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Guyana Proposed REDD+ Strategy

DRAFT 3

Non-reimbursable Technical Cooperation No. ATN/FP-14161-GY-Forest Carbon Partnership Facility Project in Guyana

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**Abbreviations**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAU</td>
<td>Business As Usual</td>
</tr>
<tr>
<td>COP</td>
<td>Conference of the Parties</td>
</tr>
<tr>
<td>EU-FLEGT</td>
<td>European Union - Forest Law Enforcement Governance and Trade</td>
</tr>
<tr>
<td>FAO</td>
<td>United Nations Food and Agriculture Organization</td>
</tr>
<tr>
<td>FCPF</td>
<td>Forest Carbon Partnership Facility</td>
</tr>
<tr>
<td>FERL</td>
<td>Forests Emissions Reference Level</td>
</tr>
<tr>
<td>FRL</td>
<td>Forest Reference Level</td>
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<tr>
<td>GFC</td>
<td>Guyana Forestry Commission</td>
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<tr>
<td>GSDS</td>
<td>Green State Development Strategy</td>
</tr>
<tr>
<td>GGMC</td>
<td>Guyana Geology and Mines Commission</td>
</tr>
<tr>
<td>GHG</td>
<td>Greenhouse Gas</td>
</tr>
<tr>
<td>LCDS</td>
<td>Low Carbon Development Strategy</td>
</tr>
<tr>
<td>MCDA</td>
<td>Multi-Criteria Decision Analysis</td>
</tr>
<tr>
<td>MNR</td>
<td>Ministry of Natural Resources</td>
</tr>
<tr>
<td>MRVS</td>
<td>Guyana’s Monitoring Reporting and Verification System</td>
</tr>
<tr>
<td>NDC</td>
<td>Nationally Determined Contribution</td>
</tr>
<tr>
<td>NTFP</td>
<td>Non-Timber Forest Product</td>
</tr>
<tr>
<td>PES</td>
<td>Payment for Ecosystem Services</td>
</tr>
<tr>
<td>REDD+</td>
<td>Reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks.</td>
</tr>
<tr>
<td>SESA</td>
<td>Strategic Environmental and Social Assessment</td>
</tr>
<tr>
<td>UNFCCC</td>
<td>United Nations Framework Convention on Climate Change</td>
</tr>
<tr>
<td>VPA</td>
<td>Voluntary Partnership Agreement</td>
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</table>
Definitions of Key Terms

**Biodiversity:** the quantity and variability among living organisms within species (genetic diversity), between species and between ecosystems. Biodiversity is not itself an ecosystem service but underpins the supply of services. The value placed on biodiversity for its own sake is captured under the cultural ecosystem service called “ethical values.” (UN, 1992)

**Climate change:** any change in climate over time, whether due to natural variability or as a result of human activity.

**CO₂e:** carbon dioxide equivalent is a term used to describe different greenhouse gases in a common unit. For any type and quantity of GHG, CO₂e represents the amount of CO₂ that would have the equivalent global warming impact.

**Degradation:** changes to the structure and/or composition of forests, resulting from anthropogenic or environmental activities and leading to continuous reduction of forests’ ability to provide goods and ecosystem services, including storage of carbon.

**Ecosystem:** a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit. Examples of ecosystems include deserts, coral reefs, wetlands, rainforests, boreal forests, grasslands, urban parks and cultivated farmlands. Ecosystems can be relatively undisturbed by people, such as virgin rainforests, or can be modified by human activity (UN, 1992).

**Ecosystem services:** the benefits that people obtain from ecosystems. Examples include food, freshwater, timber, climate regulation, protection from natural hazards, erosion control, pharmaceutical ingredients and recreation (IFC, 2012).

**Emissions:** the discharge of GHGs into the atmosphere.

**Forest:** according to the Forest Reference Level Guyana has elected to classify land as forest if it meets the following criteria: tree cover of minimum 30%, minimum height of 5 m, and minimum area of 1 ha.

**Forest carbon stock:** the amount of carbon stored in a forest, including carbon found in living vegetation, soil, litter, and deadwood.

**Forest reference emission levels or forest reference levels:** benchmark for assessing a country’s performance in implementing REDD+ activities.

**Greenhouse Gases (GHG):** gases found in the atmosphere, of natural or anthropogenic origin, capable of absorbing and re-emitting infrared radiation. According to the Kyoto Protocol, the following gases are considered GHG: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), sulphur hexafluoride (SF₆) and two groups of gases, hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).
1. Introduction

The United Nations Framework Convention on Climate Change (UNFCCC) was created to achieve the “stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.”

During the UNFCCC Conference of the Parties (COP) 13 in 2007, countries recognized the important role forests play in regulating carbon across the globe, encouraging countries to “explore a range of actions, identify options and undertake efforts, including demonstration activities, to address the drivers of deforestation.” During COP 16, countries adopted a decision, as part of The Cancun Agreements (Decision 1/CP.16), encouraging developing countries to contribute to mitigation in the forest sector by undertaking the following activities, as deemed appropriate by each Party and in accordance with their respective capabilities and national circumstances:

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

The same decision from COP 16 requests developing countries willing to participate in REDD+ to develop four elements: a national strategy or action plan; a national forest reference emission level and/or forest reference level; a robust and transparent national forest monitoring system; and a system for providing information on how the safeguards are being addressed and respected throughout the implementation of the REDD+ activities (Figure 1).

![Figure 1 Four elements for REDD+ readiness.](image-url)
It also establishes that REDD+ should be “implemented in phases beginning with the development of national strategies or action plans, policies and measures, and capacity-building, followed by the implementation of national policies and measures and national strategies or action plans that could involve further capacity-building, technology development and transfer and results-based demonstration activities, and evolving into results-based actions that should be fully measured, reported and verified” (Figure 2).

Countries at the COP recognized both the common but differentiated responsibilities towards climate change and different countries’ interest and capacities and established that REDD+ implementation must depend on the specific national circumstances, capacities and capabilities of each developing country and the level of support received.

In this regard, the Forest Carbon Partnership Facility (FCPF) was created to “assist countries in their efforts by providing them with financial and technical assistance in building their capacity to benefit from the REDD+ mechanism; to pilot a performance-based payment system for REDD+ activities, with a view to ensuring equitable benefit sharing and promoting future large-scale positive incentives for REDD+.” To pursue these two objectives the FCPF has two separate funding mechanisms: the Readiness Fund and the Carbon Fund.

With an aim to contribute to global climate change objectives, Guyana began its preparation for REDD+, considering the country’s extensive forest cover and the current institutional and legal framework (see section 5), which provide the basis to improve the country’s outcomes in terms of forest carbon emissions.

Guyana received a grant to support: improvements in the organization of the country for REDD+ readiness, including stakeholder consultations; and the preparation of the Guyana REDD+ Strategy to facilitate Guyana’s access to additional funding under performance-based incentives.

Additionally, Guyana has signed a Memorandum of Understanding with Norway “to foster partnership between both parties on issues of climate change, biodiversity and sustainable, low carbon development”, including:

- A regular, systematic policy and political dialogue to facilitate a constructive exchange of views on global climate change and relevant environmental issues such as biodiversity.
- Collaboration, knowledge building, and sharing of lessons learned within the field of sustainable, low-carbon development, with REDD-plus as the key component of this.
Collaboration on REDD-plus, including establishing a framework for financial support from Norway into a Guyana REDD-plus Investment Fund.

These collaborations, jointly with the Government of Guyana’s efforts through the Office of Climate Change at the Ministry of the Presidency, the Ministry of Natural Resources, and the REDD+ Secretariat under the Guyana Forestry Commission, comprise the preparation for REDD+ and the basis for its implementation.

REDD+ is focused on forest land, land use, and land use change. This represents only one component of the accounting of Guyana’s greenhouse gas emissions and emission reductions. The country has described approaches to reducing emissions in other sectors in a number of separate documents. Some of these documents, such as the Green State Development Strategy and Guyana’s submission of its Nationally Determined Contribution to the UNFCCC, are described briefly in Section 5. However, in general, this REDD+ Strategy only addresses non-forest sectors to the extent that they impact forest land. As a result, the greenhouse gas impacts of certain sectors are not discussed here. This includes, but is not limited to, oil and gas, agriculture, and aquatic systems.
2. Vision for Guyana’s National REDD+ Strategy

Conservation and sustainable use of forests are part of an integral view for sustainable development. As such, the vision for REDD+ within Guyana is embedded in Guyana’s Green State Development Strategy vision for 2040:

An inclusive and prosperous Guyana that provides a good quality of life for all its citizens based on a sound education and social protection, low-carbon and resilient development, providing new economic opportunities, justice and political empowerment.

This vision encompasses three key areas for action: manage natural resource wealth, support economic resilience, and build human capital and institutional capacity. These actions include all sectors (social and economic) and should guide the strategic planning and actions in all areas in the country.

In this regard, the National Biodiversity Strategy and Action Plan (2012-2020) has established that Guyana’s ecosystems and more specifically forests play a crucial role in achieving this vision.

In addition, in Guyana’s Nationally Determined Contribution to the United Nations Framework Convention on Climate Change (UNFCCC), the country considers forest as the most important sector for mitigation.

The REDD+ Strategy then has the following objectives, in line with the NDC’s aim of avoiding emissions in the amount of 48.7 MtCO2e annually (GoG 2016):

- Ensure sustainable forest management, through compliance with the various Codes of Practice that govern the timber industry using local resources.
- Maintain a low rate of illegal logging at less than 2% of production.
- Improve added-value activities locally to assist in creating a higher potential for carbon storage in long-use wood products.
- Support indigenous communities (if they choose to) to better manage their transition to more market-based means of provisioning for their social and cultural well-being in ways that continue the tradition of wise use.
- Conservation of an additional 2 million hectares through Guyana’s National Protected Area System and other effective area-based conservation measures.
- Use of Reduced Impact Logging (RIL).
- Transformation of the mining sector by 2020.

Implementation of the REDD+ strategy will be guided by the following principles1:

a. Consistency with UNFCCC guidance on REDD+;
b. Promote cross-sectoral engagement and coordination for the implementation of REDD+ policies and measures;
c. Ensure full and effective participation of relevant stakeholders, including those most vulnerable, such as local communities, indigenous peoples and women;

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1 Note that while the development of the REDD+ Strategy is being undertaken in accordance with FCPF Readiness guidance, as described in Section 1, implementation of the Strategy should continue beyond the end of Readiness support.
d. Build capacity within government institutions and non-government stakeholders;

e. Maintain consistency with methodologies and guidance as set out by the Intergovernmental Panel on Climate Change (IPCC); and

f. Consistency with national legislation and the obligations of relevant and applicable international conventions and agreements.

g. Ensure that both women and men are able to participate meaningfully and equitably, have equitable access to resources, and receive comparable social and economic benefits;

h. Ensure indigenous peoples’ rights are respected and encouraged.

i. Promote biodiversity conservation and enhancement, taking into consideration REDD+ interventions will not lead to the conversion of natural forests.
3. State of the land use

The country of Guyana is approximately 21 million hectares (ha) with 87% covered in tropical forest. The country is broadly broken into two geographic areas: the coastal plains that stretch along its 430 kilometers of coastline in the north (making up 5% of the country), and its interior highlands, a series of plateaus, flat-topped mountains, and savannahs that extend from the coastal plains to the country's southern borders.

According to the Guyana’s Land Use Plan (2013) Guyana recognizes three main types of land tenure: Private Land, Amerindian Land, and State and Government Land. Within the State and Government Land are Protected Land, State Forest and concessions including logging, mining, and agriculture. Settlement lands and private land are not considered as they are not under the current MRVS. For REDD+ development it is important to disaggregate land tenure into land use categories that have different drivers and threats of deforestation and forest degradation. These land use categories are described below and mapped in Figure 3.

**Private land.** This is land held privately by individuals or companies. This was not included in this analysis as it is not under the current MRVS REDD+ program.

**Amerindian lands.** These lands are State Forest Area (SFA) and State Lands that are designated for Indigenous People. Amerindian Lands, as provided for in the Amerindian Act 2006, are areas that are titled to Amerindian villages. This typically means that land management is to the remit of the Amerindian village and is historically limited to small-scale logging and mining operations. However, outside miners could operate in these areas with permission granted from GGMC and from the Village. There is also small-scale agriculture on these lands, mostly shifting agriculture. Amerindian titled lands require permits from the state agencies if they plan to conduct mining or if lumber is taken off their land. No permission is required for felling.

**Protected land.** The Protected Areas Act of 2011 Section 6(x) defines protected areas as areas managed for the conservation of biological diversity and the maintenance of ecosystem services. Development within these areas is restricted to those that have low-level ecological impacts and therefore excludes most forms of mining and logging, though some extraction can be permitted. Some areas are not well protected therefore illegal mining and logging activities persist, but at very low levels. Logging activities do occur in the Iwokrama forest because it is part of the management plan and was developed for those purposes.

**State forest.** According to the Forest Act Section 3, Chapter 61:01, the State Forest Area is owned and managed by the State and is a subset of State Land. This land can be granted for development by the State. Much of this land has been granted into concessions for mining, forestry or agriculture. State forests have mining concessions for sub-surface rights according to the Mining Act, and forest concessions outlined by the Forestry Act.

**State land.** State lands are identified as areas that are not included as part of the State Forest Area but are still managed by the State. Like State Forest this land can be granted into concession and is interspersed with pockets of privately held land. This does not include titled Amerindian villages. Agricultural permits are given on State Land.

**Concession.** This land is not a designated land tenure type. Concessions are actually categorized as State forest and State land, where a concession has been granted. This includes

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2 Granted by the government but specifically through the regulating/monitoring agency GGMC, GFC, GLSC.
mining, logging and agricultural concession. However, for this report concession has been made a sub category land type to help improve the understanding of where deforestation is occurring.

These different land classifications were analyzed using GIS to overlay the GFC land cover change dataset from 2001 to 2016 with the land classification boundaries. The results show concession land makes up the largest area of land in Guyana (40%), and predictably has the highest rate of deforestation (0.3% y\(^{-1}\)) (Table 1). This is followed by Amerindian land, State Forest, State Land and protected areas.
Table 1. Different land classifications in Guyana, with information on the percent forested and annual deforestation rate (not official).

<table>
<thead>
<tr>
<th>Land tenure</th>
<th>Land use categories</th>
<th>Area (km²)</th>
<th>Percent of Guyana</th>
<th>Percent forested</th>
<th>Annual deforestation rate</th>
<th>Average annual deforestation (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>State/Government Land</td>
<td>Concession</td>
<td>85,183</td>
<td>40%</td>
<td>88%</td>
<td>0.30%</td>
<td>22,601</td>
</tr>
<tr>
<td>Amerindian Land</td>
<td>Amerindian</td>
<td>32,385</td>
<td>15%</td>
<td>74%</td>
<td>0.15%</td>
<td>3,560</td>
</tr>
<tr>
<td>State/Government Land</td>
<td>State forest</td>
<td>59,412</td>
<td>28%</td>
<td>97%</td>
<td>0.04%</td>
<td>2,426</td>
</tr>
<tr>
<td>State/Government Land</td>
<td>State land</td>
<td>22,848</td>
<td>11%</td>
<td>64%</td>
<td>0.04%</td>
<td>589</td>
</tr>
<tr>
<td>State/Government Land</td>
<td>Protected area</td>
<td>11,613</td>
<td>5%</td>
<td>95%</td>
<td>0.01%</td>
<td>90</td>
</tr>
</tbody>
</table>

3.1. Historical deforestation

Land use changes in Guyana are predominantly a result of mining, logging or agricultural expansion, however historic rates of deforestation are low, ranging from 0.02% to 0.079% per year (MRVS Year 7 Version 1).

The historical rate of deforestation was assessed for 2001 to 2012, which is in line with Guyana’s REDD+ historical Reference Level period (RL). The rate and location of deforestation was established using the Guyana Forestry Commission (GFC) GIS layer called “All Change,” which maps deforestation by driver across Guyana every year. The All Change layer is used by Guyana for its Monitoring Reporting and Verification System (MRVS), and therefore in its annual MRVS reporting (GFC 2017). Total amount of deforestation by year is shown in Figure 44. On average 95% of all deforestation is from mining, logging and agriculture.

