

TRANSFORMING FOREST MANAGEMENT IN GUYANA THROUGH AN EFFECTIVE AND SUSTAINED MONITORING REPORTING AND VERIFICATION SYSTEM

PROGRESS REPORT

REPORT PERIOD: 1 JULY 2018 TO 31 DECEMBER 2019

1. Introduction

Conservation International Guyana (CI-Guyana) with funding from the Norwegian Agency for Development Cooperation (Norad) is supporting the Guyana Forestry Commission (GFC) to continue development and implementation of the national forest Monitoring Reporting and Verification System (MRVS). This second phase of implementation of the MRVS includes activities for Years 6 to 9 of the MRVS, covering the following periods:

Project proposal Assessment Year	Assessment Year	Assessment period
Year 6	2015- 2016	24 months
Year 7	2017	12 months
Year 8	2018	12 months
Year 9	2019	12 months

This project aims to contribute to the realization of Guyana’s green development pathway by improving forest management within Guyana. More specifically, it seeks to ensure that:

1. Guyana’s Forest Carbon Monitoring System is strengthened in fulfilment of the MRVS Roadmap Phase 2 and reporting on forest area change and emissions from forests is completed for Years 6 to 9 (01 January 2015 to 31 December 2019) of the Guyana-Norway agreement.
2. The MRVS more precisely accounts for the forest carbon dynamics.
3. MRVS data and results inform improvements in forest management policy and practice.
4. A third phase of MRVS operation is assured.
5. Key technical and non-technical audiences are informed on the relevant aspects of the operation of Guyana’s MRVS.
6. Guyana maintains sound forest monitoring systems, in particular, as it relates to the regulatory frameworks for responsible forest management.

The project is supporting the establishment and sustaining of a world-class MRVS as a key component of Guyana’s national REDD+ programme and wider forest governance and management. This system provides the basis for verifiably measuring changes in forest cover and resultant carbon emissions from Guyana’s forests as an underpinning for results-based REDD+ compensation in the long-term. Critically, the MRVS will also inform improved policies and practices for forest management, including for the operation of the logging and mining industries, to proactively address their impacts on forests. Transformation of forest management is being achieved primarily through the establishment of mechanisms and capacity for use of MRVS results and data as key elements of the evidence basis to design solutions for current inefficiencies in forest management.

This project is, beyond maintaining and expanding the capacity of the GFC to reliably provide assessment of forest cover change and forest emissions, building the capacity of agencies and entities with mandates for the management of forests to utilize MRVS data to improve the management of Guyana’s forests. This capacity is also critical to sustaining the impact beyond the life of this project by improving management of Guyana’s forests, a significant part of its natural patrimony, and

ensuring adequate REDD+ compensation, which are essential to securing Guyana's Green Development path.

The project is currently on track for reporting. To date, eight (8) national annual assessments of Guyana's deforestation and forest degradation have been conducted under the MRVS. This progress report outlines the progress made on implementation of the project over the period July 01, 2018 to December 31, 2019.

2. Progress on Achievement of Outcomes

2.1 Outcome 1: Guyana's Forest Carbon Monitoring System is strengthened in fulfilment of the MRVS Roadmap Phase 2 and reporting on forest area change and emissions from forests is completed for Years 6 to 9 (01 January 2015 to 31 December 2019) of the Guyana-Norway agreement.

The MRVS Interim Measures Report for Year 7 (2017) and Year 8 (2018) annual assessments were completed during the reporting period. The reports provide summaries of the 'Interim Measures' highlighting Guyana's progress towards implementation of the framework for REDD+ Interim Indicators, as well as the reporting requirements as outlined in the 2009, 2011, and 2012 and 2015 versions of the Joint Concept Note (JCN). Notably, the Year 8 Report includes emission reporting by driver of change. With the completion of the emission factor development, Guyana is now ready to move beyond reporting on REDD+ Interim Measures (which have in previous assessments focused on activity data) to full Emissions Reporting. The reports were released for a 6-week period to allow for extended stakeholder review. The full reports for Years 7 and 8 can be found [here](#).

For MRVS Years 7 and 8, a combination of Sentinel 2A (10m) and Landsat7 and 8 (30m) imagery totalling one hundred and thirty-two tiles (132) were collected and used to map and monitor forest to non-forest change by driver. Additionally, the image data was used to classify the non-forest areas into the five IPCC non-forest classes (cropland, grassland, wetlands, settlements and other land). This approach allowed for land cover change greater than one hectare to be tracked through time and attributed by its driver (i.e. mining, shifting agriculture etc.). A series of refinements to the image processing chain were implemented to facilitate the use of higher resolution Sentinel imagery at a national scale. Sentinel's five-day revisit rate will be leveraged to develop a more real-time, continuous monitoring system hosted within the MRVS.

The Years 7 and 8 analysis utilized the same mapping processes and standards as in Year 6, with a focus on the use of freely available satellite imagery. For degradation the analyses aimed to provide robust and efficient estimates via a sampling approach. Moving towards the use of open source software, Google Earth Engine was used to assist with the processing of remotely sensed data. Forest degradation was not mapped directly but estimated through a two-stage statistical sample of high-resolution aerial imagery (GeoVantage, 4 band multispectral) and PlanetScope, supplemented with Sentinel 2 A multispectral satellite images. The Mapping Standard Operating Procedures document was also updated accordingly, and a Standard Operating Procedure created for assessing Degradation. These improvements ensure that the forest change boundaries continue to be accurately positioned and delineated.

Another significant enhancement beginning in the Year 8 report is the reporting of emissions by drivers of deforestation based on the United Nations Framework Convention on Climate Change (UNFCCC) reporting format.

