforestation receive strong and realistic incentives to reduce forest emissions. At the same time, countries with standing forests and a track record of avoided deforestation would receive incentives to keep deforestation rates low, zero or negative (if, for example, rates of ARR are high). This rewards countries with a history of responsible forest policies while reducing the risk of international leakage of deforestation to these countries."

The Guyana-Norway Joint Concept Note emphasises this point: "For a global REDD+ mechanism to be effective, it must incentivise both (i) reductions in deforestation in countries with high levels of deforestation and (ii) maintenance of low deforestation rates in countries that have maintained their forest cover. If only countries with high deforestation rates are compensated for improving their forest protection under an international climate regime, deforestation pressures will move to countries with currently low deforestation, like Guyana, and the overall emissions reduction effect will be diluted or lost on the other hand. If a global incentive structure does no ensure global additionality, the international community will be paying for "hot air" and there will be no mitigation impact. "

With this method, the following steps are proposed:

- Identify a global benchmark percent of (potential) emissions per year derived by dividing global annual loss of forest carbon stock by total global forest carbon stock.
- Establish a national historic annual average emissions percent level for Guyana (2001-2012) by dividing the average annual emissions for Guyana from 2001-2012 by the total carbon stock of Guyana.
- Derive the Combined Average of the global and historic annual average emissions percent.
- Compare annual measured and verified levels, to combined average.
- The difference from the performance reporting against Guyana's national RL.

Background to Combined Reference Level

Recent studies show that compensating developing countries for even a small portion of the global benefits their forests provide might be sufficient to greatly reduce deforestation (Stern, 2007). An outcome of the eleventh Conference of the Parties (COP 11) in December 2005 was the decision that the scientific board of the UNFCCC should examine the issue of positive incentives to reduce emissions from deforestation in developing countries (UNFCCC, 2005). A group of scientists proposed the concept of ''compensated reductions'' (Santilli et al., 2005). A submission from Brazil became the first official proposal for a REDD mechanism (UNFCCC, 2006). The proposed mechanism would offer incentives to countries to reduce their deforestation in comparison to a national reference level calculated from their deforestation rate in a recent snapshot of time (1990s, or early 2000s). The general formula for a historical national reference level mechanism would be:

$I_t = (HE - E_t) \times P$

where I_t is the country incentive in year t; HE is the historical annual emissions from deforestation; E_t is the emissions from deforestation in year t; and P is the incentive payment per avoided t of CO_2.

A country's reference level is equal to its average national emissions from deforestation over a recent historical reference period, as in one variant of the original 'compensated reduction' proposal (Santilli et al 2005). When the sum of national reference levels is greater than the global business as usual emissions rates, there is the possibility that there could be more credits generated than emissions reduced at the global level, compromising additionality. To maintain additionality, Strassburg et al (2009) proposed a 'combined incentives' mechanism which would maintain the sum of national references levels equal to the global reference level through a flexible combination of higher reference levels for countries with historically low deforestation rates and lower reference levels for countries with historically high deforestation rates. This mechanism benefited considerably from the feedback received from two side-events dedicated to it at the meetings of the scientific board of the UNFCCC (Strassburg et al., 2007; Strassburg, 2008). (Busch *et al,* 2009)

Some of the key features of the Combined Incentives Mechanism include:

a) Utilises a national level approach- project level REDD mechanisms are extremely vulnerable to subnational leakage, in addition to which most deforestation is either decided or heavily influenced by national governments and are part of the long-term development strategies of each country. Though national level mechanisms are still subject to international leakage, the mechanism is comprehensive and offers incentives capable of inducing the conservation of standing forests in developing countries in every stage of the conversion process, and thereby minimizes this risk.
b) Designed to be comprehensive, by including countries in all stages of the conversion process (i.e. high, low or negative past or projected deforestation rates), while being able to stimulate forest conservation, reforestation and afforestation activities both across countries and time.
c) Offers incentives based on recent deforestation rates, so that high deforesting countries have enough incentive to reduce their deforestation rates. But it also includes an incentive for countries to keep their deforestation rates below the global average, making it attractive to countries that have been conserving their forest in the recent past.
d) Can accommodate any source of funding- either market oriented, where demand for credits is created and can be traded, or fund-oriented, where financing countries provide the resources by taxing specific commodities or income or a combination of the two.