Figure 44. On average 95% of all deforestation is from mining, logging and agriculture.

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5 These data were generated from a spatial analysis using the land cover change data from the Guyana Forestry Commission (GFC) and from government boundaries for each of the described land classifications. This data is consistent with the data used in other Guyana REDD+ reporting.
Figure 4. Historical deforestation by year in Guyana from the MRVS. Note that 2015 and 2016 are combined into one reporting year, but are separated here, using half of the reporting year for each calendar, to show approximate annual deforestation.

This deforestation is mapped across Guyana every year (Figure 5). These maps are key inputs to the model that will define both the location of deforestation, and the rate over time.
3.2. Predicted future deforestation

To inform the development of Guyana’s REDD+ Strategy it is important both to understand historical rates of deforestation and forest degradation and to model potential future impacts that different REDD+ alternatives might have on forest loss, and therefore emissions. The modeling of future deforestation projects the impacts that different REDD+ strategy alternatives would have on forest loss and the resulting GHG emissions. This section outlines the spatial modeling used to project future deforestation under different REDD+ alternatives in Guyana. This includes the assessment of historical rates of deforestation and degradation, the development of factor maps that will inform the spatial distribution of deforestation, and the resulting risk maps that will be used to project where future deforestation is most likely to occur.

To model the location of future deforestation spatial data layers (e.g. roads, rivers, settlements) were assessed against forest loss from mining, logging and agricultural, and developed into ‘factor maps.’ The factor maps include distance to relevant existing activities and features; land tenure; and elevation. The different factor maps were analyzed against past deforestation to assess which of the factor maps best predicted deforestation from mining, logging and agriculture for a 30-year period from 2016. This assessment resulted in a combination of factor maps that had the best predictive
potential for each of the three major drivers of deforestation. Figure 6 shows the areas of projected deforestation under a business as usual scenario; a more detailed explanation on the methodology and results can be found in Annex 1.

Figure 6. Map showing the location of projected future deforestation in Guyana under Business as Usual.
4. Drivers of deforestation and forest degradation

4.1. Direct drivers

As presented in the report *Analysis of Direct Drivers of Deforestation in Guyana* (Netzer et al., 2018), there are several key drivers of deforestation (Table 2). Many of the results in the report should be useful as validation and quantification of national and regional trends, and in some cases may shed new light on the spatial and temporal attributes of different drivers. This section presents an overview of the most important results from that report.

Table 2. List of all direct drivers of deforestation and degradation (D&D) and other causes of forest loss in Guyana, with annual area of change and the percent that each driver contributes to the total change (Netzer et al. 2018)

<table>
<thead>
<tr>
<th>Cause of forest change</th>
<th>Annual average deforestation 2001-2016</th>
<th>Percent of total deforestation</th>
<th>Annual average emission 2001-2016</th>
<th>Percent of total emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Area in ha</td>
<td>Emissions in t CO₂/y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mining (deforestation)</td>
<td>5,793</td>
<td>78.8%</td>
<td>5,680,423</td>
<td>55.2%</td>
</tr>
<tr>
<td>Forestry/logging (degradation)</td>
<td>NR</td>
<td>NR</td>
<td>3,673,362</td>
<td>35.7%</td>
</tr>
<tr>
<td>Forestry roads (deforestation)</td>
<td>283</td>
<td>3.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture (deforestation)</td>
<td>520</td>
<td>7.1%</td>
<td>668,115</td>
<td>6.5%</td>
</tr>
<tr>
<td>Infrastructure (deforestation)</td>
<td>330</td>
<td>4.5%</td>
<td>168,921</td>
<td>1.6%</td>
</tr>
<tr>
<td>Fire (deforestation)</td>
<td>341</td>
<td>4.6%</td>
<td>92,815</td>
<td>0.9%</td>
</tr>
<tr>
<td>Settlements</td>
<td>57</td>
<td>0.8%</td>
<td>6,268</td>
<td>0.1%</td>
</tr>
<tr>
<td>Pioneer shifting agriculture (deforestation)</td>
<td>32</td>
<td>0.4%</td>
<td>ND</td>
<td>ND</td>
</tr>
</tbody>
</table>

NR – Not Reported.
ND – No Data.

The assessment of individual drivers is important for understanding spatial location, and the historical and likely future trends of each driver.

1) **Mining**, including the associated infrastructure, is the largest driver of deforestation and therefore of GHG emissions in the land use sector – making up 55% of total annual emissions. Mining activity has been on a steep increase over the last decade, and economic projections indicate that this is likely to continue for at least another decade.

2) **Forestry** is the second largest driver of emissions at 36% of the average total annual emissions, most of which are the result of degradation, rather than deforestation. Road construction for logging is the primary source of deforestation from forestry, accounting for less than 4% of all deforestation. The industry is projected to grow over the next 10 years, though at a slower rate than mining.

3) **Agriculture** is second in area of deforestation, but a distant third in emissions, at 6.5%. Agricultural leases in Guyana have been largely stable over the last few decades. However, agriculture is expanding both on the west coast (Regions 1 and 2), and in the interior.

4) **Infrastructure** includes roads and other infrastructure that are not associated with forestry or mining (as those are included as part of the mining and forestry operations). Infrastructure accounts for 4.5% of deforestation and 1.6% of emissions.

5) **Fire** represents less than 1% of the forest loss in Guyana, however it appears to have increased dramatically over the last decade from around 20 ha⁻¹ y⁻¹ in 2001 to over 1000 ha⁻¹
1 y⁻¹ in 2015, and 2000 ha⁻¹ y⁻¹ in 2016. The spatial distribution of fire seems to be correlated with agriculture, therefore fire may represent agricultural expansion.

6) **Settlements** are an extremely small portion of the deforestation in Guyana, accounting for less than 1% of total deforestation. As defined by the MRVS, settlements include areas of new human settlement based on image evidence and population data (where available). They must be greater than 1 ha.

7) **Shifting agriculture**, as mentioned above, is extremely defuse across Guyana, and given the low rate of expansion it likely has the least potential for effectively reducing emissions from deforestation and degradation.

Results show that mining, forestry and agriculture (not including shifting agriculture) make up 97% of Guyana’s GHG emission from the land use sector, and infrastructure is largely driven by expansion of these industries (Table 2). These three primary drivers of deforestation and degradation are largely occurring in legally designated concession areas. This does not mean that there is no illegal encroachment, but it does indicate that Guyana, unlike many other developing countries, does maintain regulation over these institutions, and deforestation from illegal activity appears to be minimal. It is also important to consider that Guyana has large areas with very low population density, with relatively low pressure over the ecosystems. Therefore mining, forestry and agriculture could be influenced by well-designed government REDD+ strategies. For these reasons this Guyana REDD+ Strategy report will focus on these three drivers.

### 4.2. Indirect drivers

Drivers of deforestation do not occur in isolation, rather they have underlying conditions and causes that provide the conditions for the direct drivers to occur. A previous report (Durbin, Balraj, and Bernard, 2018) provided an analysis of indirect drivers of deforestation and forest degradation by carrying out a governance assessment following the “Framework for assessing and monitoring forest governance” (PROFOR-FAO, 2011). The assessment adapted the Framework, expanding the scope to address a broader range of issues contributing to deforestation and forest degradation in Guyana, and to understand the linkages between different indirect drivers. Results from the application of the governance tool were analyzed to develop conceptual models that depict the complexities and relationships that comprise the indirect drivers of deforestation and establish the conditions for the direct drivers. Findings from the Governance Assessment (Durbin, Balraj, and Bernard, 2018), regarding the impact of indirect drivers on the direct actions that result in deforestation and forest degradation are described in the following subsections. These findings come especially from workshops held with members of the Core Group.

#### 4.2.1. Mining and infrastructure

Mining is the major direct driver of deforestation and forest degradation in Guyana, dominated by large-scale bauxite, manganese and gold operations, as well as small- and medium-scale gold and diamond mining. Mining is currently the principal foreign exchange earner and a major source of revenue to fund the government’s economic development agenda. The primary driver of mining is high international demand for gold, mirrored in the current high price of gold, and international demand for other minerals (Durbin, Balraj, and Bernard, 2018; Sohngen and Hite 2015).

Deforestation and forest degradation from medium- and small-scale mining are driven by several factors:

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6 Notes from these workshops can be found in the full Governance Report.
• Inefficient methods and techniques cause more deforestation, since yields are low with poor recovery rates, often less than 30%.
• Lack of geological data can lead to unnecessary clearing of forests where there may be nothing substantive underground.
• Lack of capital to invest in better techniques and in obtaining better data.
• Lack of incentives from government for improved mining practices, and limited training and demonstrations.
• Lack of monitoring and enforcement caused partially by limited allocation of financial and human resources in the GGMC for these purposes.

Mining is one of the factors behind the development of new roads, as well as national initiatives to link the coastal and forested areas of the country.

Hydropower is part of the government infrastructure plans, driven by the demand for affordable electricity and the desire to reduce reliance on fossil fuels.

Compounding these issues, Guyana lacks a land policy or an operational national land use plan. While a national land use plan has been developed through a participatory process, it has not been adopted by law and is not fully implemented, nor is it prescriptive enough to guide decision making (Durbin, J., Balraj, D and Bernard, C. 2018). The Guyana Lands and Surveys Commission (GLSC) is currently leading an effort to develop a National Land Policy and revise the National Land Use Plan with the aim of incorporating an integrated approach.

4.2.2. Forestry

Timber harvest and extraction typically causes forest degradation. Logging in Guyana is primarily legal, but there is also a very small percentage of illegal logging (Government of Guyana, 2016). Logging is conducted within designated concessions, with an established annual allowable cut, with a mandate for sustainable forest management. Concession are granted under varying conditions both in size of the concession and period that the concession can be harvested. These factors can influence the volume and therefore the emission taken from any given area or concession. In addition to the extraction of logs themselves, legal logging involves creation of access roads, skid trails, and clearances for log decks, all of which impact relatively small areas of forest.

All logging is primarily driven by demand for wood. Both legal and illegal logging supply wood for domestic use and legal logging also supplies wood for export. International demand for timber, which drives legal logging, is still significant and is increasing from India, Caribbean countries, and China. Local demand, which is satisfied by both legal and illegal logging, is driven by an increase in housing resulting from increasing standards of living and government policy to increase housing.

4.2.3. Agriculture, Fire, and Shifting Agriculture

Although government policies are promoting expansion and diversification of commercial agriculture, including cultivation of soy, fruits and vegetables (Ministry of Agriculture, 2013), this is focused in coastal and savanna areas and, though impacting intact ecosystems, is not perceived to be a major driver of deforestation. In some cases, however, commercial agriculture, such as cattle rearing outside forests, leads to fires penetrating and destroying forests (Netzer, et al, 2018).

Another source of deforestation from agriculture is from shifting agriculture, which is a traditional practice of indigenous peoples. This is mostly done for subsistence and to supply local markets and is also not a significant driver of deforestation.
5. Legal and policy framework

5.1. Existing development policies and planning instruments

Most drivers have their origin in current policies, regulations and planning instruments (or in the absence of policies, regulations and planning instruments). Existing development policies and planning instruments have an influence on forests, as drivers or as part of the solutions to address them. Numerous documents have previously been developed by or for Guyana to guide the country’s efforts towards sustainable development as low carbon development and engagement in the REDD+ mechanism. These documents could be classified into two broad thematic types:

- National Strategies;
- Sector-Specific Strategies;

A wide range of development policies at the national- or sector-level and that are specific to REDD+ have been drafted over the last decade, with a broad range of potential REDD+ activities emerging from the plans, recommendations and activities. Although there is a great diversity across these plans some key themes emerge. Grouping of activities that occur across a range of policies include those focused on:

- Improving coordination across natural resource management agencies
- Improving efficiency within extractive industries
- Improving planning and zoning, inclusive of improved information on the resources
- Increasing value-added within the forestry sector
- Developing mechanisms to distribute and allocate the benefits associated with REDD+ or forest management more generally

Relevant policies and planning instruments are described in Tables 3 and 4.

Table 3. National Strategies related to REDD+ in Guyana

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>Low Carbon Development Strategy 2009</strong></td>
<td>Guyana's Low Carbon Development Strategy (LCDS) was launched in June 2009 and outlined the proposed approach to development of Guyana's path to a low carbon, sustainable development trajectory, while simultaneously combating climate change. A key part of the strategy involves deploying Guyana’s tropical forests towards addressing global climate change. It has three main components: Investment in low carbon economic infrastructure; Investment and employment in low carbon economic sectors and; Investment in Communities and Human capital. Specifically, it identifies eight priorities that will be the initial focus of LCDS implementation in 2009-2013, gives an outline a further five priorities for the period 2013-2015, and sets out the framework for further consultation and strategy development on Guyana’s long-term low carbon development. Since 2009, the LCDS has aimed to meet two complementary objectives: to sustain Guyana’s development and prosperity through following a low carbon development trajectory and; to build a model for REDD+ that can provide the world with a functioning mechanism from which insights can be drawn. In November 2009, a Memorandum of Understanding was signed between Governments of Guyana and Norway for which Norway has committed in</td>
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providing Guyana up to US$250M by 2015 for avoided deforestation once certain performance indicators are met.

Following the launch of the LCDS in 2009, a Multi-Stakeholder Steering Committee (MSSC) was formed to guide the development and subsequently the implementation of the Strategy. Following the national launch of the LCDS, a series of 15 “sub-national consultations” were held in all 10 regions of the country between June 19 and July 7, 2009 in which representatives from 222 communities participated inclusive of forest dependent and Indigenous Peoples communities. Additional outreach sessions were also convened in the three counties of Demerara, Essequibo and Berbice.

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<tr>
<td>Green State Development Strategy</td>
<td>Guyana is in the process of developing its Green State Development Strategy (GSDS) with the assistance of UNEP. The Strategy will guide Guyana’s development trajectory over the next 20 years. GSDS is the new pathway for Guyana to achieve sustainable development goals, building from the LCDS. This document serves to outline the vision, principles and central themes for the strategy as well as outlining financing options, a monitoring and evaluation framework and an institutional process for elaborating the GSDS.</td>
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**Table 4. Sector-specific Policies related to REDD+ in Guyana**

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<thead>
<tr>
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<tr>
<td><strong>Guyana’s Revised Nationally Determined Contribution submitted to the UNFCCC 2016</strong></td>
<td>Guyana submitted its revised Nationally Determined Contribution to the UNFCCC in November 2015. Guyana’s commitments under the NDC focused on forests and energy, committing to creating a Green Economy via a low-emission economic-development pathway. Unconditional commitments to realize sustainable forest management, maintaining high levels of forest legality, implement the VPA under EU-FLEGT and improve local value-added production. In addition, there are unconditional commitments to indigenous communities with regard to benefits from REDD+.</td>
</tr>
<tr>
<td><strong>National Forest Policy Statement. Guyana Forestry Commission (GFC) 2018</strong></td>
<td>Guyana developed a new National Forest Policy Statement in 2018 as the result of a consultative process between a wide variety of stakeholders. The revised policy addresses the management of forest resources in a visionary way with the development of forest resources across sectors, with a broader goal to maximize more than timber values from the resources. The overall objective goal of the Forest Policy and Plan is “The conservation, protection and utilization of the state’s forest, by ensuring its social, economic and environmental attributes and benefits are sustained and enhanced for the benefit of current and future generations of Guyanese, whilst fulfilling Guyana’s commitments under international agreements and conventions.” Within this goal are found four specific objectives (SOs) that drive all activities within the Plan. These SOs are:</td>
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| SO 1: **Sustainable Forest Management** | Includes the development of forest management strategies, including investment in the development of high-quality, sustainable forest management practices. |
| SO 2: **Forest Protection and Restoration** | Focuses on protecting and restoring forests, including the implementation of measures to prevent deforestation and forest degradation. |
| SO 3: **Forest-Based Economic Development** | Involves the development of local economic opportunities that are based on and linked to the forest. This includes the establishment of small and medium-sized enterprises that are focused on producing and marketing forest-based products. |
| SO 4: **Community Engagement and Benefit Sharing** | Involves building the capacity and participation of local communities, particularly indigenous communities, in forest management and decision-making processes. This involves ensuring that communities receive benefits from forest management activities and have a voice in how forests are managed. |

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The Policy Statement outlines the key existing issues relating to each of these four SOs and proposes a range of strategies relating to each of the four SOs. It does not propose actual activities. These are expanded in the Forest Plan.