Year 7 and 8 MRVS Results

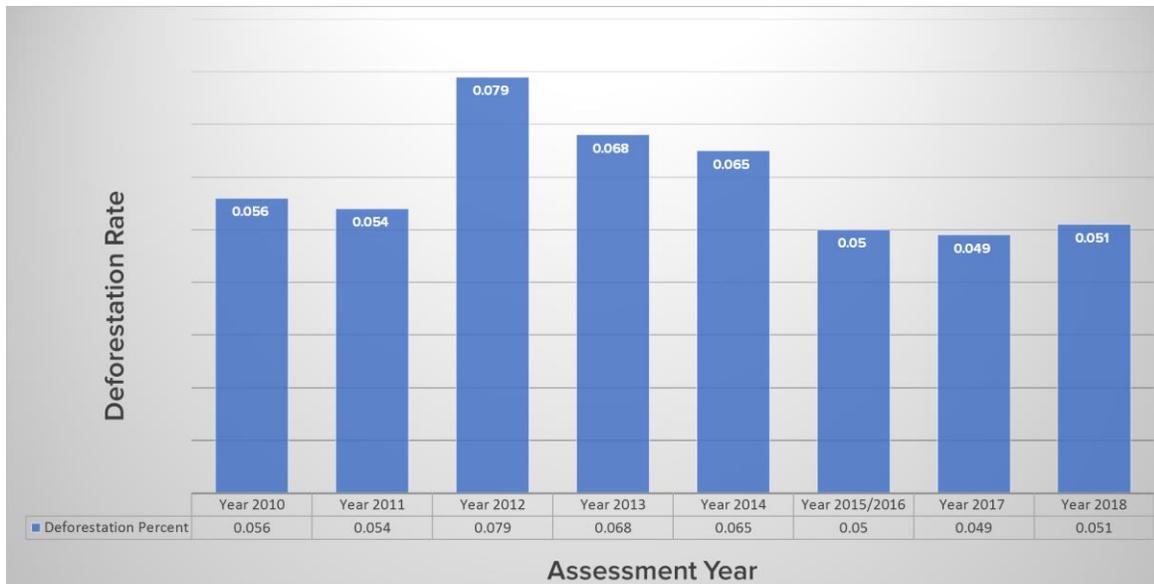
The annualized deforestation rate (change of forest to non-forest), excluding degradation, for Year 7 (2017) was estimated at 8,851 ha (0.049%), while Year 8 (2018) was estimated at 9,227 ha (0.051%). The 2017 rate was the lowest of all annual periods since 2010. The change continued to primarily be situated near the footprint of historic change, clustered around existing road infrastructure and navigable rivers. The main deforestation driver continues to be mining (sites), which accounts for 74% and 75% respectively of the deforestation in the reporting periods. The majority (78%) of the deforestation was observed in the State Forest Area.

In year 6 (covering the 24 months of 2015 and 2016) the existing “wall to wall” degradation method was replaced with the sample-based statistical estimation approach. In year 7 and 8, (2017- 2018), towards the MRVS Phase 2 objective of creating a more cost sustainable system, a refined approach was developed to report on mining and infrastructure degradation. For the reporting period, the accuracy assessment was modified to allow the use of a sample-based approach to provide a statistical estimate of both gross deforestation and degradation.

The annualised Rate of Forest Change by Period and Driver from 1990 to 2018 are detailed in the table below:

Change Period	Change Period	Annualised Rate of Change by Driver						Annual Rate of Change (ha)
		Forestry	Agriculture	Mining	Infrastructure	Fire	Settlements	
	(Years)	Annual Area (ha)						
1990-2000	10	609	203	1 084	59	171	-	2 127
2001-2005	5	1 684	570	4 288	261	47	-	6 850
2006-2009	4.8	1 007	378	2 658	41	-	-	4 084
2009-10	1	294	513	9 384	64	32	-	10 287
2010-11	1.25	186	41	7 340	298	46	-	7 912
2012	1	240	440	13 664	127	184	-	14 655
2013	1	330	424	11 518	342	96	23	12 733
2014	1	204	817	10 191	141	259	71	11 975
2015-16	2	313	379	6 782	217	1 509	8	9 208
2017	1	227	477	7442	195	502	7	8851
2018	1	356	512	7624	67	661	7	9227

The graph below shows the annual percentage change in forest area for each assessment year.



As part of the Accuracy Assessment, independent reviews of deforestation and forest degradation were conducted following the Global Observation of Forest Cover and Land Dynamics (GOF-C-GOLD) guidelines. In Year 7 (2016-2017), the accuracy assessment involved the collection of 322 sample units randomly selected from three forest strata organised by risk of deforestation. The High Risk and Medium Risk strata was assessed predominantly using Planet (2016) and GeoVantage/Planet (2017) imagery. The Low Risk stratum (where no previous activity has been recorded) was assessed using repeat coverage Sentinel/Landsat imagery. The same approach was used for 2018 except the initial interpretation was carried out by the GFC Mapping Team and checked by the independent accuracy assessment team.

The Accuracy Assessment conducted for the assessments completed in the reporting period (Year 7 and 8) included the following conclusions:

1. The estimates of deforestation based on the mapping undertaken by the GFC using largely the interpretation of Sentinel-2 MSI and PlanetScope imagery is of a good standard.
2. The methods used by the GFC, and assisted by IAP, follow the good practice recommendations set out in the GOF-C-GOLD guidelines and considerable effort has been made to acquire cloud free imagery towards the end of the census period October-December 2017 and 2018 (Year 7 and 8).
3. The estimate of the total area of change in the 12-month Year 7 period from forest to non-forest and degraded forest to non-forest is 7,722 ha, with a standard error of 1,403 ha and a 95% confidence interval (4,973 ha; 10,472 ha).
4. The estimate of the annual rate of deforestation that occurred over the Year 7 (12 month) period is 0.051% with a standard error of 0.0062% and a 95% confidence interval (0.0387%; 0.0630%).
5. The estimate the total area of change in the 12-month Year 7 period from forest to degraded forest between Y6 and Y7 is 4 764 ha, with a standard error of 730 ha and a 95% confidence interval (3 332 ha; 6 196 ha).

6. One change of 0.35 ha was detected within samples that fell within the boundary of the Intact Forest Landscape. The change was interpreted as forest degradation associated with shifting agriculture.
7. The estimate of the total area of change in the 12-month Year 8 period from forest to non-forest and degraded forest to non-forest is 6,983 ha, with a standard error of 1,276 ha and a 97.5% confidence interval (4,482 ha; 9,485 ha).
8. The estimate of the annual rate of deforestation that occurred over the Year 8 (12 month) period is 0.034% with a standard error of 0.005% and a 97.5% confidence interval (0.0240%; 0.0447%).
9. The estimate the total area of change in the 12-month Year 8 period from forest to degraded forest between Y7 and Y8 is 4,253 ha, with a standard error of 1,006 ha and a 97.5% confidence interval (2,281 ha; 6,225 ha).
10. Three changes of total 1.35 ha was detected within samples that fell within the boundary of the Intact Forest Landscape. The change was interpreted as forest degradation associated with shifting agriculture.
11. The GeoVantage (aerial survey) and PlanetScope data provided sufficient detail (spatial resolution) to assess the Sentinel-2 and PlanetScope deforestation mapping as provided by GFC. It would be difficult to make a precise assessment of degradation without access to high resolution imagery. Sentinel-2 MSI or Landsat ALI data are not sufficient for this purpose.

The methods and results of the Year 7 and 8 assessment have not been verified by an independent third party. This review is contracted through NORAD and is scheduled for April 2020. The full report of the Accuracy Assessment can be found in the Year 8 MRVS Report Appendix 4.