The combined incentives mechanism was designed to receive two kinds of incentives simultaneously. The first is based on the ''compensated reduction'' concept and is an incentive to reduce a country's emissions in comparison with its historical emissions:

$$I1 = (HE - E_t) \times P$$

The second follows the ''expected emissions'' concept that connects the incentive to the ecosystems carbon stock while maintaining global additionality. It is an incentive to emit less than it would emit if it followed an average behaviour given by the global baseline emission rate:

$$I2 = (EE - E_t) \times P$$

All countries receive both incentives at the same time. The key point is the way in which these incentives are combined. By making the weight of each incentive variable, the mechanism is able to be comprehensive enough to include all countries in a single simple formula and flexible enough to combine short-term realities with long-term sustainable goals. It does so by introducing a weighting factor, a, in the sum of both incentives. So the ''combined incentives'' mechanism formula is:

$$CI = \alpha\,(I1) + (1-\alpha)\,(I2)$$

Or

$CI = [\alpha (HE) + (1- \alpha) (EE) – E_t] \times P$

With a varying value between 0 and 1, where HE = country historic emissions; EE_i = country expected emissions; E_{it} = country emissions in year t; and P = base incentive per avoided tonne of CO_2.

The factor α weights the incentives between historical and stock (or average) incentives by influencing each country's reference level against which their performance will be assessed.

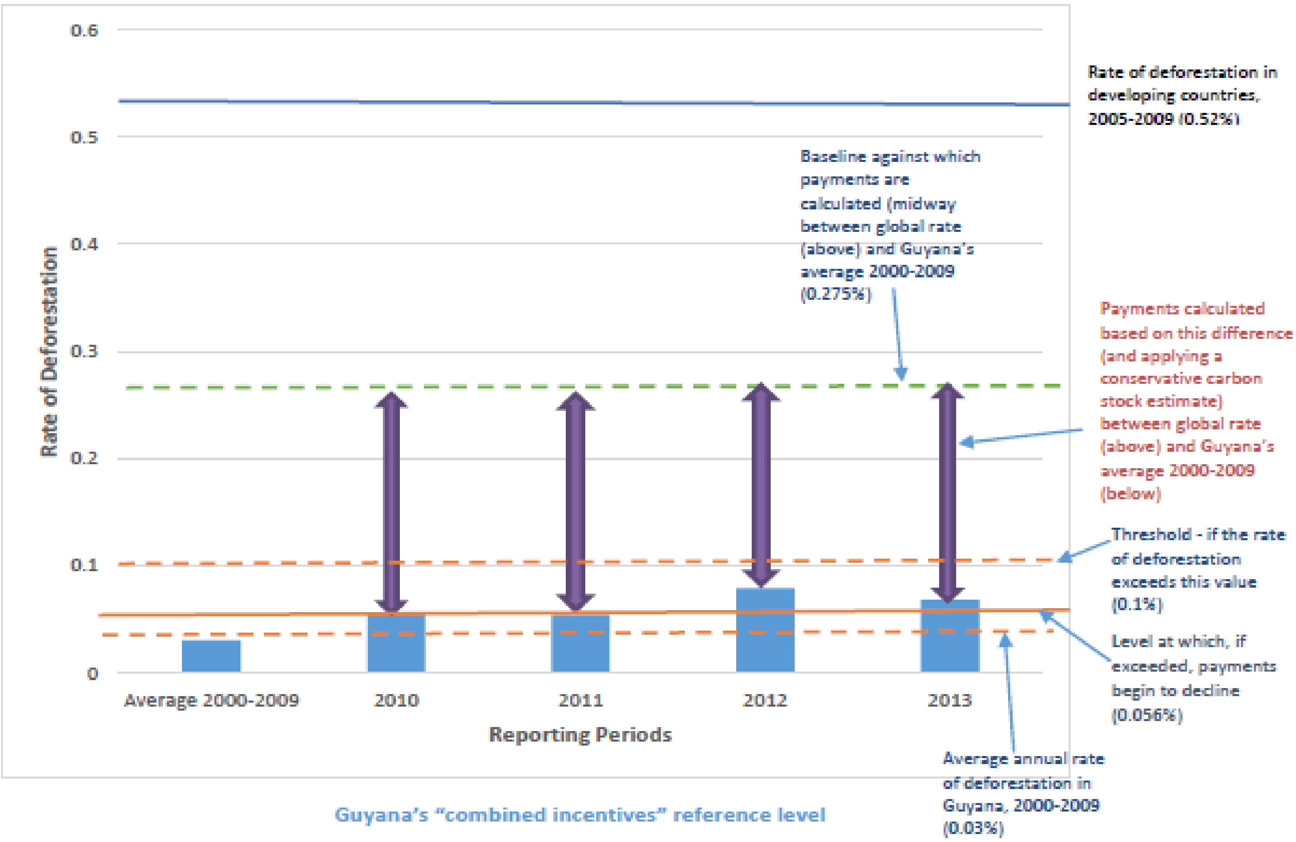
The historical emissions rate of each country is fixed. The global average emissions rate used to calculate each country's EE can be fixed at the relatively constant rate of the last 25 years.