The Policy itself represents a major conceptual shift in forest management in the country. Previous Plans and Policies had focused on the forest as a resource to be extracted for timber. The most recent iteration of the Policy however views the forest as a holistic resource with benefits arising from a range of activities, inclusive of conservation, and management should focus on this whole range of benefits rather than merely extraction.

### National Forest Plan. GFC 2018

The Forest Plan accompanies the Policy Statement and provides activities to operationalize the four SOs identified in the Policy Statement. The SOs are subdivided into eight Policy Goals:

- Forest Extraction - looking at increasing efficiency of forestry operations and reducing deforestation from extractive industries
- Promote Value-Added products and non-timber goods and services
- Conservation and Protection Strategies
- Ensure forest health through preventative and restorative measures
- Institutional Strengthening and coordination
- Improving Participation and Transparency
- Forestry Research and Information
- Education and Training

The Plan is to be implemented by the Guyana Forestry Commission with the support of a variety of other Ministries and sector agencies.

### National Land Use Plan. 2013

The National Land Use Plan (NLUP) of 2013 provides a strategic framework to guide land development in Guyana. The Plan is not a definitive or prescriptive document, but it provides support to decision making, through looking at development options and constraints throughout the country. The purpose is for it to be incorporated into the lease decision process, with the objective of encouraging decisions which optimize the use of Guyana’s resources for the benefit of its people. The Plan itself does not make any such decisions. The NLUP is built upon a number of national policies and strategies that have a direct relevance for land use and land management. A main objective of the NLUP is to enable financial resources to be targeted at optimal land uses at the regional level. The NLUP is not prescriptive in that it does not aim to zone areas of the country for particular land uses, rather it aims to suggest a number of options for particular areas that can then guide decision-makers and attract inward investment. In conjunction with the above, a further aim of the NLUP is to provide a spatial element to development planning, to show on
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<tr>
<td><strong>National Biodiversity Strategy and Action Plan (2012-2020)</strong> 2015</td>
<td>The NBSAP is the response to Guyana’s obligations under the Convention on Biological Diversity. The plan’s vision is that by 2030, biodiversity is sustainably utilized, managed and mainstreamed into all sectors contributing to the advancement of Guyana’s bio-security, and socio-economic and low carbon development. It includes priority actions and targets to comply with CDB goals and Aichi Targets. These actions and targets are aligned supported by those in this REDD+ Strategy.</td>
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### 5.2. Stakeholder overview

There are numerous stakeholders from across all ten Administrative Regions that will be consulted during ongoing development of the REDD+ Strategy. This includes agencies that previously have been involved in REDD+ related activities, such as those related to the GSDS, LCDS, the FCPF or other donor-funded REDD+ activity. This includes Guyana government agencies, international entities, civil society groups, private entities, indigenous peoples and other relevant sectors and communities. The identified actors include some Enablers, Strategic Implementing Partners or Supporting Organizations that, it is felt, should be strongly involved in the stakeholder consultations, notably the Department of the Environment, Guyana Lands and Surveys Commission, Forest Producers Association, Guyana Gold & Diamond Miners Association, Guyana Women Miners Organisation and the Guyana Youth Environment Network (GYEN), Amerindian Peoples Association. Although these organizations may not have previously been involved in REDD+ to a large extent, they represent important potential implementers for actions such as land use planning and regulatory or efficiency improvements in the extractive industries.

A thorough description of identified stakeholders and the intent for stakeholder engagement are provided in Severino et al. (2018).
6. Policies and measures to address drivers of deforestation and forest degradation

The Cancun Agreements recognize that REDD+ implementation depends on the specific national circumstances, capacities and capabilities of each country. According to these agreements, actions to tackle drivers of deforestation and forest degradation, carried out under the frame of REDD+, are requested to consider several factors such as land tenure issues, forest governance issues, gender considerations, and safeguards, and assumes there is political will to fully implement the proposed activities.

Activities undertaken by REDD+ countries should be implemented in phases, including policies and measures to address drivers of deforestation and forest degradation, however, the UNFCCC does not refer to specific guidelines regarding how these actions must be approached. Hence it is relevant that countries develop their own policies and measures according to their national circumstances, taking into account the UNFCCC decisions on REDD+.

REDD+ serves as a compensation mechanism based on verified results coming from reduced emissions from the forest sector. To facilitate monitoring of activities, as well as verification of the impact each activity has in actual emissions reduction, it is useful to describe activities in two main categories (Salvini, et al, 2014):

a) Actions towards creating the enabling conditions
b) Actions that have a direct impact on carbon emissions or removals

The first set of actions is conceptually linked to address the indirect drivers of deforestation and forest degradation, whereas the second is designed to address the direct drivers.

Effective REDD+ strategies seek to support economic growth, while reducing the impact on forests. Much of the deforestation and degradation in Guyana appears to be within legally designated areas, therefore, strategic and directed policies and regulations, monitoring, enforcement and training should be targeted to ensure an effective REDD+ approach.

Infrastructure and settlements have a low impact on deforestation in Guyana but are a consequence of mining and logging. The REDD+ strategy should take a holistic view of the forestry and mining sectors, and therefore may influence settlements and infrastructure. Deforestation and degradation from mining and forestry predominantly occur in concession areas designated for these activities and not significantly in protected or non-designated State Forest or State Land. This does not mean that there is no illegal encroachment, but it does indicate that Guyana, unlike many other developing countries, maintains regulatory control over these institutions. It also signifies that improvements to regulation and policy in the mining and forestry sector could be effective means to slow deforestation.

The distribution of deforestation by administrative units, sub-districts and administrative regions can allow those involved in REDD+ strategy to identify where activities and policies will be most effective against different drivers. For example, if a driver is prevalent in only a few regions, then it may be more efficient and applicable to develop policies and activities just for those select regions instead of attempting to apply those policies or measures nationally. Of course, it will then also be necessary to account for leakage of deforestation to other regions in modeling the emissions.

Alternatives available to address the drivers of deforestation and forest degradation are diverse in nature, including adjustments to the legal framework, strengthening governance, and implementing activities at field level. These need to be implemented jointly to have a coherent impact in changing the incentives and behaviors to effect reduced deforestation and degradation, while promoting productive activities in forested areas.
Based on the analyses described above and refining the findings from *Alternatives to Address Drivers of Deforestation and Forest Degradation* (Severino *et al.* 2018) in order to clearly classify the policies and measures between those creating the enabling conditions and those that have a direct impact on reducing emissions, there are five strategic options with different but complementary actions on which Guyana’s National REDD+ Strategy would focus.

1) **Strengthen policy, legal and institutional framework.** The actions and activities currently performed in forested areas have their origin in the current legal, policy and institutional framework, which provides the incentives to conduct activities that lead to deforestation and degradation. Improvements to the legal, policy and institutional framework are intended to create more consistency and coherence among sectors and levels of implementation to give support, and correct incentives, to activities aimed at sustainable development. Even though Guyana has policies and regulations to promote conservation, sustainable use of forest, and sustainable practices in or around forests, it has been identified that, in some cases, there are some conflicts in legislation\(^7\) and a need to improve enforcement.

2) **Direct actions in mining and forestry sectors to slow deforestation and forest degradation** to ensure the productive practices (mining, logging, agriculture) cause minimal or no harm to forest ecosystems, while working to improve economic returns over the long term.

3) **National land use planning and implementation,** to ensure several objectives: a) coherent land use across the country, b) effective monitoring and compliance, c) promoting mining, agricultural and forestry operations with reduced impact to forest ecosystems

4) **Actions to improve and maintain forests’ capacity to store carbon.** Actions should be undertaken to maintain current forests, and to increase their capacity to store carbon. This should include both well-preserved and degraded forests, and potentially even non-forest lands that could be returned to forest cover.

5) **Encourage economic alternatives to mining.** As mining is an important income source for many people in the country, promoting economic alternatives could enable some reduction in mining while not disrupting the economy.

Table 5 provides an overview of these strategic options, showing actions that create enabling conditions and actions that directly lead to emissions reductions. These actions are included in the National REDD+ Strategy as starting point. The exact details should be developed when implemented.

\(^7\) i.e. Amerindian Act, Mining Act, and Forestry Act
Table 5. Policies and measures grouped by Strategic Option, with relevant enabling conditions and actions identified.

<table>
<thead>
<tr>
<th>Strategic Option</th>
<th>Actions to create enabling conditions</th>
<th>Direct actions to reduce emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Strengthen policy, legal and institutional framework.</td>
<td>Increase communication and cross-agency reporting, including instituting quarterly or annual meetings of key leaders and joint reporting.</td>
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<td></td>
<td>Require cross-agency approval of the largest mining and forestry concessions.</td>
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<td></td>
<td>Require cross-agency approval of road-building within concessions.</td>
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<td></td>
<td>Increase budgets and efforts to ensure compliance with existing regulations in all sectors (mining, forestry, and agriculture), including employing more updated technologies, and collaboration with Amerindian and local communities.</td>
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<td></td>
<td>Update legal framework to create more consistency and coherence among sectors and to give support to and correct incentives for activities aimed at sustainable development.</td>
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<td></td>
<td>Expedite procedures to achieving land tenure clarity and security, especially for Amerindian communities.</td>
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<tr>
<td>2. Direct actions in mining and forestry sectors to slow deforestation and forest degradation</td>
<td>Develop regulations, codes of practice, and guidelines that require use of best management practices and practices that increase efficiency, with effective monitoring and verification.</td>
<td>Implementation of best management practices for mining operations</td>
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<td></td>
<td>Develop subsidy mechanisms for mining operations to implement best management practices or new measures to increase efficiency in mining operation (measured in terms of reductions in deforestation).</td>
<td>New practices to increase efficiency in mining operation</td>
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<tr>
<td></td>
<td>Develop toolkits and educational programs to increase efficiency in mining operations (measured in terms of reductions in deforestation).</td>
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<td></td>
<td>Encourage certification (FSC or other) on all forest concessions.</td>
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<td></td>
<td>Develop subsidies to encourage certification for forest concessions.</td>
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<tr>
<td></td>
<td>Strengthen existing toolkits and educational programs and develop new ones as necessary to increase efficiency and reduce impact in forestry operations.</td>
<td>Implementation of best management practices for forestry operations</td>
</tr>
<tr>
<td>3. National land use planning and implementation</td>
<td>Comprehensive (cross-sectoral and multilevel) land use planning in order to efficiently manage and rationally use natural resources, either by ensuring and/or modifying current national land use plans and its proper adoption by law.</td>
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<tr>
<td><strong>4. Actions to preserve and improve forests’ capacity to store carbon</strong></td>
<td>Strengthen management plans and guidelines for development of infrastructural planning and implementation to ensure low environmental impact practices, mainly in road construction, and to improve efficiency.</td>
<td>Replanting and regenerating forest after mining activities.</td>
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<td></td>
<td>Increase administrative and other costs for road-building.</td>
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<td></td>
<td>Incorporate new areas to the National Protected Area System.</td>
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<td>Enhance mineral mapping combined with and reducing lands available for mining and forest concessions.</td>
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<td>Implement common property resource systems on suitable lands.</td>
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<td>Encourage communities’ involvement in managing protected areas.</td>
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<td>Allow for monitoring within project and activity budgets, to ensure implementation.</td>
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<td>Development of instruments or mechanisms to finance and encourage replanting and regenerating forests after mining activities (including mine tailings).</td>
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<td>Regulations/subsidies to improve efficiency in the forestry sector by reducing waste and forest degradation (e.g., reduced impact logging).</td>
<td>Implementation of best management practices in forestry operation.</td>
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<td>Promote agroforestry via regulations or subsidies.</td>
<td>Implementation of agroforestry systems.</td>
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<td>Implement more holistic and integrated approach on managing forest fires.</td>
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<td>Develop PES system to pay for avoided deforestation or other environmental services.</td>
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<td>Develop a national system to offset carbon emissions through a cap on energy generation emissions or a carbon tax.</td>
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<td>Direct promotion of mangrove systems to protect the coast as well as associated carbon stocks.</td>
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<td><strong>5. Encourage economic alternatives to mining</strong></td>
<td>Develop income-generating activities in low-lands and coastal zones (non-forested areas) to reduce migration and reduce reliance on extractive industries.</td>
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<td>Increase production of value-added products in the agricultural and forestry sectors.</td>
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<td>Increase use of wood products in building materials.</td>
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<td>Increase productivity of agriculture in coastal areas</td>
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<td></td>
<td>Build capacity in population to engage in non-extractive industries</td>
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<td>Actions to create enabling conditions</td>
<td>Direct actions to reduce emissions</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Promotion of productivity and value-added in coastland agriculture</td>
<td>Development of suitable infrastructure (telecommunications, renewable power, etc.) to promote development in non-extractive sectors</td>
<td></td>
</tr>
<tr>
<td>Use of finance from oil income to promote economic development in non-extractive sectors</td>
<td>Retraining opportunities for those engaged in extractive industries</td>
<td></td>
</tr>
<tr>
<td>Financial incentives for those engaged in extractive industries to invest in non-extractive industries</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
As shown in Table 5 there are five direct actions to reduce emissions from deforestation, forest degradation or to increase forest carbon stock, which are also aligned with the findings of the Technology Needs Assessment (Office of Climate Change, UNEP-DTU, 2016):

1. Implementation of best management practices for mining operations.
2. New practices to increase efficiency in mining operation.
3. Replanting and regenerating forest after mining activities.
4. Implementation of best management practices for forestry operations.
5. Implementation of agroforestry systems.

The first three actions could be implemented, according to specific characteristics of each site in areas in which there are currently mining operations (Figure 7); whereas the fourth action could be implemented in areas with forestry operations (Figure 8).

The purpose of the REDD+ Strategy is to address drivers of deforestation and forest degradation from an integral view, including the indirect drivers, so the five activities must necessarily be implemented in conjunction with the actions that create the enabling conditions. The following section explores possible scenarios to implement the actions presented in the current section.
7. REDD+ Strategy Scenarios

To explore the effect of implementing the 5 Strategy Options presented in the previous section, six Scenarios were modeled based on a set of possible actions (both weak and strong) to achieve targeted rates of deforestation and degradation. The modeling is based on economic analyses to project the impact of the policies and measures, and spatial analysis to project the geographic location of the impact. Additionally, a Business as Usual (BAU) case was modeled to project the extent of deforestation and degradation in the absence of implementation of any REDD+ Strategy.

This section provides an overview of 6 proposed REDD+ Strategy scenarios. Annex 2 provides a description of the modeling of each of the scenarios and the resulting projections. The six scenarios (weak and strong for each except Scenario 6) are then compared to the BAU to assess the impact that each scenario would have on deforestation projected from 2016 to 2026, 2036 and 2046 (30 years).

**Scenario 1. Reform and strengthen policy, legal and institutional framework**

The primary drivers of land use change in Guyana revolve around the expansion of mining through granting of new mining concessions and building roads, and forestry activities. One factor that could encourage more deforestation than otherwise is lack of coordination across agencies. This could involve failure to recognize common boundaries for forest and mining concessions, duplicative road building efforts, and other examples where two different agencies could have collaborated and achieved the same timber and mining outputs with less land use change. This scenario considers adoption of a set of policy changes that improve and deepen the coordination of government agencies in Guyana both across agencies and between the national and regional democratic councils and the administrative regions.

Despite the evidence that improved institutional coordination in other regions has had some impact on deforestation8, the context in Guyana differs given that most deforestation occurs within concessions that have been legally granted by the government for mining or timber harvesting. Thus, the actions undertaken here to improve coordination across agencies will have a more limited impact on deforestation than occurs in regions where deforestation is associated with illegal activities.