Forest Restratification

A major activity completed in 2018 was the update of the forest carbon stratification – developed in 2011 for the purposes of designing a sampling plan to accurately understand the country’s forest carbon stocks¹. The restratification under the Forest Carbon Monitoring System (FCMS) included completing a new threat analysis to reassess potential for change and revising accessibility classification using updated road maps. Additionally, in response to a corrective action request from a previous verification, a provisional stratum was added for savannah forest areas. A total of 29 plots were added. The methodology and findings are detailed in the Guyana Stratification Options Assessment Report, August 2018.

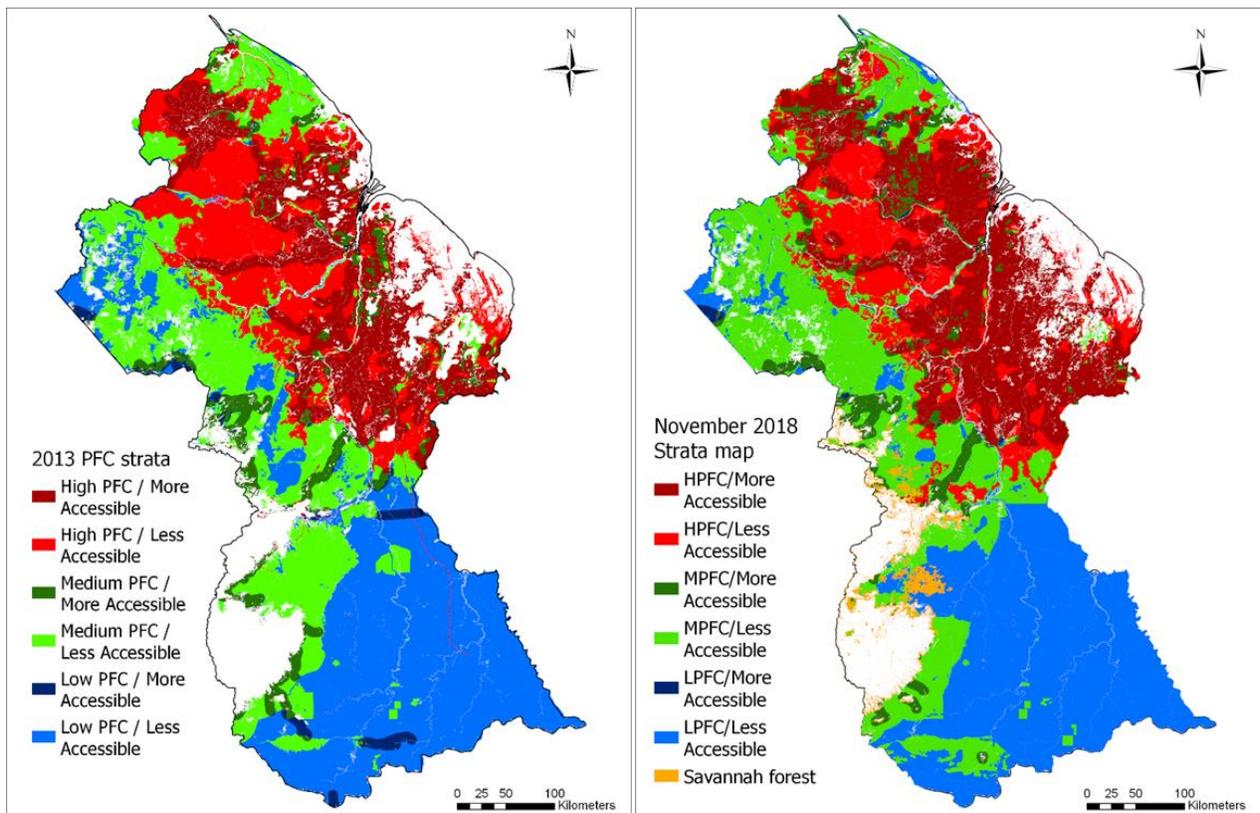
Combining plots from previous inventories with plots established in the 2018/2019 data collection effort results in a total of 108 plots and classified as follows:

- Low Potential for change, More Accessible
- Medium Potential for change, Less Accessible
- High Potential for change, Less Accessible
- Savannah forest

¹ Petrova S, Harris N, Brown S and Persaud H (2011) Spatial techniques for forest carbon stratification and sampling design for Guyana. Submitted by Winrock International to the Guyana Forestry Commission.

An iterative process was undertaken to look at the spatial location of forest carbon plots with low stocks near the savannah region in southwestern Guyana. The conclusion of the work clearly pointed to the fact that there are genuine ecological conditions that result in a natural forest with small sparse trees, but this was not predicted by lower tree heights and proximity to savannah. Thus, it was evident that there is a lack of difference in carbon stocks in the mapped ‘savannah forest’ stratum from any surrounding existing stratum. As a result, the study recommended that the savannah forest does not warrant a unique stratum and should be dropped

Between 2013 and 2019, the High potential for change – more accessible (HPfC MA) strata increased the most significantly, while the High potential for change- less accessible (HPfC LA) and Low potential for change – more accessible (LPfC MA) strata decreased the most. The updated 2019 stratification map shows that although forest cover in Guyana is not decreasing in overall size, it is under increasing threat given new roads and more concession area. The updated map will be useful to direct the sampling design for future carbon sampling plots to update the forest carbon stock values used in Guyana’s forest monitoring program. Further research is required to understand these changes. The potential for change strata of the 2013 and 2018 maps are illustrated below:



The table below shows the carbon stocks by pool for the five strata in Guyana’s FCMS. The 95% confidence interval (CI) represents the sampling error only.

Stratum	AG Tree (t C/ha)	BG Tree (t C/ha)	Saplings (t C/ha)	Standing Dead Wood (t C/ha)	Lying Dead Wood (tC/ha)	Litter (tC/ha)	Sum Carbon Pools* (t C/ha)	Number of plots	95% CI as a % of mean
HPfC MA	201.0	47.2	4.2	2.0	10.8	3.7	265.2	31	10.2%
HPfC LA	238.3	56.0	3.6	2.3	7.3	3.2	307.5	15	14.2%
MPfC MA	207.3	48.6	3.4	3.3	9.0	3.6	271.7	16	16.6%
MPfC LA	216.5	50.8	3.0	2.3	7.9	3.3	280.5	21	12.7%
LPfC MA	215.5	50.6	3.0	3.2	9.8	2.8	282.1	6	32.1%
LPfC LA	177.4	41.6	3.2	3.2	6.9	3.2	232.2	19	14.6%

Work was undertaken to develop, and test methods based on a combination of satellite-based maps and field-based observations for estimating gross carbon emissions caused by degradation due to gold mining in Guyana, where gold mining is the main cause of deforestation.