Approach used in Guyana Norway Agreement

Through the Guyana Norway Agreement, a provisional national reference level[36] is being used that guides the amount of payment Norway contributes to the Guyana REDD+ Investment Fund. To date, Norway has made four payments, totalling US$150 million, to the Guyana REDD+ Investment Fund (GRIF) based on verified results as compared to the "combined incentives" reference level described below. In parallel to the use of this approach, Guyana is evaluating deforestation and degradation drivers and how various future scenarios may be developed to establish a future reference level.

If designed for maximum effectiveness and efficiency this reference level methodology could allow for significant variations in individual countries' deforestation rates while still ensuring global additionality. However, in the absence of a global system would imply that Guyana would be eligible for significant payments even if it were to increase its deforestation along a business-as-usual ("no REDD+") trajectory. Therefore, pending the introduction of a global incentive system, Guyana and Norway agreed on the use of a temporary cap - whereby Guyana's emissions are basically capped at the current rate, but payments are made—in a sliding scale—based on a separate "crediting (or payments) baseline". The payments baseline is calculated as midway point between the rate of deforestation in Guyana from 2000-2009 (0.03%) and the average deforestation rate for developing countries between 2005 and 2009 (0.52%), or a payments baseline of 0.275%. The "cap" on emissions was set as the deforestation rate in 2010 (0.056%). If Guyana exceeds this rate in any given year, the payments are reduced on a sliding scale, up to the rate of 0.1%, at which point there are no payments made. This cap would not be needed if an international REDD+ mechanism were in place.

[36] The term "reference level" is used, consistent with the Norway-Guyana Joint Concept Note.



Guyana's "combined incentives" reference level

Source: Emerging approaches to Forest Reference Emission Levels and/or Forest Reference Levels for REDD+ Guyana: Combined Incentives reference level in partnership with Norway, UNREDD Programme, October 2014

Main Justification for the Combined Reference Level approach being used by Guyana:

- ***A step-wise and flexible approach***. The reference level agreed between Guyana and Norway allows for continuous improvement over time, including the addition of degradation (as the MRV system is developed) as well as an adjustment in the reference level approach consistent with UNFCCC decisions.
- ***High degree of transparency***. Annual reporting on performance indicators and MRV progress is made available online, along with the independent assessments or verification reports. To date, Guyana has completed forest area change assessments for 4 annual periods, along with a significant block of historic years. The periods covered are: 1990–2000; 2001–2005; 2006 to September 2009 (Benchmark); 1 October 2009 to 30 September 2010 (Year 1); and 1 October 2010 to 31 December 2011 (Year 2).
  Over the years, there have been improvements in technologies used for conducting the forest area change assessment. One such improvement has been in the use of high level 5 metre resolution imagery-previously, Landsat 30m resolution imagery was used to map and measure forest area change for Guyana. The improved resolution enabled better identification of change boundaries, drivers of change

and areas of forest degradation. In particular, it was revealed that the mapping of forest degradation is more precise when using high resolution imagery rather than medium-resolution imagery.

- ***Provision of incentives for a HFLD country***. The "combined incentives" approach provides an opportunity for Guyana as a historically low deforestation country to receive payments for continued forest conservation.
- ***An interim method to account for degradation***. The use of a proxy measure and conservative accounting (i.e. the use of a discount on payments received) is an innovative way to account for emissions while Guyana improves its ability to measure and monitor degradation more accurately. From the commencement of the Agreement with Norway to 2014, Guyana has undertaken a number of technical studies to inform a scientifically sound methodology to account for forest degradation.