**Scenario 2. Direct actions in mining and forestry sectors to slow deforestation and forest degradation**

Deforestation in Guyana is driven by gold mining and forestry activities. Based on data from GFC’s land cover change dataset, the efficiency of the mining sector’s use of land for gold extraction has fallen in recent years. Based on data from the MRVS, about 2.5 hectares of deforestation occur for each 100 ounces of gold output produced before 2015, and had been increasing by about 0.1 hectare per 100 ounces each year. It declined to around 1.2 hectares of deforestation per 100 ounces of gold output in the years 2015-2017. There are several different activities that could slow deforestation. These measures relate to efforts to improve productivity in the mining and forestry sectors to limit area deforested and efforts to reduce road-building. The effect of these measures on deforestation

---

8 Improved coordination among federal and state agencies is at least partly responsible for the reductions in deforestation that occurred after the early 2000s in neighboring Brazil, although no studies have attributed the effect of various actions taken by the Brazilian government (e.g., Nepstad et al., 2014; Moutinho et al., 2016).
rates will depend on numerous factors, including whether voluntary or regulatory approaches are used to encourage or enforce participation.

As a special case of this Scenario, an analysis was undertaken of the potential impact of a complete stop to deforestation from mining below the 4th parallel\(^9\) and in all protected areas in Guyana (Figure 9). This area makes up 37% of Guyana’s total land area, however due to protection status and the remoteness of the southern region only 6% of Guyana’s total deforestation is in this area. Of that deforestation 5% is related mining, with an average of 68 ha y\(^{-1}\). The majority of deforestation in this region is ‘rotational shifting agriculture,’ which makes up 60% of all the forest loss. If all mining in protected areas and below the 4th parallel were stopped, the current rates of mining continue into the future, emissions of approximately 63,000 t CO\(_2\)e could be avoided each year.

\[\text{Figure 9. Map of all protected areas and the area below the 4th parallel where deforestation from mining could be stopped.}\]

\(^9\) The fourth parallel referred to here is a reference to the line of latitude that is 4 degrees north of the Earth's equatorial plane.

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Scenario 3. National Land Use Planning and Implementation

Conservation efforts globally have included a wide range of activities, including designating protected areas, forest certification (FSC), strict land use planning and zoning, and common property management systems. Guyana has used all of these methods to date but could revisit the scale of implementation nationally in order to increase carbon storage. Land use planning also includes efforts to plan development of infrastructure related to mining and forestry, including road building. This scenario examines new national land use planning and implementation to protect additional forests from deforestation.

Scenario 4. Improve forests’ capacity to store carbon

This scenario explores direct actions that would enhance carbon stocks by increasing the area of forests through reforestation and afforestation efforts. For example, from the period 2010 to 2017, the GFC land cover change dataset illustrates that 6 out of 10 hectares that experience forest degradation after timber harvesting have been regenerated. This is typically a natural regeneration process, however post-harvest activities could increase regeneration through improved clearing of downed wood, or other site preparation. Increasing regeneration by 33%, from 6 to 8 out of 10 hectares would represent up to 20,000 additional hectares of forests, or 3000-5000 additional hectares per year, which amounts to a 14% reduction in net deforestation. The proposed activities could be targeted to specific areas, or to a broad selection of forests in the country. The activities under consideration could be encouraged via subsidies, direct government action, regulations, or market-based efforts (taxes and carbon offsets).

To understand the potential impacts of forest restoration on abandoned mining sites in Guyana it is important to know what areas are available, and what efforts are required for successfully reforesting these areas. To estimate the area of mining land that is available for restoration, this study assumed that mining sites older than 5 years could be nearing the end of their mining activities. The area of deforested mining land >5 years old is 66,600 ha. These abandoned mining sites will be in a variety of conditions. While GGMC provides guidance on mine closure and reclamation plans, individual mines are allowed to design their own closure plan (Canada 2012). The natural restoration of forest on abandoned mining sites can take many decades due to the loss of soil properties, in terms of their physical, chemical, and biological arrangement (Sullivan and Amacher 2013, 2010). Therefore, it is assumed that most abandoned mining sites in Guyana that have not undergone any active forest restoration or have not been re-mined will remain bare without forest cover. Research has shown that the process for natural colonization can be delayed depending on the circumstances of the mined area and the time scales for regrowth are often long (Ash et al. 1994; Armstrong et al. 2000 in Cooke et al., 2002). This could provide an opportunity under the national REDD+ Strategy to enact restoration policy that would facilitates the restoration of currently degraded mining sites.

Numerous studies, reports and guidance documents have been published on reclamation and reforestation of abandoned mining sites from around the world. This report is not meant to advise on what methods would be most appropriate for Guyana. However, a review of the current literature suggest that these efforts require sufficient capital investment and diligent effort for the successful re-establishment of site topography and soil properties necessary for tree growth. In the US estimate range from US$200 ha to US$700 ha for successful restoration of trees on previously mined sites (Sullivan and Amacher 2010).

The growth of natural forest in Guyana would result in approximately 5.1 tC ha\(^{-1}\) y\(^{-1}\), equal to 18.7 tCO\(_2\) e ha\(^{-1}\) y\(^{-1}\) (Bernal, Murray, and Pearson 2018). If only 10% of Guyana’s estimated 66,600 ha of
abandoned mining sites were reforested this would equate to an annual emission reduction of 124,558 tCO₂ e y⁻¹.

Scenario 5. Encourage economic alternatives to mining

Many of the mining activities that occur in Guyana result from small scale mining claims, which can also cause additional environmental damage. If economic growth opportunities in non-land using sectors rose, labor may move from the mining sector to other sectors, maintaining or increasing employment, while reducing employment in the mining sector. According to the World Bank (2018), in the last 10 years, mineral rents as a share of Gross Domestic Product have more than doubled, although growth has slowed in the last 5 years. Other industries, including construction, have grown about 40% over the last 10 years as a share of GDP, while the service sector has increased a modest 2%. In contrast the agricultural and forestry sectors have declined as a share of GDP.

According to FAO (2018), the main crops in Guyana are rice and sugar cane, encompassing 194,000 hectares in 2016. In recent years, the area devoted to plantations has increased by over 25,000 hectares. Since 1961, rice yields have risen 1.0% per year. This modest rate of increase is heavily influenced by the last decade when rice yields fell by 2.0% per year. Sugar cane has followed a similar trend, with yield reductions in the last decade. Despite the decline in yields for rice, overall output has increased 3% per year in the last decade as the area of land devoted to rice has expanded by nearly 50%. An alternative approach to extensification, or the use of more land to increase output, is to intensify production, likely by increasing inputs, such as fertilizer, water (irrigation) or machinery. There may be potential in Guyana to increase yields through increased fertilizer use given that nitrogen inputs have remained fairly stable since the early 2000s (FAO, 2018), perhaps explaining why yields have not increased. It is important to note that any increase in nitrogen use will also increase CO₂ equivalent emissions, depending on the technology used to spread the fertilizer. These emissions, however, will be far smaller than those from deforestation, but fertilizer use can lead to run-off into waterways if not properly managed.

Currently, 20-25% of annual timber harvests are exported as logs and the ratio of domestic sawnwood production to sawlog production is 0.25 m³ sawnwood per 1 m³ sawlogs. This relatively low recovery factor indicates that a relatively small share of the domestically consumed industrial roundwood is processed in the wood processing sector. Much more is likely used informally elsewhere in the economy, with a large amount likely used in low value activities. Efforts to increase efficiencies in the wood processing sector and to increase value-added could reduce waste, enhance recovery and improve profitability. It also could increase overall output without generating an increase in timber harvesting activities. For this analysis, the assumption was that efforts to improve efficiency in the wood processing and efforts to diversify into new production processes and wood product categories to increase the use of wood in end products are undertaken.

Scenario 6. Eliminate deforestation from mining

This scenario examines the elimination of deforestation associated with mining. While Guyana would implement programs to eliminate deforestation under this scenario, assuming that the mining sector is not eliminated. Instead, the mining sector would adapt by becoming more efficient and continue to produce gold output. Specifically, the assumption was that deforestation due to mining slows from its current rate to zero by 2035. Deforestation from other activities, such as forest fires and agricultural expansion are assumed to continue after 2035, although the total rate of deforestation is lower.
The activities that would be implemented to reduce deforestation include the following policies and measures:

- Implementation of laws and regulations that prohibit deforestation in mining operations after 2035.
- Subsidy programs that incentivize companies to eliminate deforestation while they continue to produce gold, including best management practices or new measures to increase efficiency in mining operation (measured in terms of reductions in deforestation).
- Subsidy programs to encourage small mining operations to exit the industry and shift to other sectors.
- Carbon tax on emissions that occur when deforestation occurs in gold mining operations, implemented to be in full force by 2035 (i.e., full tax).

Only strong actions were considered to achieve this scenario, given that eliminating deforestation is expected to be a substantially complicated effort. It was assumed that there is no change in timber harvesting activity that occurs as a result of implementation of these activities.

The scenario assumes that there is a 35\% reduction in gold mining output over time. Thus, this scenario uses methods to reduce deforestation associated with mining but does not entirely eliminate the mining activity itself.

7.1. Impact of Scenario Implementation

In all of the scenarios, the weak implementation approaches have only modest impacts on deforestation rates. The strong implementation scenarios, however, have more widespread and substantial impacts. Scenario 6 has the greatest impact of all the scenarios, dropping to about 0.01\% by 2035, when all new deforestation from mining ceases. The strong implementation of scenario 3 has the second largest effect on deforestation of all the scenarios, which remains under 0.08\% for the entire projection period up to 2046 (Figure 10). Scenario 3 involves national land use planning and implementation of the planning to reduce deforestation. The strong implementation of scenarios 1 and 4 could maintain deforestation below 0.10\% over the entire projection period. Scenario 4 focuses on a variety of instruments and policies to reduce deforestation, from Payments for Ecosystem Services (PES) to cap and trade. Scenario 5, which focuses on encouraging economic alternatives to mining, does not end up having strong enough effects to keep rates below the 0.10\% threshold for the entire projection period to 2046.

Looking at timber harvests, the largest impact on cubic meters of timber harvested is from scenario 4, which focused on actions to improve the capacity of forests to store carbon (Figure 11). Scenario 3 has the next largest impact.

In terms of total greenhouse gas emissions, from both deforestation and degradation from timber harvest, scenario 3 has the most substantial impact, while scenario 4 has the next highest (Figure 12).

Spatially, the largest area of deforestation under the baseline occurs in the northwestern region and the middle of the country (Figure 13). This result is not surprising, given current deforestation due to mining and other activities. The strong implementation of scenario 3 has important implications for the spatial distribution of deforestation, reducing it to fairly modest levels in all but the northwestern most region of Guyana. All of the scenarios reduce deforestation in the southern part of the country to low levels.
Figure 10. Projected rates of deforestation under a BAU compared to the strong version of all Scenarios. 1. Reform and strengthen policy, legal, and institutional framework; 2. Direct actions in mining and forestry sectors; 3. National land use planning and implementation; 4. Actions to improve and maintain forests’ capacity to store carbon; 5. Encourage economic alternative to mining; 6. Eliminate deforestation from mining. Note that the lines for scenarios 1, 2, and 4 are overlapping.

Figure 11. Projected rates of timber harvesting under a BAU compared to the strong version of all scenarios. 1. Reform and strengthen policy, legal, and institutional framework; 2. Direct actions in mining and forestry sectors; 3. National land use planning and implementation; 4. Actions to improve and maintain forests’ capacity to store carbon; 5. Encourage economic alternative to mining. Note that scenarios 1, 2, and 5 are overlapping. Note that scenario 6 (Eliminate deforestation from mining) is not included as it is not projected to impact timber harvest.
Figure 12. Projected greenhouse gas emissions from deforestation and forest degradation for the BAU (with upper and lower limits) and six proposed REDD+ Strategy scenarios. Projections are the total GHG emissions by decade from 2016 to 2026, 2026 to 2036, and 2036 to 2046. 1. Reform and strengthen policy, legal, and institutional framework; 2. Direct actions in mining and forestry sectors; 3. National land use planning and implementation; 4. Actions to improve and maintain forests’ capacity to store carbon; 5. Encourage economic alternative to mining. 6. Eliminate deforestation from mining. While this figure depicts the impact of each scenario implemented singularly, it is important to note that the individual scenarios are not mutually exclusive, nor will their combined impact be the sum of the impact of each individual scenario. See section 6.9 for further description.
Figure 13. The total area of deforestation (ha) by Region projected to 2026 for BAU and six proposed REDD+ Strategy scenarios.
7.2. Sensitivity of Results

The area deforested is quite sensitive to assumptions about economic growth and in particular to assumptions about shifts in global gold prices. The upper limit BAU case, as discussed above, increases deforestation significantly. This can have potentially important impacts on the area deforested throughout the country, with the exception of the eastern border area with Suriname (East Berbice) and several of the districts along the coast. The impact on deforestation is most obvious in the central and northwestern parts of the country.

Under the BAU upper limit case, deforestation rates rise to nearly 0.20% by 2046. The scenario analysis assumes the same proportional impacts of the six scenarios on deforestation rates; given this assumption, over the projection period from 2016-2046 none of the scenarios maintain deforestation rates below 0.10%. These results suggest that under a high mining growth scenario, deforestation rates could be substantial in Guyana.

7.3. Interactions across scenarios

The analysis currently assumes that each scenario stands alone, in that it can be carried out individually. When considering the policies and measures involved in each scenario, however, it is clear that there could be important interactions. For instance, scenario 1 focuses on reforming and/or strengthening policy frameworks in Guyana. It is likely that many of the actions in this scenario could be necessary for some of the other scenarios, and in particular scenario 3. For instance, if a new national land use plan is developed and implemented, it likely would involve substantial reforms to both the forestry and mining concession approval efforts, which is included in scenario 1.

Similarly, scenario 2 focuses on direct actions to slow deforestation and forest degradation, but the actions considered do not include direct subsidies or payments to halt deforestation in any specific mining districts, or even concessions, or to reduce timber harvesting in specific regions (which would reduce degradation, depending on leakage). Direct payments for such actions were instead included in scenario 4. Thus, scenarios 2 and 4 can be viewed as complementary. Many of the actions in scenario 4 can happen with or without scenario 2 actions, but they may be made more effective if scenario 2 is implemented. And in fact, scenario 4 may also be more effective if scenario 1 is implemented.
8. Economic analysis and cost implications

An analysis was developed to assess the impact that implementation of each of the scenarios will have on annual revenue. Table 6 presents estimates of the annual revenues in gold mining and forestry for each of the scenarios. The estimates have been annualized over a 30-year period using a 5% discount rate. The assumptions used to develop these estimates are described here.

Table 6. Estimates of the annual revenues in gold mining and forestry for the alternative scenarios. The change in revenues is the change relative to the baseline.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Mining</th>
<th>Forestry</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Change</td>
<td>Change</td>
<td></td>
</tr>
<tr>
<td>S0 BAU</td>
<td>$1,509.9</td>
<td>$162.1</td>
<td></td>
</tr>
<tr>
<td>S1 weak</td>
<td>$1,494.8</td>
<td>$(15.1)</td>
<td>$162.1</td>
</tr>
<tr>
<td>S1 strong</td>
<td>$1,434.4</td>
<td>$(75.5)</td>
<td>$154.0</td>
</tr>
<tr>
<td>S2 weak</td>
<td>$1,509.9</td>
<td>$ -</td>
<td>$161.0</td>
</tr>
<tr>
<td>S2 strong</td>
<td>$1,434.4</td>
<td>$(75.5)</td>
<td>$152.4</td>
</tr>
<tr>
<td>S3 weak</td>
<td>$1,509.9</td>
<td>$ -</td>
<td>$162.1</td>
</tr>
<tr>
<td>S3 strong</td>
<td>$1,283.4</td>
<td>$(226.5)</td>
<td>$145.9</td>
</tr>
<tr>
<td>S4 weak</td>
<td>$1,509.9</td>
<td>$ -</td>
<td>$158.9</td>
</tr>
<tr>
<td>S4 strong</td>
<td>$1,434.4</td>
<td>$(75.5)</td>
<td>$129.7</td>
</tr>
<tr>
<td>S5 weak</td>
<td>$1,479.7</td>
<td>$(30.2)</td>
<td>$158.9</td>
</tr>
<tr>
<td>S5 strong</td>
<td>$1,434.4</td>
<td>$(75.5)</td>
<td>$154.0</td>
</tr>
<tr>
<td>S6</td>
<td>$1,164.66</td>
<td>$(345.2)</td>
<td>$162.1</td>
</tr>
</tbody>
</table>

The mining estimates focus on gold mining. Consistent with the underlying scenario, it was assumed that gold prices are constant from 2017 to 2046. Then the projected quantities extracted were used to determine gold revenues. Gold revenues in the country increase from $831 million per year to over $3.6 billion per year by 2046. This amounts to an annual equivalent amount, at a 5% discount rate, of $1.51 billion per year ($1509.9 million/yr).