Across the stratum the stocks varied from 232 t C/ha in LPfC LA to 308 t C/ha in HPfC LA, and uncertainties were less than 17% for all strata except LPfC MA, the smallest stratum. An important outcome of the restratification was that the changes in the carbon stocks between the 2016 and 2019 plot analyses represented a regression to the mean, with the strata with higher values in 2016 (HPfC LA and MPfC) showing lower stocks in 2019 and the stratum with the lowest results in 2019 (LPfC MA) showing higher stocks in 2019. This requires further examination of the usefulness of stratification as it pertains to the stock assessment and will be further investigated in the continued development and improvement to the FCMS.

During the initial development of the FCMS, various approaches to stratification were assessed, and it was determined that stratifying based on biogeographic characteristics did not result in significant differences between strata². Therefore, stratification was based on two factors: 1. the potential for future land use change and 2. accessibility. This allowed for efficient sampling and the development of initial emission factors focused on the area with higher potential for change. Guyana's first reference level was based on these emission factors, with the understanding that it would be revised with stepwise improvements as additional data were collected.

A key reason for stratification is to lower the uncertainty of estimates. However, with all stocks combined, the total sampling error is lower than the summed stratified estimates (95% confidence interval equal to 5.1% of the mean), providing further support for eliminating the separate strata.

The decision was thus made in May 2019 to proceed with a single carbon stock for forests in Guyana. With a single stratum all pools were combined as given in the Table below which shows country-wide forest carbon stocks by pool for all forests in Guyana.

² Stratification based on biogeographical characteristics was reevaluated in 2018, using additional plot data to assess the potential for stratification based on forest type, rainfall, elevation, soil type, and latitude. Based on this analysis, none of these alternatives were provided an improvement over stratification based on potential for change and accessibility. See Stratification Options Assessment Report, submitted to GFC by Winrock International, August 2018.

AG Tree (t C/ha)	BG Tree (t C/ha)	Saplings (t C/ha)	Standing Dead Wood (t C/ha)	Lying Dead Wood (t C/ha)	Litter (t C/ha)	Sum Carbon Pools (t C/ha)	Number of plots	95% CI as a % of mean
205.8	48.3	3.7	2.6	8.6	1.6	270.6	118	5.1%

A Sustainable Long-Term Monitoring Plan was prepared in December 2019. This plan proposes a sustainable long-term approach to carbon stock monitoring that allows costs to be spread evenly across years, engages staff on a regular basis and thereby diminishes the need for retraining, and will yield regular data collection across the forest that will keep the inventory current. Some of the considerations of the plan include:

- Re-inventory period and the frequency with which data points should be replaced in the inventory that defines REDD+ emission factors- examining the use of permanent plots. The proposed design is an inventory period: 20 years, with 5% of total plot number measured every year. Over 20 years all plot data is replaced, in a rolling manner.
- Increasing the number of biomass plots from 118 which represents just 6 plots measured each year with a 20-year re-inventory period.
- Annual measurements at 2 logging concessions, one each reduced impact logging and non-RIL logging, with 20 plots measured in each concession. Over 20 years, this results 40 concessions and 400 total plots. Selected concessions should be distributed across representative practices and concession sizes. Better data from small concessions on forest harvest which requires more field work to improve the dataset.
- Continued use of current methodology for mapping mining degradation, infrastructure degradation and forest harvest calculations.
- Inclusion of activity data related to mangroves. This would consider the measurement of increase or decrease and the impacts on carbon.

Capacity Development

A draft Standard Operating Procedure (SOP) was developed to guide the improved mapping of degradation. The Guyana REDD MRV Statistical Change Assessment Standard Operating Procedure Guide gives practical advice and examples of how to assess forest change from a stratified random sample. It identifies the drivers of change in forest land cover and the time period in which the change took place. The guide covers the following topics:

- definitions of deforestation, degradation and forest change;
- detailed change and change driver category descriptions;
- rules for identifying and quantifying change;
- illustrated examples for identification of the drivers of forest change;
- how to identify the time that change took place; and
- how to assess the certainty of the interpretation.

GFC staff also benefited from training on use of the Google Earth Engine and preparation for the implementation of the Continuous Resource Monitoring System (CRMS) for the Year 9 MRVS change assessment.

2.2 Outcome 2: The MRVS more precisely accounts for the forest carbon dynamics.

Non-REDD+ Payment Options

As Guyana embarked on the second phase of its MRV System (2015 to 2019), lower cost satellite options were explored. For deforestation mapping, a combination of ESA Sentinel 2 and Landsat imagery provides a sound alternative to RapidEye with high enough resolution and sufficient temporal coverage to generate an annual snapshot of forest change. The two Sentinel satellites 2A and 2B enable repeat imaging of the same spatial location every five days at a spatial resolution of 10 m. Combined with the Landsat constellation (L7 and L8), this represents 6 to 7 observations per month, making the data a valuable resource for monitoring forest change. The Sentinel satellites are equipped with the state-of-the-art Multispectral Imager (MSI) instrument that offers high-resolution optical imagery. Sentinel's five-day revisit rate will also be leveraged to develop a more real time, continuous monitoring system hosted within the MRVs.

The change in imagery has affected neither the definition of forest nor the SoP for mapping change. The Accuracy Assessment has also confirmed that the accuracy of the mapped product has not been affected. The spatial accuracy and co-registration of Sentinel-2 imagery was found to be better and more consistent than that of RapidEye.

The Google Earth Engine (GEE), a computing platform that allows users to run geospatial analysis on Google's infrastructure, is being used under a non-commercial policy to enable more real time monitoring. The GEE combines a multi-petabyte catalogue of satellite imagery and geospatial datasets with planetary-scale analysis capabilities and makes it available to detect changes, map trends, and quantify differences. The GEE replaced the Environment for Visualizing Image (ENVI) software that was used in previous years of the MRVS. The GEE was used for enhanced vegetation indices (EVI), persistent cloud masking, and for conducting change detection mapping for Year 8. The mapping team received training on the use of this tool and now uses the platform to perform remote sensing tasks.

An assessment is being conducted on the use of overflight data versus PlanetLabs data for degradation mapping and Accuracy Assessments. This is currently the costliest aspect of the mapping assessments and hence identification of less costly options will help secure least-cost options for the operation of the MRVs.