6.3 Establishing the Global Benchmark Percent of Potential Emissions per Year

In determining what an appropriate global rate, Guyana looked toward the available global assessments for tropical counties. There are several scientific papers that have directly calculated a global average emission rate, or more precisely, a global average rate of forest carbon stock loss (global forest carbon stock loss divided by global forest carbon stock).

A summary of the various options are presented in Figure 7 below and addresses the use of global rates of average annual forest loss and emissions loss. In the current version of the RL used by Guyana in the bilateral cooperation agreement with the Government of Norway, the rate of forest loss (based on deforestation) was used. Following the establishment of the system of reporting on emissions, and having established historic emissions for the period 2001 to 2012 as presented in the earlier chapters of this Proposal, Guyana is proposing that is RL now be based on emissions level using the global as well as the national level based on emissions. In this way, the "E's" in Figure 7 below, were found to be particularly relevant to Guyana. This is necessary because if Guyana was to continue using an area based average (deforestation rate or "F's" as termed in Figure 7 below), it will be at the cost of excluding forest degradation which is a core part of Guyana's reporting on emissions, both historic and annual emissions. Further, to use an area based global estimate (likely to include only deforestation) with an emission rate national level (including both deforestation and forest degradation) will be incongruent.

Given the above, among the more applicable proposals to Guyana are Baccini A. et. al. 2012 in: "Estimated carbon dioxide emissions from tropical deforestation improved by carbon-density maps". This paper concludes that annual loss of forest carbon stock (1.0 PgC/yr) by total forest carbon stock (228.7 PgC) = 0.44%/yr. These findings are a result of combining estimates of aboveground carbon stocks with regional deforestation rates. This assessment was done using multi-sensor satellite data to estimate aboveground live woody vegetation carbon density for pan-tropical ecosystems. This study was published by Woods Hole Research Centre (WHRC). The goal of Baccini et al. 2012 was to update the record of net emissions from tropical forest land use and land use change. The method used by the WHRC tracks annual per hectare change in carbon stocks when (1) forest area is cleared for cropland, pasture, or shifting agriculture; (2) forests are harvested; (3) plantations are established; and (4) agriculture lands are abandoned and returned to forests.

Among the key reasons for the selection of Baccini et. al 2012 as the global average emissions percent, are those outlined below:

- **Inclusion of Forest Harvest** – Baccini et. al. 2012 includes forest harvest and the sources of emissions emanating from this land use. Guyana's reporting on RL similarly integrates this land use within its historic and routine reporting on emissions.
- **Reporting on Land Use/Drivers** – Baccini et. al. 2012 utilizes an approach that utilizes deforestation events to land cover and specific land uses. This is also the method that has been used by Guyana in reporting annually on drivers of deforestation and forest degradation.
- **Gross versus Net Emission** – Baccini et. al. 2012 concludes on a net average global emission rate of 0.44% and a gross emission rate of 0.96% (the gross emissions also include those coming from shifting cultivation activities). Gross emissions does not take into account removals of carbon. Whilst recognizing that Guyana is reporting on Gross Emissions to date, it is the plan to include removals of carbon as the next development of the national MRVS. As such, it is seen as a conservative estimate of 0.44%, applicable to the Guyana context and prepares for the medium term developments within Guyana's national MRVS. In addition to being conservative, this use of this level also emphasizes the commitment of Guyana to keep deforestation and forest degradation levels, as low as possible and continue along a low carbon development pathway.
- **Reporting on Global Carbon Stock** – Baccini et. al. 2012 provides estimates for both global average rate of carbon stock loss and global forest carbon stock. The generation of both values by Baccini et. al. 2012, which are necessary for the combined RL for Guyana, also presents another advantage of using this approach. Some studies establish only global average rate of carbon stock loss.
- **Period of Study** - the time period used by Baccini et. al. 2012 covers the period 2001 to 2010, this time series is in close synergy with the historic period utilized in the Guyana Historic Emissions computations of 2001 to 2012 and therefore makes this method very congruent in this temporal scope, to the Guyana's proposal.