Forestry revenues are based on export prices of $314 per m³ in 2018, and internal prices of $228 per m³ in the same year. Export prices are assumed to rise along a path provided by the paper by Tian et al (2018), which has prices rising at 1% per year initially, with the rate falling to 0.5% per year by 2032. Internal prices rise at the same rate. Around 21% of total timber harvest is exported, and it is assumed that this remains constant over time.

Table 7 presents estimates of the revenues for the GGMC and the GFC based on the projected outputs of the sectors and typical royalties and/or rentals paid for mining or forestry concessions and outputs. The projected outputs have been annualized using a 5% discount rate.
### Table 7. Projected change in annual government revenue due to scenarios

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Mining</th>
<th>Change</th>
<th>Forestry</th>
<th>Change</th>
<th>Total Change</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>S0 BAU</td>
<td>$ 94.92</td>
<td></td>
<td>$ 6.32</td>
<td></td>
<td>$ (94.92)</td>
<td></td>
</tr>
<tr>
<td>S1 weak</td>
<td>$ 93.97</td>
<td>$ (0.95)</td>
<td>$ 6.32</td>
<td>$ (0.32)</td>
<td>$ 93.97</td>
<td>$ (0.95)</td>
</tr>
<tr>
<td>S1 strong</td>
<td>$ 90.17</td>
<td>$ (4.75)</td>
<td>$ 6.00</td>
<td>$ (0.32)</td>
<td>$ 90.17</td>
<td>$ (5.06)</td>
</tr>
<tr>
<td>S2 weak</td>
<td>$ 94.92</td>
<td></td>
<td>$ 6.27</td>
<td>$ (0.04)</td>
<td>$ 94.92</td>
<td>$ (0.04)</td>
</tr>
<tr>
<td>S2 strong</td>
<td>$ 90.17</td>
<td>$ (4.75)</td>
<td>$ 5.94</td>
<td>$ (0.38)</td>
<td>$ 90.17</td>
<td>$ (5.12)</td>
</tr>
<tr>
<td>S3 weak</td>
<td>$ 94.92</td>
<td></td>
<td>$ 6.32</td>
<td></td>
<td>$ 94.92</td>
<td></td>
</tr>
<tr>
<td>S3 strong</td>
<td>$ 80.68</td>
<td>$ (14.24)</td>
<td>$ 5.69</td>
<td>$ (0.63)</td>
<td>$ 80.68</td>
<td>$ (14.87)</td>
</tr>
<tr>
<td>S4 weak</td>
<td>$ 94.92</td>
<td></td>
<td>$ 6.19</td>
<td>$ (0.13)</td>
<td>$ 94.92</td>
<td>$ (0.13)</td>
</tr>
<tr>
<td>S4 strong</td>
<td>$ 90.17</td>
<td>$ (4.75)</td>
<td>$ 5.05</td>
<td>$ (1.26)</td>
<td>$ 90.17</td>
<td>$ (6.01)</td>
</tr>
<tr>
<td>S5 weak</td>
<td>$ 93.02</td>
<td>$ (1.90)</td>
<td>$ 6.19</td>
<td>$ (0.13)</td>
<td>$ 93.02</td>
<td>$ (2.02)</td>
</tr>
<tr>
<td>S5 strong</td>
<td>$ 90.17</td>
<td>$ (4.75)</td>
<td>$ 6.00</td>
<td>$ (0.32)</td>
<td>$ 90.17</td>
<td>$ (5.06)</td>
</tr>
<tr>
<td>S6</td>
<td>$ 66.41</td>
<td>$ (28.51)</td>
<td></td>
<td></td>
<td>$ 66.41</td>
<td>$ (28.51)</td>
</tr>
</tbody>
</table>

### Scenario 1 -- Strengthen policy, legal and institutional framework:

For this scenario, it was assumed that under the weak scenario there is a 1% reduction in revenues from gold mining and under the strong scenario it was assumed there is a 5% reduction in gold mining. The weak scenario implements relatively modest efforts to limit wasteful deforestation that occurs when mining operations are implemented. It is expected that these efforts will have limited effects on actual mining operations and thus will not change revenues substantially. A 1% reduction in output results in a $15.1 million/yr loss in direct national output from gold mining.

The strong scenario is projected to have a larger effect on mining because actions are compulsory for firms. That is, companies are required to seek cross-agency approvals for road-building and other elements of mining operations. This raises costs for firms, which results in lower levels of output. It was assumed that firms are able to maintain production levels, although land used by mining falls. The most important effect of these activities will be on land use and not on mining output. It was assumed that the effect on mining output will be 5%, resulting in a loss of $75 million per year in gold mining output.

### Direct implementation costs:

The analysis relies heavily on the work of Cunha et al. (2016), who estimated the government costs of implementing reforms in Brazil to reduce deforestation ranged from $308-$923 per hectare of reduced deforestation. Estimates from within this range were used in this modeling.

For the weak implementation, the government is assumed to spend $100 per hectare of deforested land in program development, implementation and enforcement costs, and a subsidy of $300 per hectare of reduced deforestation land to the firms for them to implement programs that increase the efficiency of mining and reduce deforestation on mining land. It was assumed that the program is only 30% efficient, such that the government pays $300/ha on 3 hectares for every 1 hectare of reduced deforestation.

For the strong implementation of this program, it was assumed a higher level of government expenditure, $200 per hectare of land that is deforested in program development costs, and an
increase the per hectare payment to $340 per hectare of deforested land for companies that enroll in the program and reduce their rate of deforestation. This higher payment encourages the higher level of participation, and a higher level of effectiveness, 50%. It was assumed that these activities encourage mining operations to reduce mining and shift some resources into forest protection.

Scenario 2 -- Direct actions in mining and forestry sectors to slow deforestation and forest degradation:

It was assumed that the weak scenario has no effect on mining output. The activities envisioned under this scenario focus on slowing deforestation by increasing the efficiency of mining operations. For the weak implementation, the government is assumed to spend $100 per hectare of deforested land in program development, implementation and enforcement costs, and a subsidy of $200 per hectare of reduced deforestation land to the firms for them to implement programs that increase the efficiency of mining and reduce deforestation on mining land. It was assumed that the program is only 30% efficient, such that the government pays $200/ha on 3 hectares for every 1 hectare of reduced deforestation.

For the strong implementation of this program, it was assumed a higher level of government expenditure, $300 per hectare of land that is deforested in program development costs, and an increase the per hectare payment to $400 per hectare of deforested land for companies that enroll in the program and reduce their rate of deforestation. This higher payment encourages the higher level of participation, and a higher level of effectiveness, 50%. It was assumed that these activities encourage mining operations to reduce mining and shift some resources into forest protection.

Scenario 3 -- National Land Use Planning and Implementation

The weak scenario is assumed to lead to no change in output. The activities in the weak scenario encourage mining operations to undertake modest efforts to reduce deforestation associated with mining, focusing on reducing the amount of road-building that occurs through voluntary actions. The strong scenario implements new fees on roads associated with mining to provide additional incentives to reduce the amount of road-building that occurs, and certain areas are set as off-limits for mine development through the expansion of protected areas. Better mapping is used to determine where deposits are likely to occur in advance. It was assumed that these are relatively effective at reducing the amount of deforestation that occurs. Although mining is assumed to become more efficient in the use of roads, these efficiency improvements do not entirely offset the reduction in output, and outputs are assumed to fall 15% relative to the business as usual (note that deforestation falls 35%).

For the weak implementation, the government is assumed to spend $200 per hectare of deforested land in program development, implementation and enforcement costs, and a subsidy of $200 per hectare of reduced deforestation land to the firms for them to implement programs that increase the efficiency of mining and reduce deforestation on mining land. It was assumed that the program is only 30% efficient, such that the government pays $200/ha on 3 hectares for every 1 hectare of reduced deforestation.

For the strong implementation of this program, it was assumed a higher level of government expenditure, $300 per hectare of land that is deforested in program development costs, and an increase the per hectare payment to $600 per hectare of deforested land for companies that enroll in the program and reduce their rate of deforestation. This higher payment encourages the higher level of participation, and a higher level of effectiveness, 50%. It was assumed that these activities encourage mining operations to reduce mining and shift some resources into forest protection.
For forest degradation, it was assumed no change in costs and no change in timber harvesting under the weak scenario. Under the strong scenario, administrative and direct costs are expected to increase 5% or $420,000 per year. This increase in costs is expected to be slightly less than the 10% reduction in timber harvesting that is expected to occur.

Scenario 4 -- Improve forests’ capacity to store carbon,

This scenario focuses more intensively on regeneration of forests after mining activity, and other actions that will enhance forest carbon stocks. It is assumed that these activities have minimal effect on mining output in both the weak and the strong case. Under the weak case, it was assumed that they have no effect on mining output, and in the strong case, it was assumed they reduce mining output by 4%. The effect on output results from the diversion of resources into reforestation activities, which is assumed to modestly affect investments in activities associated with mining outputs (e.g., they divert machinery, labor, or funding from extraction activities). Costs in mining are hard to know, but Overman et al. (2019) provide extraction costs ranging from $200-$1200 per ounce extracted. Companies, such as Guyana Goldfields report cash costs in the $800-$900 per ounce range, ignoring royalties paid to the government, and total outlays of $1100-$1200 per ounce once exploration and other costs are included. This suggests that net revenues at current prices of around $1230 per ounce are modest at best. Small increases in costs associated with programs in scenario 4 thus would be expected to influence outputs by reducing margins.

For the weak implementation, the government is assumed to spend $100 per hectare of deforested land in program development, implementation and enforcement costs, and a subsidy of $100 per hectare of reduced deforestation land to the firms for them to implement programs that increase the efficiency of mining and reduce deforestation on mining land. It was assumed that the program is only 30% efficient, such that the government pays $100/ha on 3 hectares for every 1 hectare of reduced deforestation.

For the strong implementation of this program, it was assumed a higher level of government expenditure, $300 per hectare of land that is deforested in program development costs, and an increase the per hectare payment to $600 per hectare of deforested land for companies that enroll in the program and reduce their rate of deforestation. This higher payment encourages the higher level of participation, and a higher level of effectiveness, 50%. It was assumed that these activities encourage mining operations to reduce mining and shift some resources into forest protection.

Under the weak scenario for forest degradation, there is only a 2% reduction in timber harvesting. To accomplish this reduction, it was assumed that it requires a 2% increase in the expenditures of the GFC to develop and implement voluntary programs to reduce forest degradation by 2%. For the more extensive strong program, there is a 20% reduction in timber harvesting, which leads to a 4% increase in costs for GFC, and a $4 per m³. Total costs under the strong scenario are $2.8 million per year.

Scenario 5 -- Encourage economic alternatives to mining

It was assumed that the weak and strong cases have a direct effect on output, reducing it in proportion to the reduction in mining. The rationale for this is that these scenarios directly focus on reducing deforestation by reducing output. That is, individuals and capital in the mining sector are incentivized to reduce their participation in that sector and instead participate in other sectors in the economy. Thus, they factor driving the reduction in deforestation is a reduction in output itself.

For the weak implementation, the government is assumed to spend $200 per hectare of deforested land in program development, implementation and enforcement costs, and a subsidy of $200 per 40
hectare of reduced deforestation land to the firms for them to implement programs that increase the efficiency of mining and reduce deforestation on mining land. It was assumed that the program is only 30% efficient, such that the government pays $200/ha on 3 hectares for every 1 hectare of reduced deforestation.

For the strong implementation of this program, it was assumed a higher level of government expenditure, $400 per hectare of land that is deforested in program development costs, and an increase the per hectare payment to $200 per hectare of deforested land for companies that enroll in the program and reduce their rate of deforestation. This higher payment encourages the higher level of participation, and a higher level of effectiveness, 50%. It was assumed that these activities encourage mining operations to reduce mining and shift some resources into forest protection.

Scenario 6--Reduce deforestation from mining activity over time to 0

In Scenario 6 (Reduce deforestation from mining activity over time to 0), it was assumed that there is only a 35% reduction in mining output along with the reduction in deforestation. This scenario is assumed to be implemented through stringent application of new laws in Guyana that would forbid new mining roads and land clearing for mining activities. Mining operations can continue to operate on land that has already been deforested, so that they continue producing mining output. The new laws and regulations require mining operations to become more efficient in order to remain in business. It was thus assumed that there is a 35% reduction in output associated with the reduction in mining.

For this scenario, it was assumed a higher level of government expenditure, $300 per hectare of land that is deforested in program development costs, and an increase the per hectare payment to $600 per hectare of deforested land for companies that enroll in the program and reduce their rate of deforestation. This higher payment encourages the higher level of participation, and a higher level of effectiveness, 50%. It was assumed that these activities encourage mining operations to reduce mining and shift some resources into forest protection.

It is important recognize that it will be difficult to achieve the goals in Scenario 6 given the historical record in which the area deforested per unit gold extracted has increased over time. The results in Sohngen and Hite, 2016 illustrate that a 1% increase in gold output would increase deforestation by 0.72%. Their model focused on results up to 2015. Data from the MRVS since then suggests that mining in Guyana became more efficient between 2015 to 2017, with hectares deforested per 100 ounces of gold output declining from over 2 to around 1.2. In order to implement Scenario 6 and achieve only a 35% reduction in output as projected here, Guyana mining operations will need to become substantially more efficient in terms of land use.

The forestry output effects are direct. That is, for each scenario, it was assumed a direct reduction in output under the initial scenario, and these direct changes in output are modeled in the table above.

Analysis of the effect of harvesting timber from areas deforested for mining

Additionally, an analysis was made to estimate the current timber harvesting operations amount to the extraction of 4.96 m³ per ha of area harvested each year. The business as usual future projected area of land deforested due to mining rises from 7,846 ha currently to nearly 20,000 by 2046. Assuming these hectares have typical stocking of wood and wood types that could enter markets, this area deforested could provide 37,000 m³ per year initially, or 6.8% of current timber output. Over time, this output would increase to 98,000 m³ per year, or over 13% of the total timber output. On average from 2017 to 2046, it was estimated the area deforested each year due to mining could provide around 9.7% of total timber output. If this wood displaced current market outputs, it would
reduce the emissions from forest degradation proportionally, that is, by 9.7% on average over the next 30 years.

**Implementation costs**

Annual implementation costs over a 30-year period, assuming a 5% discount rate, are provided in table 8 for each of the scenarios. These costs include estimated increases in government expenditures to manage the newly implemented programs, as well as the direct costs to pay mining companies or forestry companies to change practices on their land.

*Table 8. Annual implementation costs annualized over 30-year period using a 5% discount rate.*

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Mining</th>
<th>Forestry</th>
<th>Total</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Million US $/yr</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S0 BAU</td>
<td>$ 1.41</td>
<td>$ 0.08</td>
<td>$ 1.49</td>
<td></td>
</tr>
<tr>
<td>S1 weak</td>
<td>$ 3.53</td>
<td>$ 0.42</td>
<td>$ 3.96</td>
<td></td>
</tr>
<tr>
<td>S2 weak</td>
<td>$ 1.60</td>
<td>$ 1.80</td>
<td>$ 3.40</td>
<td></td>
</tr>
<tr>
<td>S2 strong</td>
<td>$ 4.77</td>
<td>$ 1.71</td>
<td>$ 6.48</td>
<td></td>
</tr>
<tr>
<td>S3 weak</td>
<td>$ 2.66</td>
<td>$ 0.00</td>
<td>$ 2.66</td>
<td></td>
</tr>
<tr>
<td>S3 strong</td>
<td>$ 7.34</td>
<td>$ 0.42</td>
<td>$ 7.76</td>
<td></td>
</tr>
<tr>
<td>S4 weak</td>
<td>$ 1.30</td>
<td>$ 0.17</td>
<td>$ 1.47</td>
<td></td>
</tr>
<tr>
<td>S4 strong</td>
<td>$ 5.73</td>
<td>$ 1.79</td>
<td>$ 7.52</td>
<td></td>
</tr>
<tr>
<td>S5 weak</td>
<td>$ 2.50</td>
<td>$ 0.17</td>
<td>$ 2.67</td>
<td></td>
</tr>
<tr>
<td>S5 strong</td>
<td>$ 4.77</td>
<td>$ 0.42</td>
<td>$ 5.20</td>
<td></td>
</tr>
<tr>
<td>S6</td>
<td>$ 10.13</td>
<td></td>
<td>$ 10.13</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Implementation costs are derived by applying the fixed and per hectare costs described above to the relevant changes in area of land deforested over the projections for each scenario. The implementation costs are then discounted at a 5% discount rate and summed. The implementation costs include only the costs to the government of implementing the programs and any payments made to landowners. They do not include the resulting changes in the flows of output shown in Table 6 above.