New Development Areas

A new proposed methodology for the refinement of methods for determining the extent and scale of shifting cultivation was developed over 2018 and 2019 and is reflected in the Year 8 forest cover and emissions reporting. It covers five areas to quantify the carbon stock reduction in terms of annual area change and carbon stock removals.

A field mission to collect data across a range of ages of cropping and fallow stages in shifting cultivation areas was undertaken in 2018 to generate data for development of a time-average stock across the full cycle. The data was however highly variable, requiring a substantially greater field effort to ensure sufficiently robust data to develop an appropriate emission factor. Given the minimal contribution of shifting cultivation to overall deforestation, such an effort is not warranted. Based on this assessment an average long-term shifting cultivation carbon stock of 6.1 ± 0.1 t C/ha was adopted.

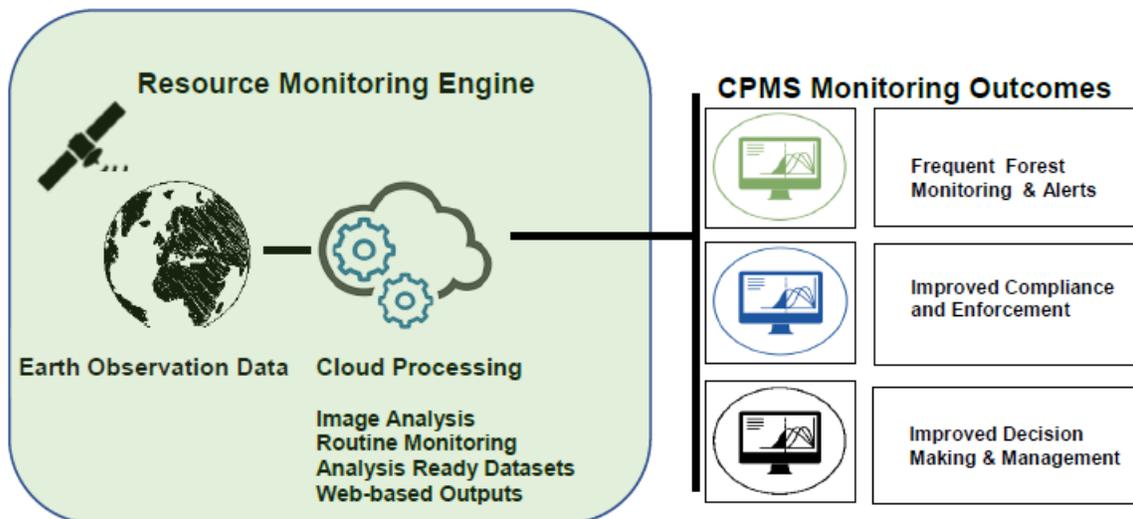
Reporting on timber harvesting and illegal logging has been mainstreamed under full emissions accounting using existing methods. Degradation estimates for mining and infrastructure were computed using new methods developed over 2018 and 2019 as a part of moving towards a more comprehensive yet sustainable (in terms of financing and technical implementation) MRVS implementation post-2020. This aspect of sustainability refers to determining estimates for mining and infrastructure degradation without costly high-resolution imagery or aerial surveys. These improvements provide a robust measure of both deforestation and degradation that aligns with Guyana’s desire to pursue a low or no-cost REDD+ implementation option – this is an integral part of the Phase 2 objective whilst moving toward full emissions accounting.

A real-time system will assist Guyana to meet its commitments to the United Nations Framework Convention on Climate Change (UNFCCC) as well as Sustainable Development Goals (SDGs). A key focus is to support capacity building on forest monitoring at the GFC and stakeholders, which includes indigenous communities.

A prototype system modelled on the functionality of the current MRVs was designed to allow more frequent monitoring of Guyana’s forests. The system, the Continuous Resource Monitoring System (CRMS), also aims to reduce the reliance on commercial satellite imagery and software, using a cloud-based processing environment hosted by Google Earth Engine (under free license) to access freely available optical satellite data – including Landsat, Sentinel 2A/2B and radar Sentinel 1A.

The design concept of the CRMS presented in the figure below, is showing the link between satellite imagery, held and processed in the cloud, and the final output layers which can either be held by the GFC within the MRVs, or hosted on a web-based GIS platform.

Further, in Year 8 (2018) the GFC sought to expand its use of Google Earth Engine (GEE) for image processing and EVI’s downloads and for cloud masking Sentinel imagery. The GEE platform, made freely available to Guyana, provides access to significant cloud processing capability, satellite images (optical and radar) and other open source datasets.



Scientific Publications

A paper co-authored by the GFC in 2018 titled “Quantifying the trade-off between cost and precision in estimating area of forest loss and degradation using probability sampling in Guyana” was published in Remote Sensing of Environment. This paper drew extensively on the Guyana forest change dataset created by the GFC mapping team.

Related to the FCMS, a paper titled “Carbon emissions from tropical forest degradation around mining areas in Guyana” is being developed. This paper will describe and test two methods for estimating the area of forest degradation (i.e. activity data) and the corresponding emission factors (EF) from activities in the forests surrounding mining. It will also estimate gross carbon emissions from forest degradation caused by mining and compare the emissions generated and the efficacy of the methods.

The GFC further contributed to work by author Alvaro Ivan Lau Sarmiento on the publication: “Assessing biomass and architecture of tropical trees with terrestrial laser scanning, October 30, 2018.” The main objective of the study was to explore the use of 3D models from terrestrial laser scanning point clouds to estimate biomass and architecture of tropical trees. In this thesis a dataset of forest inventory was created. This was developed with the use of a terrestrial laser scanner (TLS) point clouds and destructive tree harvesting from three tropical regions: Indonesia, Guyana and Peru.

2.3 Outcome 3: MRVS data and results inform improvements in forest management policy and practice.

MRVS Data Platform

Two options for sharing the MRVS results have so far been considered. These are:

1. An existing interagency platform available through the Geospatial Information Management Unit (GIMU) of the Ministry of Natural Resources; and
2. Linkages with Forest Watcher, a mobile app that allows offline display of forest change alerts.

The GIMU’s platform is to be used for active communication and feedback between the Ministry of Natural Resources, the Guyana Forestry Commission, and forest owners and managers. The reporting framework for collating MRVS at concession level is to be established on this platform as well.

Additionally, GEE applications to assist the GFC to improve forest monitoring and legality by enabling real-time processing of large volumes of earth observation data to provide analysis-ready forest monitoring products.

Influencing Forest Policy

A report on the “Review of MRVS applications for forest management and land use allocations in Guyana” was prepared following a series of stakeholder consultations. The Report outlines existing uses of MRVS data outside the primary reporting on the Guyana Norway Agreement, including:

1. the MNR and GGMC identifying areas of high intensity mining and forestry use;
2. the PAC using the MRVS data in analyses to inform the National Protected Areas System expansion strategy; and
3. the GLSC use to assess land degradation on non-forest land.