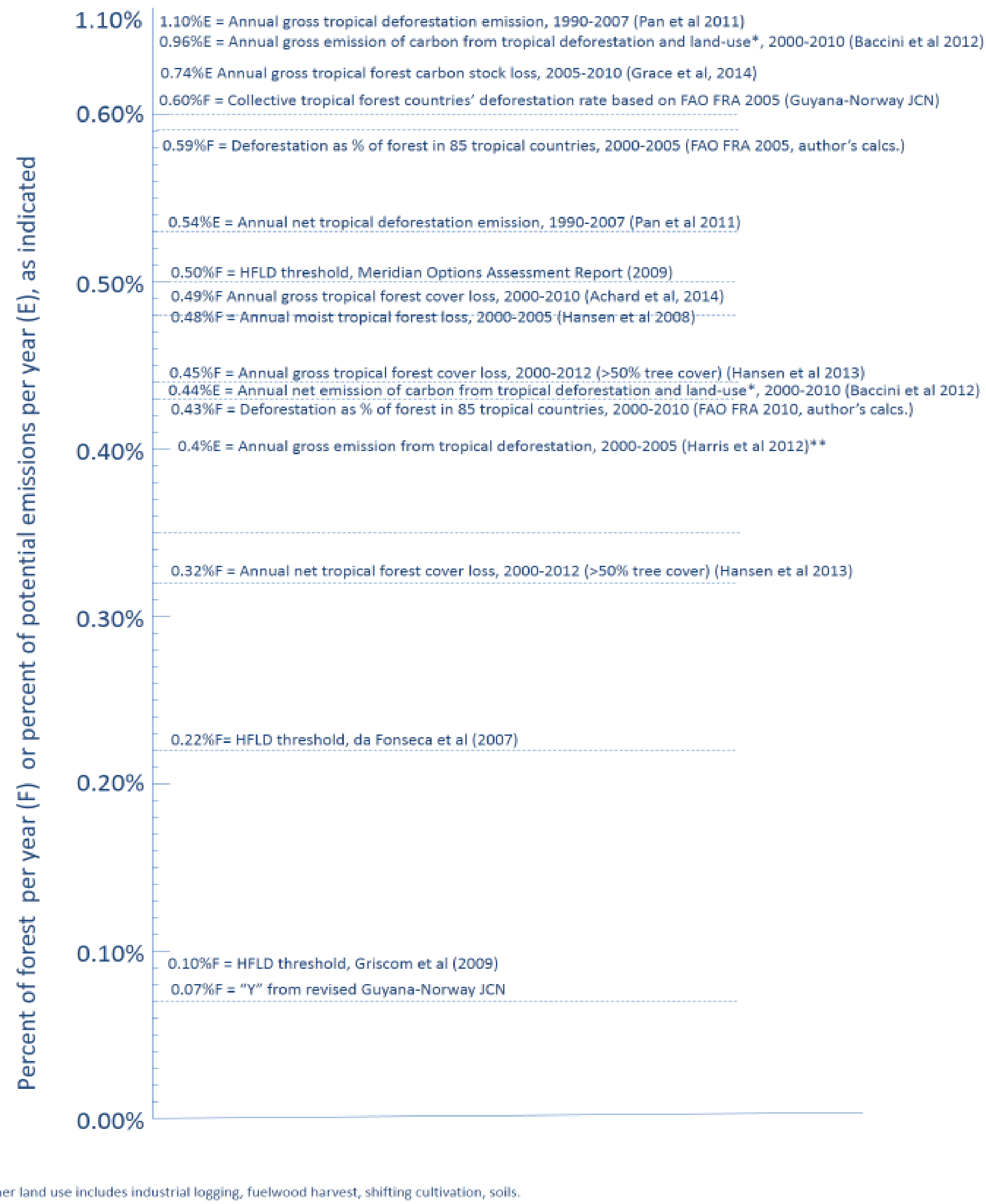


Figure 7: Summary Scientific Papers concluding on Global Average Emissions Rate

6.4 Proposed Reference Level for Guyana

Guyana's proposal for Reference Level for REDD+ is the use of the Combined Reference Level Approach, using a global forest carbon emissions loss of 0.44%.

Based on Table 7, a carbon stock level of 300 t C ha^{-1}, is being used which represents the average level without soils across the strata. The Medium Potential for Change Area as well as the High Potential for change, Less Accessible area record 300 t C ha^{-1} and 351 t C ha^{-1}. Whilst the High Potential for Change More Accessible area recorded 259.8 t C ha-1, the value of 300 t C ha^{-1} is used as an average. The carbon stock level across the Strata including soils range between 431 t C ha^{-1} and 359.1 t C ha^{-1}. Based on Section 5.3 and Table 13(a), which provides the total average annual emissions for Guyana for the period 2001 to 2012, Guyana has developed it Proposal for Reference Level for its REDD+ Programme.