**Carbon changes**

Table 9 provides a summary of the carbon changes in annual tons CO₂ per year and the average implementation costs in $/t CO₂. The average cost is the total implementation cost described in table 8 in the present value of government costs, divided by the total change in carbon in million tons per year. The government cost captures only the expenditure by government on programs they implement to reduce carbon emissions, and payments they make to the forestry and mining sectors to reduce deforestation or forest degradation. These estimates do not include changes in outputs in the sectors themselves, thus ignore the market opportunity costs of implementing the carbon program.
Table 9. Carbon changes and implementation costs in $/ton CO₂

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Emission Change</th>
<th>Forestry</th>
<th>Total Emission Change</th>
<th>Total Change</th>
<th>Average Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Million tons/yr</td>
<td>3.50</td>
<td></td>
<td>$/t CO₂</td>
<td></td>
</tr>
<tr>
<td>S0 BAU</td>
<td>10.83</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1 weak</td>
<td>(0.22)</td>
<td>3.50</td>
<td>(0.22)</td>
<td>(2.34)</td>
<td>$ 6.89</td>
</tr>
<tr>
<td>S1 strong</td>
<td>8.66 (2.17)</td>
<td>3.32 (0.17)</td>
<td>(2.34)</td>
<td>$ 1.69</td>
<td></td>
</tr>
<tr>
<td>S2 weak</td>
<td>10.18 (0.65)</td>
<td>3.47 (0.02)</td>
<td>(0.67)</td>
<td>$ 5.04</td>
<td></td>
</tr>
<tr>
<td>S2 strong</td>
<td>8.66 (2.17)</td>
<td>3.29 (0.21)</td>
<td>(2.38)</td>
<td>$ 2.73</td>
<td></td>
</tr>
<tr>
<td>S3 weak</td>
<td>10.29 (0.54)</td>
<td>3.50</td>
<td>(0.54)</td>
<td>(4.14)</td>
<td>$ 4.92</td>
</tr>
<tr>
<td>S3 strong</td>
<td>7.04 (3.79)</td>
<td>3.15 (0.35)</td>
<td>(4.14)</td>
<td>$ 1.87</td>
<td></td>
</tr>
<tr>
<td>S4 weak</td>
<td>10.40 (0.43)</td>
<td>3.43 (0.07)</td>
<td>(0.50)</td>
<td>$ 2.93</td>
<td></td>
</tr>
<tr>
<td>S4 strong</td>
<td>8.66 (2.17)</td>
<td>2.80 (0.70)</td>
<td>(2.86)</td>
<td>$ 2.62</td>
<td></td>
</tr>
<tr>
<td>S5 weak</td>
<td>10.61 (0.22)</td>
<td>3.43 (0.07)</td>
<td>(0.29)</td>
<td>$ 9.31</td>
<td></td>
</tr>
<tr>
<td>S5 strong</td>
<td>10.29 (0.54)</td>
<td>3.32 (0.17)</td>
<td>(0.72)</td>
<td>$ 7.25</td>
<td></td>
</tr>
<tr>
<td>S6</td>
<td>4.22 (6.61)</td>
<td></td>
<td>(6.61)</td>
<td>$ 1.53</td>
<td></td>
</tr>
</tbody>
</table>

9. Safeguards, Land Tenure and Benefit Sharing Mechanism

9.1. Cancun Safeguards

The UNFCCC recognizes that safeguards are a key part of REDD+ implementation and links the Cancun safeguards to results-based payments, requiring that countries:

a) Implement REDD+ activities in a manner consistent with the Cancun REDD+ safeguards. REDD+ activities, regardless of their type of funding source, are to be implemented in such a way that the Cancun REDD+ safeguards are addressed and respected. Guyana will thus take steps to define how the Cancun REDD+ safeguards will be implemented, and to ensure compliance with the safeguards throughout the implementation of REDD+ activities.

b) Establish a system to provide information on how the Cancun REDD+ safeguards are being addressed and respected. The establishment of a Safeguard Information System (SIS) for providing information on how the Cancun REDD+ Safeguards are being addressed is one of the four required elements to access results-based payments within the UNFCCC mechanism on REDD+. As such a SIS must be established that provides information on how all actions identified within the National REDD+ Strategy are being conducted in line with the Cancun REDD+ Safeguards.

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10 Decision 1/CP.16 paragraph 69, Decision 2/CP.17, Paragraph 63
11 UNFCCC Decision 1/CP.16 Paragraph 71(d).
12 UNFCCC Decision 1/CP.16 paragraph 71
Guyana should thus establish a system to provide information on how the seven Cancun safeguards are being addressed and respected in all phases of implementation of REDD+ activities.

c) Provide a summary of information on how the Cancun REDD+ safeguards are being addressed and respected\textsuperscript{13}.

To receive results-based payments, Guyana will present their most recent summary of information demonstrating how the safeguards have been addressed and respected.

In the final series of decisions on REDD+, agreed in Paris at COP 21, Parties to the UNFCCC developed some further guidance “on ensuring transparency, consistency, comprehensiveness and effectiveness when informing on how all the safeguards referred to in decision 1/CP.16, appendix I, are being addressed and respected.” As part of this guidance, the COP “strongly encourages” developing country Parties, when providing the summary of information on how the Cancun REDD+ Safeguards are being addressed and respected, to include, inter alia: “A description of each safeguard in accordance with national circumstances.”

Based on these requirements Guyana has taken steps to initiate the clarification of the Cancun REDD+ safeguards within the Guyanese context.

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\textbf{Box 1: Cancun Safeguards}

The Cancun REDD+ safeguards were established (UNFCCC Decision 1/CP.16 Appendix 1 paragraph 2, following general agreement within the UNFCCC Conference of the Parties (COP) that actions on REDD+ should not only ‘do no harm’ but should where possible ‘do good’ in supporting broader social and environmental development goals.

When undertaking the activities referred to in paragraph 70 of this decision (the five REDD+ activities), the following safeguards should be promoted and supported:

(a) That actions complement or are consistent with the objectives of national forest programmes and relevant international conventions and agreements;

(b) Transparent and effective national forest governance structures, taking into account national legislation and sovereignty;

(c) Respect for the knowledge and rights of indigenous peoples and members of local communities, by taking into account relevant international obligations, national circumstances and laws, and noting that the United Nations General Assembly has adopted the United Nations Declaration on the Rights of Indigenous Peoples;

(d) The full and effective participation of relevant stakeholders, in particular indigenous peoples and local communities, in the actions referred to in paragraphs 70 and 72 of this decision;

(e) That actions are consistent with the conservation of natural forests and biological diversity, ensuring that the actions referred to in paragraph 70 of this decision are not used for the conversion of natural forests, but are instead used to incentivize the protection and conservation of natural forests and their ecosystem services, and to enhance other social and environmental benefits;

(f) Actions to address the risks of reversals;

(g) Actions to reduce displacement of emissions.

\textsuperscript{13} Decision 9/CP, Paragraph 4, UNFCCC Decision 2/CP.17, op cit, Paragraph 63 and 64.
9.2. Land Tenure

REDD+ Safeguards under the UNFCCC, aims to ensure indigenous peoples and local communities’ rights are respected. In this regard, Guyana has established a land-titling process. However, the process still has pending areas to regularize, mainly in lands claimed by Amerindian communities.

Land tenure clarity is a key element for REDD+ implementation, from the decision of activities to be performed in the field, to planning and for sharing benefits arising from implementation and from results achieved; thus, ensuring it should be a foundation element.14

Numerous authors have shown that insecure property rights can influence deforestation, with most evidence suggesting that deforestation increases when property rights are insecure (e.g., Deacon, 1999; Aruajo et al, 2009). Strengthening property rights can thus potentially slow deforestation. In many locations, however, property rights are not provided individually, but instead to groups, or communities. Evidence from many locations suggests that community-based forest management systems can also slow deforestation (e.g., Miteva et al, 2012; Agrawl & Chhatre, 2006; Blackman, 2015; Fortmann et al., 2017; Alix-Garcia, 2007, Rasolofoson et al., 2015; Takahashi & Otsuka, 2016; Robinson et al., 2017). More recently, evidence is now starting to emerge that property rights through forest certification approaches, such as FSC, may also slow deforestation (Blackman et al., 2018).

9.3. Benefit sharing

It is expected that REDD+ will bring benefits to the country and the different stakeholders involved in its implementation. These benefits could come either from the actual implementation of actions and measures or from the benefits arising from the results achieved.

According to PwC (2012), benefits related to REDD+ may not always involve a direct monetary payment, and the total benefit delivered may be a combination of many different forms of benefits. (monetary and nonmonetary) divided in two broad categories: forest rent and incentives.

Guyana is committed to develop and adopt a benefit sharing plan, that will include:

- Distribution criteria and timelines,
- Types of beneficiaries,
- Respect for customary rights to lands and territories and reflect broad community support, and
- Where there are activities solely for the benefit of indigenous peoples, it will necessary to proactively engage with the relevant indigenous peoples to ensure their ownership, buy-in and participation in the design, implementation, equitable benefit sharing, monitoring and evaluation of activities.1

This benefit sharing plan should take into account current experiences in the country as the Opt-in mechanism developed under the GRIF.

One critical component of benefit sharing, as well as the development of REDD+ in general is land tenure. Land tenure describes the relationships people and institutions have with land and land-based resources and includes both formal and informal ownership along. The long-term success of REDD+

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14 There is a consultancy currently being executed to Analyze Land Tenure and Carbon Ownership to inform the allocation of Benefits and Rights and the Development of a Benefits Sharing Mechanism for the Implementation of REDD+ in Guyana, that should give more details on the relevant aspects to include in the National REDD+ Strategy.
in Guyana depends on clarification of tenure rights for land, forests, and carbon. Because a tenure system identifies who has access and use rights for resources, if the system is not clearly established and agreed, the incentives for proper management of forest resources is reduced. Clear and secure tenure is needed to establish accountability, ensure inclusion in decision-making, and to confirm that rights and benefits are appropriately provided.

By the time this report was developed, there is an ongoing consultancy to *Analyze Land Tenure and Carbon Ownership to inform the allocation of Benefits and Rights and the Development of a Benefits Sharing Mechanism for the Implementation of REDD+ in Guyana* with goal to

- Provide information and recommendations related to carbon ownership and the allocation of benefits and rights related to carbon offset payments, and
- Develop an equitable and mutually agreeable Benefits Sharing Mechanism for REDD+ Implementation in Guyana.

10. Readiness process

According to the UNFCCC (Decision 1/CP.16) countries willing to participate in the REDD+ mechanism, should have in place four elements, to be ready for REDD+: Forest Reference Emission Level and/or Forest Reference Level, National Forest Monitoring System, Safeguards Information System, and the National Strategy. Guyana submitted their Readiness Preparation Proposal to the FCPF in 2012 and has advanced in three of these elements in the previous years. The National Strategy is now being developed to serve as the final guiding document for the direction the country will take in the future.

10.1. National Forest Reference Level (FRL)

Guyana developed and submitted to the UNFCCC its Reference Level for REDD+. The FRL use of the Combined Reference Level Approach, in which a global forest carbon emissions loss (0.435%/yr) is combined with the rate of annual emissions from forests (2001-2012, 0.049%), to obtain a reference level of 0.242%, that represents 46,301,251 tCO₂/yr.

10.2. National Forest Monitoring System

Guyana began development of a National Forest Monitoring System (NFMS) in 2009 and has steadily improved on it in the last 10 years. The NFMS includes five major components:

- The Monitoring, Reporting, and Verification System (MRVS) Roadmap, Phases 1 developed in 2009 and Phase 2 developed in 2014;
- Annual reporting on forest change, providing activity data, through the MRVS Interim Measures Reports, with Years 1-7 completing, covering 2011 through 2017;
- Accuracy assessments of the Interim Measures Reports;
- The Forest Carbon Monitoring System, which includes the sample design and implementation framework and development of emission factors; and
- Independent, third party verification.

These components allow Guyana to develop emissions estimates from deforestation and forest degradation by activity, across the country. These are then compared to the Forest Reference Level...
10.3. Safeguards Information System

According to the UNFCCC, the SIS should\textsuperscript{15}:

- Be consistent with guidance in decision 1/CP.16, appendix I, paragraph 1;
- Provide transparent and consistent information that is accessible by all relevant stakeholders and updated on a regular basis;
- Be transparent and flexible to allow for improvements over time;
- Provide information on how all of the safeguards are being addressed and respected;
- Be country-driven and implemented at the national level;
- Build upon existing systems, as appropriate.

\textsuperscript{15} UNFCCC Decision 12/CP.17 Paragraph 2
11. Next steps

This document represents Draft 3 of Guyana’s proposed REDD+ Strategy. It has been developed in response to initial stakeholder input and to allow for continued stakeholder review. The REDD+ Strategy will be reviewed and revised over multiple iterations. Each iteration will be presented to the Project Execution Unit for FCPF within the Ministry of Natural Resources, for their dissemination and review, as deemed appropriate. Additionally, further review will be conducted on each version of the draft strategy, as shown in the table below.

This Draft of the Strategy will be reviewed by the Core Group and will serve as the basis for the stakeholder consultations for the development of the Strategic Environmental and Social Assessment (SESA). Additional opportunities for stakeholder consultation will occur through the SESA/ESMF process and in collaboration with Global CAD, who are conducting a separate consultancy on stakeholder engagement. The final Strategy will also incorporate recommendations from the SESA and results from other consultancies conducted under the FCPF project, specially the one related to land tenure and benefit sharing.

Following the review and revision process of the Strategy drafts, a multi-criteria decision analysis tool will be developed, allowing MNR and the Core Group to identify final strategies and their projected impact.

<table>
<thead>
<tr>
<th>Item</th>
<th>Date</th>
<th>Review</th>
<th>Brief description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Draft 1, Strategy Options</td>
<td>Past version</td>
<td>Stakeholder consultation</td>
<td>Various stakeholders had the opportunity to provide input through a national consultation workshop.</td>
</tr>
<tr>
<td>Draft 2, Strategy Options</td>
<td>Past version</td>
<td>Review by Core Group and public comment</td>
<td>Draft 2 incorporates input from MNR, the SESA/ESMF team, and national stakeholder consultations. A workshop was held with the Core Group to receive detailed feedback and identify the approach to finalize the Strategy. (Note that members of the Core Group had opportunity to review earlier versions, but this provides the first formal review by the Core Group as an official entity.) This version also serves as the basis for discussion and stakeholder feedback during SESA workshops.</td>
</tr>
<tr>
<td>Draft 3, Strategy Options</td>
<td>This version</td>
<td>Review by Core Group and SESA team</td>
<td>Draft 3 is intended to be a near complete version of the Strategy, and a workshop will be held with the Core Group to discuss this draft as well as the development of the MCDA.</td>
</tr>
<tr>
<td>Item</td>
<td>Date</td>
<td>Review</td>
<td>Brief description</td>
</tr>
<tr>
<td>---------------------</td>
<td>----------------</td>
<td>---------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>MCDA tool</strong></td>
<td>30 June 2019</td>
<td>MCDA will be implemented to identify final Strategy</td>
<td>The finalized MCDA tool will be used by MNR and the Core Group to identify the final strategies and their projected impacts. This session will be facilitated by the Consortium, but the final decisions will be made by the Core Group and MNR.</td>
</tr>
<tr>
<td><strong>Final Strategy report</strong></td>
<td>30 October 2019</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
References


Government of Guyana. 2012. Guyana's Readiness Preparation Proposal to the FCPF. Available at: https://www.forestcarbonpartnership.org/country/guyana

Government of Guyana. 2016. Guyana's Revised Intended Nationally Determined Contribution. Available at: https://www4.unfccc.int/sites/NDCStaging/Pages/All.aspx


Annex 1. Predicted future deforestation

To model the location of future deforestation spatial data layers (e.g. roads, rivers, settlements) were assessed against forest loss from mining, logging and agricultural, and developed into ‘factor maps.’ The factor maps include distance to relevant existing activities and features; land tenure; and elevation. The different factor maps were analyzed against past deforestation to assess which of the factor maps best predicted deforestation from mining, logging and agriculture for a 30-year period from 2016. This assessment resulted in a combination of factor maps that had the best predictive potential for each of the three major drivers of deforestation.