A series of policy dialogues with stakeholders in government, private sector and environmental NGOs were held to discuss data usage and data sharing protocols for the MRVS.

Resulting from the exploration the use of MRVS spatial data and outputs for planning and development purposes by agencies and the potential for broader application over time, the GFC signed Memoranda of Understanding on the use of the MRVS data with several agencies. Some agencies also requested and received training for their staff in the use of the data. Data sharing arrangements are currently established with the following entities:

- i. Protected Areas Commission
- ii. Faculty of Agriculture and Forestry, University of Guyana
- iii. Environmental Protection Agency
- iv. Central Housing and Planning Authority
- v. Office of Climate Change – Third National Communication
- vi. National Agricultural Research and Extension Institute
- vii. Ministry of Public Infrastructure
- viii. Hydro meteorological Services, Ministry of Agriculture
- ix. Guyana Geology and Mines Commission
- x. Policy Forum Guyana

With the consistent compilation, analysis and dissemination of MRVS results on a typically annual basis, its role in informing national processes such as natural resources policy and management is envisaged to increase. In Year 8, there was a significant broadening of the application of the MRVS data and products for purposes aligned or complementary to national REDD+ objectives and forest policy and management. These broader applications have allowed for a beneficial shift towards the increased use of remote sensing data and scientific reporting to inform forest management, governance and decision-making on natural resource management across forested land.

In continuing work on supporting the development of Community Monitoring Reporting and Verification programmes within communities, the GFC embarked on a programme in 2018 and trained 23 Indigenous communities in CMRV. These sessions aimed to build capacities of communities in CMRV principles and methodologies by modifying the national scale methodologies to make them applicable at community scale. This activity included a ground verification exercise of pre-selected forest change areas, which were captured/mapped within their respective communities. A standard data collection form was developed for use by each community, along with the necessary equipment and other resources for them to carry out the exercise. This data will be used as part of the verification process to determine the accuracy of the forest assessment aspect of the MRVS.

2.4 Outcome 4: A third phase of MRVS operation is assured.

Work under this outcome has commenced and the first draft of the roadmap is expected to be completed in the first quarter of 2020. A more targeted approach for engagement on the roadmap development than undertaken for the previous phases will be utilized. It is envisioned that engagements will primarily be with specialized experts who can provide the required technical input.

The development of the structure of the MRVS Phase 3 is proposed as follows:

MRVS Routine / Operational

1. Routine reporting of Deforestation and use of EF for degradation
2. Linkages with CMRV – piloting an integrated system or at least sharing of base data

3. Communication strategy
 - Promote science publications and collaboration
 - Link to UG -Teaching module related to the MRV use of big data and applications
 - Dissemination of change layers
 - Conferences / papers
 - Promotional features
 - Workshops

Sustainability

1. Expansion beyond MRVS to develop the national forest monitoring system
2. Expansion of technical capabilities of GFC mapping team
3. Streamline process and support other programs (linking into the Indigenous People's Planning process)
4. Work with selected partners / agencies to develop monitoring products, be involved in projects and receive funding
5. South- south collaboration – transfer of system linking with Suriname and other countries
6. Evaluate carbon credit payment scenarios Eco-system services
7. Research
 - Dynamics of shifting cultivation
 - Afforestation / regeneration
 - Degradation
 - Map accuracy

MRVS Phase 3 will seek to determine the extent to which the objectives as defined in MRVS Phase 2 have been met, and assess the likelihood of achieving them upon project completion; as well as identify potential options for improving the program which could include modification of methods and approaches, activities, milestones, program timelines, responsibilities of the Executing Agency's staff, schedule of activities and budget allocations.

2.5 Outcome 5: Key technical and non-technical audiences are informed on the relevant aspects of Guyana's MRVS.

Local Outreach and Engagement

Consultation and Outreach Consultants were hired to conduct national outreach on REDD+ activities, specifically the MRVS and REDD+ related areas. The consultant executed 12 dialogue and capacity building sessions with three hundred and twenty-seven (327) national stakeholders in 2018. Non-technical communication materials, including on the MRVS design, results and impact, were disseminated prior to conducting of sessions with national and community stakeholders. The new 2020 sessions will focus on forest-based communities, activities related to the drivers of deforestation, and experiences of the consultation and outreach workshops held in 2018.

International Exchange and Engagement

Guyana's first Summary of Information (SoI) is presented which features output from the national MRVS. This is in accordance with the decision established in the United Nations Framework Convention on Climate Change (UNFCCC) regarding policy approaches and positive incentives on issues relating to reducing emissions from deforestation and forest degradation, and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks (REDD).

2.6 Outcome 6: Guyana maintains sound forest monitoring systems, in particular as it relates to the regulatory frameworks for responsible forest management.

An Independent Forest Monitoring audit, the fourth such audit, was completed in March 2019 and covered the calendar year 2018. The audit covered the production and sale of logs (including industrial round wood, piles, poles and posts) and lumber. It involved examining all stages of the chain of custody as it relates to logs and lumber for the four concession types issued in Guyana.

The audit was system-based and entailed a combination of desktop review of documents and records; interviews with GFC staff, Forest Sector Operators (FSOs), and independent stakeholders; and field inspections of concession areas, sawmills, lumberyards and GFC field stations, to verify and cross-reference evidence obtained from document reviews and interviews.

The Fourth Audit excluded non-timber forest products (NTFPs). Special emphasis was placed on field work to assess how Guyana's Wood Tracking System (WTS) was being implemented on the ground. Like the Third Audit, sampling was based on the Forest Stewardship Council® (FSC®) formula used for calculating the number of sites to be included in a multi-site certification. This provides a rational basis for the extrapolation of results from the sample inspected to the total.

For 40 of the 43 indicators assessed, the audit team found that the systems and procedures were operating effectively, and that satisfactory compliance with the specific indicators could be demonstrated. For the remaining 3 Indicators, the absence of relevant activity in the sample period meant that the audit team was unable to record a finding. For example, there were no hydropower projects during the reference period for audit sampling.

The audit team raised seven specific observations in relation to:

- the systems and procedures of the GFC; or
- the Indicators themselves.

Based on document reviews and field inspections, the audit team concluded that:

- Overall, the compliance/monitoring system is working as it was intended;
- Both GFC staff and FSOs are fully conversant with the compliance/monitoring systems, and the associated requirements;
- FSOs understood and accepted the need for the compliance/monitoring systems for demonstrating to their buyers the legal sources of their wood produce;
- Stakeholders again confirmed that the compliance/monitoring regime was working well, and any illegal activities that may be occurring are low, and limited largely to the domestic market; and
- There are opportunities to improve further the compliance/monitoring regime.