Using a level of 300 t C ha^{-1}, Guyana's Reference Level Proposal for its REDD+ Programme is 48,794,580 t CO_2.

This is illustrated below:

Setting the Reference Level			
	Global average rate of forest carbon stock loss (global forest carbon stock loss divided by global forest carbon stock) - Baccini et. al. 2012	0.440	%
	Guyana's 2001-2012 Average Historic Emissions Level (derived by dividing the historic emissions of 11,667,734 tCO2 by total forest carbon converted to CO2 of 19,517,832,109tCO2). The total forest carbon stock in tC is 5,318,210,384 tC.	0.060	%
	Combined reference level in % =	0.250	%
	Combined reference level in t CO2=	48,794,580	tons CO2

Guyana's proposal is as follows:

- **Setting the Reference Level:**
  - Using a global percent of forest carbon emission loss of 0.44%, as the global level, and
  - establishing the historic annual average emissions percent level for Guyana (2001-2012) by dividing the average annual emissions for Guyana from 2001-2012 by the total carbon stock of Guyana: that is emissions of 11,667,734 tCO2 divided by total stock of 19,517,832,109 tCO2 = 0.06%,
  - derive the Combined Average of the global and historic annual average emissions percent by: 0.44% + 0.06% divided by 2 = 0.25%.

- **Computing Annual REDD+ Performance based on Reference Level:**
  - Annual Reported Emissions percent (computed by dividing the annual report forest carbon emissions loss by the total forest carbon stock of Guyana) that is concluded following

measurement and verification, inclusive establishment of accuracy levels, is then subtracted from Combined Average of 0.25%, and the last step taken to:

- **Computing Performance Payment:**
  - compute performance payment based on the price per tCo2, derived by taking the difference between the annual report emissions percent and the Combined Average, translating this
  - This is presented graphically below, in Figure 8:

Financial Incentives Baseline and the Use of the Sliding Scale for REDD+ Incentives

One of the key considerations in Guyana's Proposal for Reference Level for REDD+ is the integration of a financial incentives baseline within the payment computation. One example of this model is currently in use in the bilateral agreement between Guyana and Norway.

One of the justifications of integrating this baseline is the clear expression of commitment by Guyana that its programme on REDD+ is aimed foremost at ensuring environmental integrity is maintained whilst advancing a low carbon development pathway.

Further key consideration is also extended in ensuring congruence with existing methods, such as those established for the FCPF Carbon Fund which allows for 0.1% of adjustments to emissions over the historic level.

This approach is compatible with the Government of Guyana's declared long-term strategy to maintain the maximum amount of forest cover in Guyana, if an appropriate incentive structure is in place to make Guyana' LCDS viable. This is being done through a balanced mix of maintaining forests under full protection (areas where only small-scale subsistence farming by forest dependent communities is allowed) and sustainable commercial forest management.

This Proposal, at this stage does not indicate final decision on this area, as discussions are still ongoing at the national level on best ways of addressing this matter. As such, thresholds relating to this baseline are not presented in this Proposal.

As part of the application on the financial incentives baseline, Guyana is considering the integration of a sliding scale as part of the incentives mechanism. This may be applied in a similar manner as done in the current Guyana Norway Agreement but with new thresholds and period ranges. The main objective of the use of the sliding scale will be to further elaborate a commitment to ensuring that Guyana's REDD+ programme aims at assuring environmental integrity and in doing so, ensure that emission cannot rise too much from the historical levels before payments are reduced. Through this mechanism, Guyana may only request payment if emissions actually stay low and continue to stay low, whilst still allowing room for development. Further, through this mechanism, Guyana proposes that one-off predictable and controllable deforestation events should be allowed for critical national infrastructure that is part of Guyana's transition to a low carbon development path and not form part of the sliding scale mechanism.

This mechanism will therefore mean:

a) that a ceiling on the level of emissions that can take place within a set period, with incentives still flowing up to that agreed level,

b) the accommodation of limited annual upward variations to ensure that the incentive structure still makes REDD+ a positive development choice for Guyana; and

c) that Guyana is incentivized to maintain over 99% of its forest cover as part of its LCDS and REDD+ commitments.