Table 1. Spatial factor maps that best predict location of deforestation for mining, logging and agriculture events.

<table>
<thead>
<tr>
<th>Mining</th>
<th>Logging</th>
<th>Agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance to existing mining</td>
<td>Distance to existing logging roads</td>
<td>Distance to existing agriculture</td>
</tr>
<tr>
<td>Distance to roads</td>
<td>Distance to degradation from logging</td>
<td>Distance from non-forest</td>
</tr>
<tr>
<td>Distance to settlements</td>
<td>Distance to logging camps</td>
<td>Distance to roads</td>
</tr>
<tr>
<td>Distance to rivers</td>
<td>Distance to roads</td>
<td>Distance to settlements</td>
</tr>
<tr>
<td>Land class/tenure</td>
<td>Distance to settlements*</td>
<td>Land class/tenure***</td>
</tr>
<tr>
<td>Elevation*</td>
<td>Land class/tenure***</td>
<td></td>
</tr>
</tbody>
</table>

* Elevation was categorized into 500m bands.
** Settlements are areas of human habitation.
*** Three main land tenure classifications: private land, titled lands (e.g. Amerindian lands), and State lands (comprised of forest, mining, agriculture, settlement and protected areas)). Within the State Land are concessions that have been granted by the government.

Each of the factor maps (see Figures 1, 2, and 3) were assessed individually to identify scaling and weighting that best explained the relationship with deforestation. The distance to existing mining, logging, agriculture, roads, and rivers used a natural log transformation which gives higher probability of deforestation closer to the event than would a linear distance. The distance to settlements used a square root transformation which provided a better fit to the data than a linear or log-linear relationship. Settlements were inversely related to deforestation, suggesting that the likelihood of deforestation is higher farther from settlements. In the case of elevation and land tenure each map was run though a maximum likelihood function that assesses existing deforestation within the different categories (i.e. land tenure types and elevation bands) and ranks each category based on the prevalence of deforestation. More deforestation provides a higher ranking, and therefore assumes there is a higher likelihood of future deforestation occurring there.
Figure 1. Factor maps for predicting the location of mining. Starting from the top left: 1) distance to mining, 2) distance to rivers, 3) distance to roads, 4) distance to settlements, 5) elevation 100m bands, and 6) land tenure.
Figure 2. Factor maps for prediction future logging events. From top left: 1) distance to degradation from logging, 2) distance to logging camps, 3) distance to existing logging roads, 4) distance to roads, 5) distance to settlements, and 6) land tenure.
Figure 3. Factor maps for prediction future agriculture events. From top left: 1) agriculture concessions maximum likelihood classified, 2) distance to agriculture, 3) land tenure maximum likelihood classification, 4) distance to roads, and 5) distance to settlements.

After combining all the factor maps, a final risk map was produced that illustrates the potential for any given unit of forest land to be deforested. The higher the value the more likely it is that a parcel of land will be deforested in the future model. Figures 4, 5, and 6 show the final risk maps for mining, logging, and agriculture, respectively. (Note that the scale is specific to each risk map, and not
The risk maps are used in combination with the projected rate of deforestation under each of the scenarios presented in Section 60. The projected rate of deforestation under each scenario defines the area of land that will be deforested, and therefore the number of hectares converted from forest to non-forest into the future. The risk maps tell the model where that deforestation is most likely to occur, converting forest to non-forest on the higher risk values before moving to lower risk values.

Figure 4. Final risk map that shows the potential for any given unit of forest land to be deforested due to mining.
Figure 5. Final risk map that shows the potential for any given unit of forest land to be deforested due to logging.
Figure 6. Final risk map that shows the potential for any given unit of forest land to be deforested due to agriculture.
Annex 2. Modeling of scenarios

The six potential scenarios of policies and measures to reduce deforestation and forest degradation, described in section 6 (Table 5), were each modeled based on a set of possible actions (both weak and strong) to achieve targeted rates of deforestation and degradation. The modeling is based on economic analyses to project the impact of the policies and measures, and spatial analysis to project the geographic location of the impact. Additionally, a Business as Usual (BAU) case was modeled to project the extent of deforestation and degradation in the absence of implementation of any REDD+ Strategy. The six scenarios (weak and strong for each) are then compared to the BAU to assess the impact that each scenario would have on deforestation projected from 2016 to 2026, 2036 and 2046 (30 years).

1. Business as Usual

Economic projection of the business as usual (BAU) case were developed based on the analysis in Sohngen et al. (2016). Deforestation rates in that analysis were based on an economic projection of gold output in Guyana. Gold output was projected as a function of four variables, gold prices, interest rates, exchange rates and time. For this analysis, the function was updated with data including the years 2015-2017 and then projected future outputs assuming that gold prices, interest rates and exchange rates remained at their 2017 levels in the future. These assumptions are consistent with market conditions in the past 5 years. Over longer periods, however, real (corrected for inflation) gold prices have increased, 1.6% per year over the last 40 years and 4.6% per year over the last 20 years. For a longer-term, high demand projection it was assumed that gold prices increase at 1% per year and interest rates double to 10%, although they are assumed to remain constant over time.

For all of the scenarios, a Monte Carlo, or bootstrap, simulation was conducted, in which the variance-covariance matrix from the regression model was used to make a set of parameter draws. Then the different set of parameters was used to make future projections under the BAU and the high demand. This provides a distribution of projections that make it possible to identify the upper and lower bound, or upper and lower confidence limit. For an upper limit, the upper 95% confidence limit was used for the high demand model, and for a lower limit - 95% confidence limit of the BAU scenario. The BAU, upper limit and lower limit are shown in Figure 7. Projected gold output for Guyana under the BAU, and the upper and lower limits of the projections. The upper and lower limits are based on projections associated with the 95% confidence intervals from the estimated parameter distributions.

![Guyana Gold Output](image)

*Figure 7. Projected gold output for Guyana under the BAU, and the upper and lower limits of the projections. The upper and lower limits are based on projections associated with the 95% confidence intervals from the estimated parameter distributions.*
Given the way the upper and lower limits are constructed, they represent a wide range of outcomes. The upper limit is the upper end of the 95% confidence interval associated with the high demand scenario. This upper limit represents extremely strong growth in gold output, but it is important to recognize that it would be consistent with the relationship identified from the historical data. Similarly, for the lower limit, output is still projected to grow modestly, even under an assumption of constant real gold prices.

These scenarios of gold output are translated into annual area of land used for mining using the models described in Sohngen et al. (2016). Figure 8a presents historical deforestation, and three projections consistent with the gold output projections shown in 7. Under the BAU scenario, the area deforested annually increases from around 8,200 hectares per year at present to over 21,000 hectares per year by 2047. In the upper limit case, the area deforested increases to over 34,000 hectares per year, and in the lower limit case, the area deforested increases to 16,000 hectares per year.

The area changes are translated into % changes in deforestation in 8b. The current payments under the agreement with Norway are a function of the difference between the reference level deforestation rate of 0.25% per year and the actual deforestation rate, with a triggering threshold at 0.10%. If deforestation exceeds this threshold then payments will be withheld under the Norway-Guyana Partnership. Future thresholds of course are a policy decision, however, Figure 8b illustrates the effects of a rising deforestation rate. If the threshold is defined as 0.10%, then in the BAU, Guyana will cross that threshold in 2042. There is, however, a risk that Guyana could cross the threshold much earlier under the upper limit scenario.

Figure 8a. The BAU for deforestation in Guyana modeled out to 2046 with upper and lower bounds showing the expected range of deforestation over that period based on economic modeling.
The distribution of deforestation in Guyana for 2026, 2036 and 2046 under the business as usual is shown in Figure 9. Deforestation follows the historical pattern and occurs near places where deforestation has already happened. This outcome is a function of the model, which assumes future deforestation is correlated with past deforestation. Figure 9 shows three key areas where a large portion of the deforestation is projected to occur. The effect of future deforestation on emissions under a BAU scenario (including upper and lower limit) is shown in Figure 10. In the BAU case, emissions are projected to be 124 million tons CO$_2$e between 2016 and 2026 and rise to 128 million tons CO$_2$e between 2036 and 2046. The lower limit of emissions is projected to be 98 million tons CO$_2$e for the decade 2036 to 2046, while the upper limit is projected to be 193 million tons CO$_2$e for the same decade.
Figure 9. Map showing the location of projected future deforestation in Guyana under Business as Usual.
Figure 10 GHG emission from deforestation projected into the future under BAU scenario, with upper and lower limits. Projections are the total GHG emissions by decade from 2016 to 2026, 2026 to 2036, and 2036 to 2046.

Figure 11 shows the gross deforestation by region under the BAU. In the initial decade deforestation is concentrated more in the northwest, however, over time deforestation spreads out and increases more uniformly in the northern part of Guyana.
Figure 11. The total area of deforestation (ha) by Region projected into the future under the BAU scenario. Results indicate the total area of deforestation for each decade after 2016 through 2046

The BAU for timber harvesting is constructed similarly using the timber production model developed for Guyana from Sohngen et al. (2016). The model in this case includes a larger number of inputs than the deforestation model because it includes both timber supply and demand components. For projection purposes the following assumptions were considered:

- Exchange rates are held constant
- Population increases at 1.5% per year (an important demand input)
- Guyana per capita income increases at 1.5% per year in local currency.
- US gross domestic product per capita increases at 2.5% per year
- US sawtimber prices remain constant.

For the timber projections, upper and lower limits were constructed using a bootstrap, or Monte Carlo technique, by which the model was estimated multiple times using independent draws of the underlying data. This was done 500 times and constructed 500 different projections. Thereafter, the upper 97.5 percentile and lower 2.5 percentile was used to determine the 95% confidence interval. The BAU case and these upper and lower limits are shown in Figure 12 below, along with the historical data over which the model was estimated. The BAU timber output trends up over the
projection period from 2016 to 2046, increasing to 732,000 m³ output per year, which is nearly
double the 2016 output, but is only 60% greater than the average output from 2001 to 2016. At the
upper limit, output would increase to over 1.1 million m³ per year, and at the lower limit output
would decline to about 330,000 m³ per year.

Figure 12 Projected timber output for Guyana under the BAU, and the upper and lower limits of the projections. The upper and lower limits are based on projections associated with the 95% confidence intervals from the estimated parameter distributions.

2. Reform and strengthen policy, legal and institutional framework

The primary drivers of land use change in Guyana revolve around the expansion of mining through
granting of new mining concessions and building roads, and forestry activities. One factor that could
encourage more deforestation than otherwise is lack of coordination amongst agencies. This could
involve failure to recognize common boundaries for forest and mining concessions, duplicative road
building efforts, and other examples where two different agencies could have collaborated and
achieved the same timber and mining outputs with less land use change. This scenario considers
adoption of a set of policy changes that improve and deepen the coordination of government agencies
in Guyana both across agencies and between the national and regional democratic councils and the
administrative regions. Improved coordination among federal and state agencies is at least partly
responsible for the reductions in deforestation that occurred after the early 2000s in neighboring
Brazil, although no studies have attributed the effect of various actions taken by the Brazilian
government (e.g., Nepstad et al., 2014; Moutinho et al., 2016). Despite the evidence that improved
institutional coordination in other regions has had some impact on deforestation, the context in
Guyana differs given that most deforestation occurs within concessions that have been legally
granted by the government for mining or timber harvesting. Thus, the actions undertaken here to
improve coordination across agencies will have a more limited impact on deforestation than occurs
in regions where deforestation is associated with illegal activities.

Policies and Measures:

- Increase communication and cross-agency reporting, including instituting quarterly or
  annual meetings of key leaders and joint reporting. This includes meetings and
  communication with higher level policy makers.
• Require cross-agency approval of mining and forestry concessions.
• Require cross-agency approval of road-building within concessions.
• Increase budgets and efforts to ensure compliance with existing regulations in all sectors (mining, forestry, and agriculture)

*Weak actions* focus on non-regulatory measures to encourage increased communication, particularly with respect to road-building and other infrastructure. Efforts would include easier transfer of data across agencies and providing data publicly. Road building accounts for 8% of the total deforestation that results from mining, and 1% of the deforestation in logging concessions, thus the potential impact on deforestation is relatively modest. Further, in this scenario it was assumed that the actions are not regulated, or required by law, so coordination will have a limited effect on deforestation, particularly in the near-term. Importantly, however, improved coordination and trust would be important precursors to stronger agency interactions and efforts in the future. The actions would not target timber harvesting and have no effect on harvesting.

⇒ Slow deforestation rate 2%; No change in timber harvesting/degradation.

*Stronger actions* require cross-agency interaction, including cross-agency approval of policy actions that change carbon outcomes, such as large new mining concessions, new road building related to mining or agriculture, etc. Stronger actions would require *ex ante* carbon impact analysis within agencies, with direct line authority to stop or limit new policy actions that would increase carbon emissions. Depending on how strongly governmental authorities decide to implement new regulatory requirements, any requirement for carbon analysis could stop some new mining projects from going forward and would increase costs for smaller mining permits such that fewer permits are obtained. These actions would slow down approval of new mining and forest concession allocations and approvals for building access roads. It was assumed that the government implements these regulations in a way that achieves a 20% reduction in deforestation, noting that there likely would be a concomitant reduction in mining output. Any reductions in timber harvests in concessions that require new approvals, however, would likely result in increased harvesting activities elsewhere (i.e., leakage) leading to a smaller anticipated reduction in timber harvesting, assumed to be 5%.

⇒ Slow deforestation rate 20%; Slow timber harvesting 5%.

Figures 13 (a,b) and 14 below present the projected changes in deforestation and timber harvesting, respectively, that would occur in the future under the weak and strong implementations of this scenario. The historical (measured) data points are shown and used to develop a historical average from 2001 to 2012. A business as usual (BAU) projection is based on this average and serves as a baseline against which the strategy scenarios are compared.
Figure 13a. Projected rates of deforestation under a BAU compared to Scenario 1 weak (2% reduction in deforestation) and stronger (20% reduction in deforestation) actions. Historical deforestation is plotted (black dots) based on deforestation from 2001 to 2012.

Figure 13b Projected rates of deforestation under a BAU compared to Scenario 1 weak (2% reduction in deforestation) and stronger (20% reduction in deforestation) actions. Historical deforestation is plotted (black dots) based on deforestation from 2001 to 2012.
3. Direct actions in mining and forestry sectors to slow deforestation and forest degradation

Deforestation in Guyana is driven by gold mining and forestry activities. Based on data from GFC’s land cover change dataset, the efficiency of the mining sector’s use of land for gold extraction has fallen in recent years. Currently, about 2.5 hectares of deforestation occur for each 100 ounces of gold output produced, but in recent years this ratio has been increasing by about 0.1 hectare per 100 ounces each year. There are several different activities that could slow deforestation. These measures relate to efforts to improve productivity in the mining and forestry sectors to limit area deforested and efforts to reduce road-building. The effect of these measures on deforestation rates will depend on numerous factors, including whether voluntary or regulatory approaches are used to encourage or enforce participation.

Policies and Measures:

- Develop toolkits and educational programs to increase efficiency in mining operations, where efficiency improvements are measured in terms of reductions in deforestation.
- Provide subsidies to mining operators to implement best management practices or new measures to increase efficiency in mining operations.
- Develop regulations that require use of best management practices and practices that increase efficiency, with effective monitoring and verification.
- Develop Payment for Ecosystem Services (PES) system to pay for avoided deforestation.
- Encourage Forest Stewardship Council (FSC) certification for interested forest concessions.