3. Summary Discussion of Progress and Impact

The MRVS has continued to advance an internationally recognised system that uses robust methods for monitoring deforestation and forest degradation. The project has incrementally sought to incorporate new datasets and processing methods further ensuring the non-REDD+ options are fully integrated into the national assessments.

The most recent Year 8 report outlines the significant progress made to move the monitoring into full emissions reporting beyond just the overall rate of change but reporting on emissions by driver of change. This was supported by the completion of the re-stratification exercise and the

improvements to the FCMS. The update will be useful to direct future carbon sampling plots to update the forest carbon stock values used in this monitoring program.

Specific efforts were made to update and incorporate a more complete suite of information on drivers of change as the current national reference level is under review. This included in-depth analyses in understanding forest degradation mapping and the effects on the loss of carbon in areas surrounding mining and shifting agriculture. The result of this review refined methods for mapping change and are fully documented in the updated SOP. In addition, examining the separation of savannah forest on reported carbon stocks which through field work and other research did not warrant a unique status. The completed Sustainable Long-Term Monitoring Plan discusses progress and planned next steps for these and other carbon related activities.

Notable mechanisms have been put in place to ensure access to data and training are available through inter-agency collaboration, public outreach and development of the CMRV. This project has maintained and expanded the capacity of the GFC to reliably provide assessment of forest cover change and forest emissions, build the capacity of agencies and entities with mandates for the management of forests to utilize this data to improve the management of Guyana's forests. The testing of the Continuous Resource Monitoring System has advanced the efforts to utilise a low-cost and near-real time method for future use. This will allow two parallel reports to be prepared for the final year of assessment.

Progressively the GFC has improved the implementation of recommendations related to agreed policies and procedures for financial management set out for the project. Following two site reviews in June and December of 2019, there has been a clear and positive enhancement in the accounting for the project in compliance with the terms and conditions of the grant agreement. A technical walk through of the Forest Area Assessment Unit of the GFC provided an update on the specific mechanisms being adopted for the Year 9 assessment and the preparations to move toward a near-real-time system.

Given the development of this MRV system to consistently, accurately and reliably assess tropical forest change in a low deforestation context is quite notable. The positive outcome of the Mid-Term Review of the MRVS project conducted during the reporting period provides an independent analysis of the progress of the work to date. Based on this report, CI recognises the need for an appropriate communication strategy around forest protection and forest monitoring and will be actively engaged with the GFC and other partners in this regard. The fourth Independent Forest Monitoring audit which focused on the field work related to wood tracking on the ground further produced a positive report with no significant findings.

The Year 9 Assessment report is scheduled to be completed three months prior to the project end date to ensure enough time for financial and technical close-out of the project. The Terminal Evaluation of the project will be conducted in the new implementation period.

4. Factors affecting Project Implementation and Achievement of Results

As part of the oversight of the project during the reporting period, the matter of local mapping and coordination costs for GFC staff was under review. This proposal was thought to be one of the main

factors that is responsible for the successful development of the Guyana MRVS in a manner that has created local ownership and national management capability. This capacity was built within the Commission and is a key part of the sustainability plan for the MRVS project.

However, based on the internal discussions within the GFC, a proposal was submitted for a budget reallocation from Local Mapping and Coordination Staff Costs to Travel and Logistics. This entailed covering field related costs to strengthen efforts related to Community Monitoring, Reporting and Verification (CMRV) engagements. With this adjustment, the staff costs were covered by the GFC and this change would support more linkages between the national system and the community MRVS.

During this review period, there were minor delays in the implementation of the project. However, through relationship and trust-building the implementation of the technical aspects of the project is on track. The organization structure remains and is fully functional.

5. Summary Report Against Project Results Framework

Planned Results	Indicators	Means of Verification (Data Sources) / Comments	Baseline (values)	Targets 2018	Targets 2019	Results Summary 2019
GOAL: Guyana's Green Development Pathway secured.	Guyana's Green Economic Strategy exists and includes implementation of a REDD+ or other programme to verifiably reduce emissions from the forest sector	Review of national development documents.	Strategy is being developed	Strategy completed and includes REDD+ as a measure.		Strategy completed.
	Level of emissions from Guyana's forests compared to committed levels and thresholds.	Review of MRVS Reports and data	Estimated at 11.7 million ton CO ₂ in Mean for 2001-2012	< 48.8 million tons	< 48.8 million tons	Total CO ₂ Emissions for Guyana for 2018 from Forest Sector 11,520,210 (t CO ₂ /ha)
Outcome 1. Guyana's Forest Carbon Monitoring System is strengthened in fulfilment of the MRVS Roadmap Phase 2 and reporting on forest area change and emissions from forests is completed for Years 6 to 9 (01 January 2015 to 31 December 2019) of the Guyana-Norway agreement.	Number of significant capacity or financial gaps exists in the GFC's GIS Unit by 2017.	Assessment of human and other capacity of the GFC's GIS Unit.	Gap for a Reporting Manager/Coordinator	0	0	0
	Number of MRVS reports published detailing quantification of forest carbon emissions, forest cover, and forest cover change for MRVS Years 6 to 9 following IPCC guidelines and verified by a third party.	MRVS Reports	Last verified report published in 2015 covering January 1 to December 31, 2014. An unverified report is to be published in 2017 covering January 1 to December 31, 2015	1 Verified report for Year 7 published	1 Verified report for Year 8 published	The report for MRVS Year 7 (1 January 2017 to 31 December 2017) was first published (HERE) by the GFC on 21 November, 2018. The report for MRVS Year 8 (1 January 2018 to 31 December 2018) was first published (HERE) by the GFC on 22 November 2019.