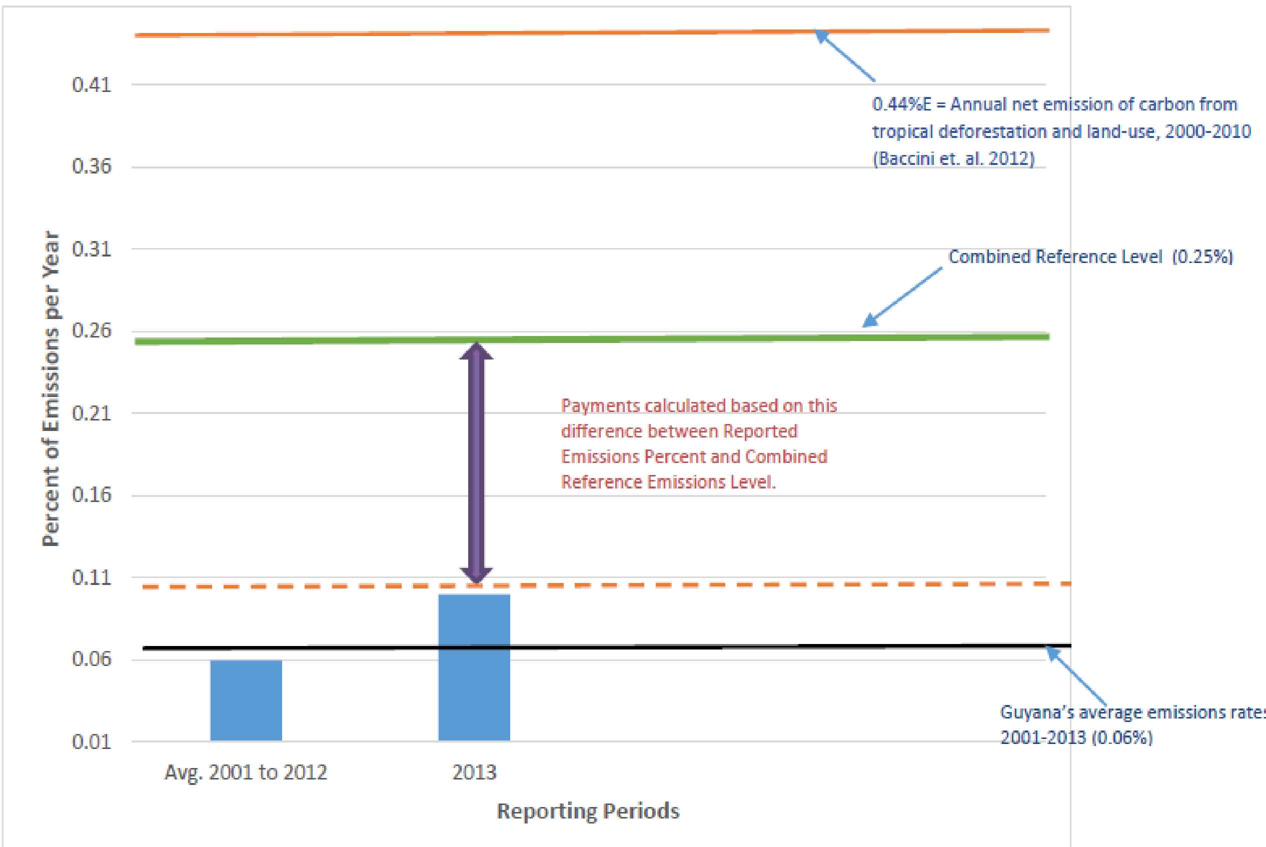


Figure 8: Guyana's Proposal for Reference Level for REDD+

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Accompanying Documents

1. Guyana Forestry Commission, **Forest Carbon Monitoring System: Emission Factors and their Uncertainties, Version 2**, June 2014

2. Guyana Forestry Commission, **Guyana REDD+ Monitoring Reporting & Verification System Year 3 Interim Measures Report (01 January 2012- 31 December 2012),** December 2013

3. Guyana Forestry Commission, **Sampling Design and Implementation Plan for Guyana's REDD+ Forest Carbon Monitoring System (FCMS): Version 2**, June 2014

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5. Guyana Forestry Commission, **Spatial Analysis for Forest Carbon Stratification and Sample Design for Guyana's FCMS: Version 2**, June 2013

6. **Workbook for Estimating Historic CO2 Emissions from Deforestation and Selective Logging, June 2014** (MS Excel)

These are available at: https://www.mediafire.com/folder/mjpw23xbm2ms8/Annex_to_Guyana's_RL_Proposal