Weaker actions focus on developing educational and voluntary programs to encourage small and medium scale miners as well as larger mining companies to become more efficient in their use of land for mining purposes. The educational programs will be assumed to be introduced nationwide but taken by 40% of the active mining operators distributed equally across the regions. Because the approaches are not mandatory, only 15% of the operators are assumed to use any of the new
approaches. Also, because they are voluntary, the operators are assumed to choose approaches that have low costs. The model assumes that these voluntary measures, when fully implemented, slow deforestation to 2.3 hectares for each 100 ounces of gold output, or by 6%. According to FSC International, around 386,000 hectares have been certified in Guyana, representing only about 5% of the total area of forests in Guyana with wood cutting permits. A key issue in certification is that it can potentially reduce the impact of logging without changing the overall supply of timber (i.e., the intensity of logging), although recent evidence suggests that the main effect on carbon results from changing intensity (Martin et al., 2015). If certification does reduce logging on the sites where certification occurs, leakage could occur (e.g., Sohngen and Brown, 2004). For this analysis, it was assumed that each additional 100,000-hectare expansion of the area of land under certification reduces overall timber harvesting by 0.1%, and it was assumed that voluntary efforts to increase certification double the area certified to 700,000 hectares, then timber harvesting declines by 0.7%.

⇒ Slow deforestation by 6%; Slow timber harvesting by 0.7%.

Stronger actions convert the educational programmes into certification program for mining and require individuals or companies with mining concessions to receive annual training on techniques and measures to reduce deforestation and improve efficiency. Further, all forestry concessions will become certified for sustainable forest management (FSC or other, including local system). Regulations are instituted that limit land use change to 2 hectares per 100 ounces of gold removed. This would slow deforestation by 20% in mining areas. Certification in forestry and mining concessions is estimated to reduce deforestation similarly by 20%. Per the discussion above, if all forestry concessions were required to become FSC certified, this would be an additional 6,000,000 hectares of certified forests, which would reduce timber harvesting by 6% (0.1% per additional 100,000 hectares).

⇒ Slow deforestation by 20%; Slow timber harvesting by 6%.

Stronger actions could also include direct implementation of Payments for ecosystems services (PES) or carbon trading schemes that target specific areas where deforestation is likely to occur or use other criteria. The costs (payments) and benefits (carbon) of such programs will be evaluated in future iterations of the modeling.

Figure 15 a and b and Error! Reference source not found. Figure 16 present the projected changes in deforestation and timber harvesting, respectively, that would occur in the future under the weak and strong implementations of this scenario.
Figure 15a. Projected rates of deforestation under a BAU compared to Scenario 2 weak (6% reduction in deforestation) and stronger (20% reduction in deforestation) actions. Historical deforestation is plotted (black dots) based on deforestation from 2001 to 2012.

Figure 15b. Projected rates of deforestation under a BAU compared to Scenario 2 weak (6% reduction in deforestation) and stronger (20% reduction in deforestation) actions. Historical deforestation is plotted (black dots) based on deforestation from 2001 to 2012.
4. National Land Use Planning and Implementation

Conservation efforts globally have included a wide range of activities, including designating protected areas, forest certification (FSC), strict land use planning and zoning, and common property management systems. Guyana has used all of these methods to date but could revisit the scale of implementation nationally in order to increase carbon storage. Land use planning also includes efforts to plan development of infrastructure related to mining and forestry, including road building. This scenario examines new national land use planning and implementation to protect additional forests from deforestation.

Policies and Measures

- Strengthen management plans and guidelines for development of infrastructural planning and implementation to ensure low environmental impact practices, mainly in road construction, and to improve efficiency.
- Increase administrative and other costs for road-building
- Incorporate new areas to the National Protected Area System.
- Enhance mineral mapping combined with and reducing lands available for mining and forest concessions, by limiting permits.

Weak actions focus on improved planning efforts for infrastructure development and road building, particularly around mining and forestry concessions. There is evidence from GFC land cover change dataset that road-building has become more efficient in mining concessions in recent years, potentially slowing deforestation. Over the period 2013-2016, road building associated with mining accounted for 8% of all mining related deforestation, down from 13% during the period 2009-2012. If road building had remained at its earlier period levels during the 2013-2016 period, around 550 more hectares would have been deforested. Better planning to reduce the amount of road-building associated with new mining, thus, could reduce deforestation by about 5%. For the weaker options, it was assumed no changes in the area of timber harvesting concessions, so there is no change in timber harvesting.
Reduce deforestation by 5%; No change in timber harvesting.

*Stronger actions* develop new plans for infrastructure development, establish new administrative fees for road-building, map out mining areas and limit mining to those regions with the highest mining potential, and set-aside new protected areas. Protected areas and focusing mining to specific locations can lower deforestation in certain regions but must be combined with sufficient institutional investment to protect the areas that are designated either as protected zones or regions where mining should not occur. This scenario assumes that the government also invests in institutions and infrastructure to ensure that the protected areas are indeed protected (scenario 1). Thus, to achieve the level of reduction in deforestation suggested below, the strong version of scenario 1 must also be implemented (e.g. the two must be implemented together). In addition, it was assumed that there is a 20% reduction in the area of land available for forest concessions, leading to a 10% reduction in timber harvesting. The smaller change in timber harvesting results from assumed leakage of 50%.

Reduce deforestation by 35%; Slow timber harvesting 10%

Figure 17a and b and 18 present the projected changes in deforestation and timber harvesting, respectively, that would occur in the future under the weak and strong implementations of this scenario.

![Figure 17a. Projected rates of deforestation under a BAU compared to Scenario 3 weak (5% reduction in deforestation) and stronger (35% reduction in deforestation) actions. Historical deforestation is plotted (black dots) based on deforestation from 2001 to 2012.](image-url)
If the **stronger actions** of this scenario (3) combined with strong version of scenario 2, e.g., efforts to reduce the amount of forest loss per unit of gold extracted, the reduction in deforestation would increase by an additional 20%.

⇒ Reduce deforestation by 55%; Slow timber harvesting 10%
5. Improve forests’ capacity to store carbon

This scenario explores direct actions that would enhance carbon stocks by increasing the area of forests through reforestation and afforestation efforts. For example, from the period 2010 to 2017, the GFC land cover change dataset illustrates that 6 out of 10 hectares that are considered deforested after timber harvesting have been regenerated. Increasing regeneration by 33%, from 6 to 8 out of 10 hectares would represent up to 20,000 additional hectares of forests, or 3000-5000 additional hectares per year, which amounts to a 14% reduction in net deforestation. The proposed activities could be targeted to specific areas, or to a broad selection of forests in the country. The activities under consideration could be encouraged via subsidies, direct government action, regulations, or market-based efforts (taxes and carbon offsets).

Policies and measures

- Regulations/subsidies/carbon markets/direct government action for replanting and regenerating forests after road building, forestry harvests and mining activities.
- Regulations/subsidies/direct government action to promote increased forest recovery in the mining sector, including recovery from mine tailings.
- Regulations/subsidies to improve efficiency in the forestry sector by reducing waste and forest degradation (e.g., reduced impact logging).
- Promote agroforestry via regulations or subsidies.
- Implement more holistic and integrated approach on managing forest fires.
- Direct promotion of mangrove systems\textsuperscript{16} to protect the coast as well as associated carbon stocks

\textit{Weaker actions} focus on voluntary and non-regulatory efforts to encourage reforestation both in degraded forest areas (potentially where past harvests have occurred or in mangrove) and mined areas. Because voluntary efforts do not include subsidies, it is assumed that these programmes have limited enrollment and have limited impact. For forestry, the proposed activities would raise the costs of forest activities in forestry concessions by encouraging activities to regenerate forests after harvesting has occurred. Because the weaker actions scenario focuses on voluntary efforts, these practices are implemented by a small proportion of individuals with wood cutting permits, so the effects on harvesting are only a reduction of 2%.

\textbullet Reduce net deforestation by 4%; Slow timber harvesting 2%

\textit{Stronger actions} would incorporate regulations, potentially combined with financial subsidies that require mining and forestry concession operators to adopt improved practices that restore carbon, these regulations could include support for restoration forest and mangrove areas not related to mining or forestry operations. Because these actions are required, higher levels of adoption occur, and quicker regeneration of deforested areas occurs. Regulating more intensive practices to regenerate forests or reduce impacts of logging would raise costs and reduce incentives to log forests. Some lands would likely come out of official production. If institutions prevent leakage on other state-owned lands, then harvests will fall proportionally, but if leakage occurs, then the reduction in harvests will be smaller.

\textbullet Reduce net deforestation by 20%; Slow timber harvesting 20% (without leakage) or 10% (with leakage)

\footnotesize\textsuperscript{16} This can incorporate both protection of existing mangrove forests and expansion of mangroves. Note, however, that mangroves are not currently included separately in Guyana’s FREL, and there is not yet a comprehensive analysis on the impact of mangroves on emissions and removals under REDD+.
Figure 19 a and b and 20 present the projected changes in deforestation and timber harvesting, respectively, that would occur in the future under the weak and strong implementations of this scenario.

Figure 19a. Projected rates of deforestation under a BAU compared to Scenario 4 weak (4% reduction in deforestation) and stronger (20% reduction in deforestation) actions. Historical deforestation is plotted (black dots) based on deforestation from 2001 to 2012.

Figure 19b. Projected rates of deforestation under a BAU compared to Scenario 4 weak (4% reduction in deforestation) and stronger (20% reduction in deforestation) actions. Historical deforestation is plotted (black dots) based on deforestation from 2001 to 2012.
Figure 20. Projected rates of timber harvesting under a BAU compared to Scenario 4 weak (2% reduction in harvesting) and stronger (20% reduction in harvesting) actions. Historical harvesting is plotted (black dots) based on harvesting from 2001 to 2012.

6. Encourage economic alternatives to mining.

Many of the mining activities that occur in Guyana result from small scale mining claims, which can also cause additional environmental damage. If economic growth opportunities in non-land using sectors rose, labor may move from the mining sector to other sectors, maintaining or increasing employment, while reducing employment in the mining sector. According to the World Bank (2018), in the last 10 years, mineral rents as a share of Gross Domestic Product have more than doubled, although growth has slowed in the last 5 years. Other industries, including construction, have grown about 40% over the last 10 years as a share of GDP, while the service sector has increased a modest 2%. In contrast the agricultural and forestry sectors have declined as a share of GDP.

According to FAO (2018), the main crops in Guyana are rice and sugar cane, encompassing 194,000 hectares in 2016. In recent years, the area devoted to plantations has increased by over 25,000 hectares. Since 1961, rice yields have risen 1.0% per year. This modest rate of increase is heavily influenced by the last decade when rice yields fell by 2.0% per year. Sugar cane has followed a similar trend, with yield reductions in the last decade. Despite the decline in yields for rice, overall output has increased 3% per year in the last decade as the area of land devoted to rice has expanded by nearly 50%. An alternative approach to extensification, or the use of more land to increase output, is to intensify production, likely by increasing inputs, such as fertilizer, water (irrigation) or machinery. There may be potential in Guyana to increase yields through increased fertilizer use given that nitrogen inputs have remained fairly stable since the early 2000s (FAO, 2018), perhaps explaining why yields have not increased. It is important to note that any increase in nitrogen use will also increase CO₂ equivalent emissions, depending on the technology used to spread the fertilizer. These emissions, however, will be far smaller than those from deforestation, but fertilizer use can lead to run-off into waterways if not properly managed.

Currently, 20-25% of annual timber harvests are exported as logs and the ratio of domestic sawnwood production to sawlog production is 0.25 m³ sawnwood per 1 m³ sawlogs. This relatively
low recovery factor indicates that a relatively small share of the domestically consumed industrial roundwood is processed in the wood processing sector. Much more is likely used informally elsewhere in the economy, with a large amount likely used in low value activities. Efforts to increase efficiencies in the wood processing sector and to increase value-added could reduce waste, enhance recovery and improve profitability. It also could increase overall output without generating an increase in timber harvesting activities. For this analysis, it was assumed that efforts to improve efficiency in the wood processing and efforts to diversify into new production processes and wood product categories to increase the use of wood in end products are undertaken.

Policies and measures

- Increase productivity of agriculture in coastal areas
- Increase production of value-added products in the agricultural and forestry sectors, including subsidies for investments in new technologies or improved production processes.
- Develop income generating activities in low-lands and coastal zones (non-forested areas) to reduce migration and reduce reliance on extractive industries.
  - Build capacity in population to engage in non-extractive industries
  - Promotion of productivity and value-added in costland agriculture
  - Development of suitable infrastructure (telecommunications, renewable power, etc.) to promote development in non-extractive sectors
  - Use of finance from oil income to promote economic development in non-extractive sectors
  - Retraining opportunities for those engaged in extractive industries
  - Financial incentives for those engaged in extractive industries to invest in non-extractive industries

*Weaker Actions* focus on educational efforts to encourage adoption of intensification in the agricultural sector, including more intensive uses of fertilizers on rice and sugar cane. In addition, the government subsidizes wood processing companies to learn about new production processes in the industry and encourages exchanges with companies in other countries to provide opportunities to see different technologies in action. New educational programs are developed to increase the use of wood products in building materials.

- Reduce deforestation 2%; Reduce logging 1%.

*Stronger Actions* include subsidies for farming enterprises to increase the use of fertilizers on existing farmlands. Any subsidies must be limited to existing farmlands so as not to encourage additional deforestation. Subsidies are also provided for wood processing firms to improve efficiency through modernization of their equipment. Such subsidies could include low interest loans.

- Reduce deforestation 5%; Reduce logging 5%.

Figure 21 a and b and 22 present the projected changes in deforestation and timber harvesting, respectively, that would occur in the future under the weak and strong implementations of this scenario.
Figure 21a. Projected rates of deforestation under a BAU compared to Scenario 5 weak (2% reduction in deforestation) and stronger (5% reduction in deforestation) actions. Historical deforestation is plotted (black dots) based on deforestation from 2001 to 2012.

Figure 21b. Projected rates of deforestation under a BAU compared to Scenario 5 weak (2% reduction in deforestation) and stronger (5% reduction in deforestation) actions. Historical deforestation is plotted (black dots) based on deforestation from 2001 to 2012.
7. Eliminate deforestation from mining

This scenario examines the elimination of deforestation associated with mining. While Guyana would implement programs to eliminate deforestation under this scenario, it was assumed that the mining sector is not eliminated. Instead, the mining sector would adapt by becoming more efficient and continue to produce gold output. Specifically, it was assumed that deforestation due to mining slows from its current rate to zero by 2035. Deforestation from other activities, such as forest fires and agricultural expansion are assumed to continue after 2035, although the total rate of deforestation is lower.

The activities that would be implemented to reduce deforestation include the following policies and measures:

- Implementation of laws and regulations that prohibit deforestation in mining operations after 2035.
- Subsidy programs that incentivize companies to eliminate deforestation while they continue to produce gold, including best management practices or new measures to increase efficiency in mining operation (measured in terms of reductions in deforestation).
- Subsidy programs to encourage small mining operations to exit the industry and shift to other sectors.
- Carbon tax on emissions that occur when deforestation occurs in gold mining operations, implemented to be in full force by 2035 (i.e., full tax).

Only strong actions were considered to achieve this scenario, given that eliminating deforestation is expected to be a substantially complicated effort. It was assumed that there is no change in timber harvesting activity that occurs as a result of implementation of these activities.
The scenario assumes that there is a 35% reduction in gold mining output over time. Thus, this scenario uses methods to reduce deforestation associated with mining but does not entirely eliminate the mining activity itself.

Figures 23 a and b present the projected changes in deforestation that would occur in the future under the implementations of this scenario.

*Figure 23a. Projected rates of deforestation under a BAU compared to Scenario 6 actions. Historical deforestation is plotted (black dots) based on deforestation from 2001 to 2012.*

*Figure 23b. Projected rates of deforestation under a BAU compared to Scenario 6 actions. Historical deforestation is plotted (black dots) based on deforestation from 2001 to 2012.*