Planned Results	Indicators	Means of Verification (Data Sources) / Comments	Baseline (values)	Targets 2018	Targets 2019	Results Summary 2019
	Level of uncertainty in the determination of emission from forests	Assessment of MRVS Report	90% confidence +/- 5%			95%
Output 1.1. Forest Cover and forest carbon monitoring system implemented with annual assessments of forest cover conducted for Years 6 to 9, key advancements incorporated as appropriate.	Number of assessments of landcover change in Guyana, with drivers of changes from forest to non-forest determined and reported following IPCC criteria, completed.	Assessment of MRVS Report		1 Assessment for Year 7	1 Assessment for Year 8	The report for MRVS Year 7 (1 January 2017 to 31 December 2017) was first published (HERE) by the GFC on 21 November, 2018. The report for MRVS Year 8 (1 January 2018 to 31 December 2018) was first published (HERE) by the GFC on 22 November 2019.
	Number of non-carbon NDC commitments, including EU FLEGT, are tracked and linked to MRVS.	Assessment of MRVS Report	No NDC commitments are tracked in MRVS	1		N/A
	Number of spatial data sets on forest area change, including drivers of change, produced.	GFC GIS database		1 for Year 7	1 for Year 8	The data was produced by the GFC and is housed within its GIS Laboratory database.
Output 1.2 Forest Carbon Monitoring System implementation of key activities advanced, as identified in the MRVS Phase 2 Roadmap.	Number of annual estimates of emissions from forest activities produced using forest carbon data from three risk strata.	Assessment of MRVS Report		1 Estimate for Year 7	1 Estimate for Year 8	The estimate was published in the Year 7 and Year 8 MRVS report.
	An updated long-term forest carbon monitoring framework is produced	Assessment of project reports	Existing long-term forest carbon monitoring framework completed in 2015	-	Sustainable Long Term Monitoring Plan for Guyana submitted	A Sustainable Long Term Monitoring Plan for Guyana was prepared in December 2019.
Outcome 2. The MRVS more precisely accounts for the forest carbon dynamics.	Number of new methods incorporated into the MRVS to enhance precision of net emission estimates.	Assessment of MRVS Report Assessment of project reports	Preliminary exploration of new areas for development	Improved methods for treating shifting cultivation tested		Improved methods for treating shifting cultivation tested and documented in Interim Measures Report 8.

Planned Results	Indicators	Means of Verification (Data Sources) / Comments	Baseline (values)	Targets 2018	Targets 2019	Results Summary 2019
		MRVS SOPs				
	Methods for the operation of the MRVS in the absence of REDD+ payments are in place.	MRVS SOPs		-		N/A
Output 2.1. Methods for the operation of the MRVS in the absence of REDD+ payment are determined.	Number of methods for non-REDD+ MRVS assessed	Assessment of project reports	Some testing done using free data sources	At least 2 options assessed	One preferred option ran in parallel with MRVS.	Sentinel imagery has been fully integrated into the MRVS.
Output 2.2. New areas under the MRVS Developed	At least one method for treatment of shifting cultivation tested.	Assessment of project reports		Methods identified	Options tested.	A methodology has been tested and is documented in the Year 8 report.
	At least one option for near-real-time monitoring for high priority sites tested.	Assessment of project reports		Options tested	Options tested	Sentinel imagery using a Google Earth Engine Platform tested given the high frequency and availability of imagery.
Outcome 3: MRVS data and results inform improvements in forest management policies.	Number of new or revised forest management policies in Guyana informed by MRVS results and data.	Assessment of Forest Management policies in Guyana	None	1	1	
Output 3.1. Platform for access to and utilization of MRVS data to inform forest management policy and practice developed.	A mechanism for the utilization of MRVS data in forest management is established.	Report describing the MRVS Platform. Data sharing protocols		Options for the Mechanism explored	Mechanism established	Options have been proposed following engagement of potential and current users of the data. A prototype of the platform developed.
Output 3.2. Application of MRVS data for decision making tested at a	Number of cases in which MRVS data is used to inform decision making at the policy and programme level across the natural resources sector	Project reports	No cases	2 cases	4 cases	The MRVS data is being used by several entities, including for development of the National REDD+ Strategy. Application in 7 cases - 10 institutions. See Year 8 report for details of use.

Planned Results	Indicators	Means of Verification (Data Sources) / Comments	Baseline (values)	Targets 2018	Targets 2019	Results Summary 2019
variety of levels and scales.						
Outcome 4. A third phase of MRVS operation is assured.	GFC's plans and budget for post 2020 includes operation of the MRVS.	Assessment of GFC's Annual plans.	-	-		N/A
Output 4.1. A roadmap for advancement of the MRVS into its third phase is developed.	A guiding document for the continued development and implementation of the MRVS, post-2019 is developed	Project reports		-	MRVS phase 3 road map completed	Guiding document prepared and to be reviewed by technical expert group.
Outcome 5. Key technical and non-technical audiences are informed on the relevant aspects of Guyana's MRVS.	Level of awareness and knowledge of the value of a functional MRVS, REDD+ and related SFM national and international commitments within the public and private sector stakeholders in the logging and mining sectors	Analysis of data from communication and feedback monitoring mechanism. Survey of target audience	Unknown	6	7	General outreach in 12 workshops total participants: 85 villages and communities were represented, 14 forestry associations, 10 processing facilities, and 26 governmental and non-governmental agencies.
	Number of citations of information on Guyana's MRVS in major international publications	Analysis of scientific literature on MRVS and REDD+.	0	1		N/A
Output 5.1. Technical and non-technical knowledge products focused on the development and implementation of the MRVS produced.	Number of communication tools focused on the MRVS and forest management	Project reports and materials produced	0	4	8	
	Number of scientific papers on the development and implementation of Guyana's MRVS submitted for publication.	Assessment of scientific literature on MRVS and related topics.	0	1		4 scientific publications

Planned Results	Indicators	Means of Verification (Data Sources) / Comments	Baseline (values)	Targets 2018	Targets 2019	Results Summary 2019
Output 5.2. Stakeholder engagements to improve capacity to understand and utilize MRVS data conducted.	Number of MRVS awareness and capacity building sessions held with stakeholders directly involved in forest management.	Project reports	0	2	4	23 indigenous communities trained in CMRV in 2018.
	The percentage of men compared to women who attend the awareness and capacity building sessions	Reports on awareness sessions		+/- 5%	+/- 5%	
OUTPUT 5.3 Lessons from the development and implementation of the MRVS shared globally with key audiences.	Number of south-south exchanges hosted or attended	Project reports	0	1		1 in 2018 (Regional Cooperation Project: Satellite Observation of the Guianas (Projet de Coopération Régionale d'Observation des GuYanes par SATellite))
	Number of international events at which Guyana's MRVS is featured	Project reports	0	1		N/A
Outcome 6. To complete the third and fourth audit for Independent Forest Monitoring (IFM).	Number of significant negative audit findings.	Assessment of findings of the IFM Audits.		0		No Significant findings were documented in the fourth IFM audit
Output 6.1 A third (2016) and a fourth (2018) audit for Independent Forest Monitoring (IFM) in Guyana is completed following agreed terms.	Number of final IFM Audit Reports completed.	Assessment of findings of the IFM Audits.	3 (Scoping Audit, 2 Assessments)	1 Report for Year 7		The fourth IFM audit was completed in 18 th February, 2019.