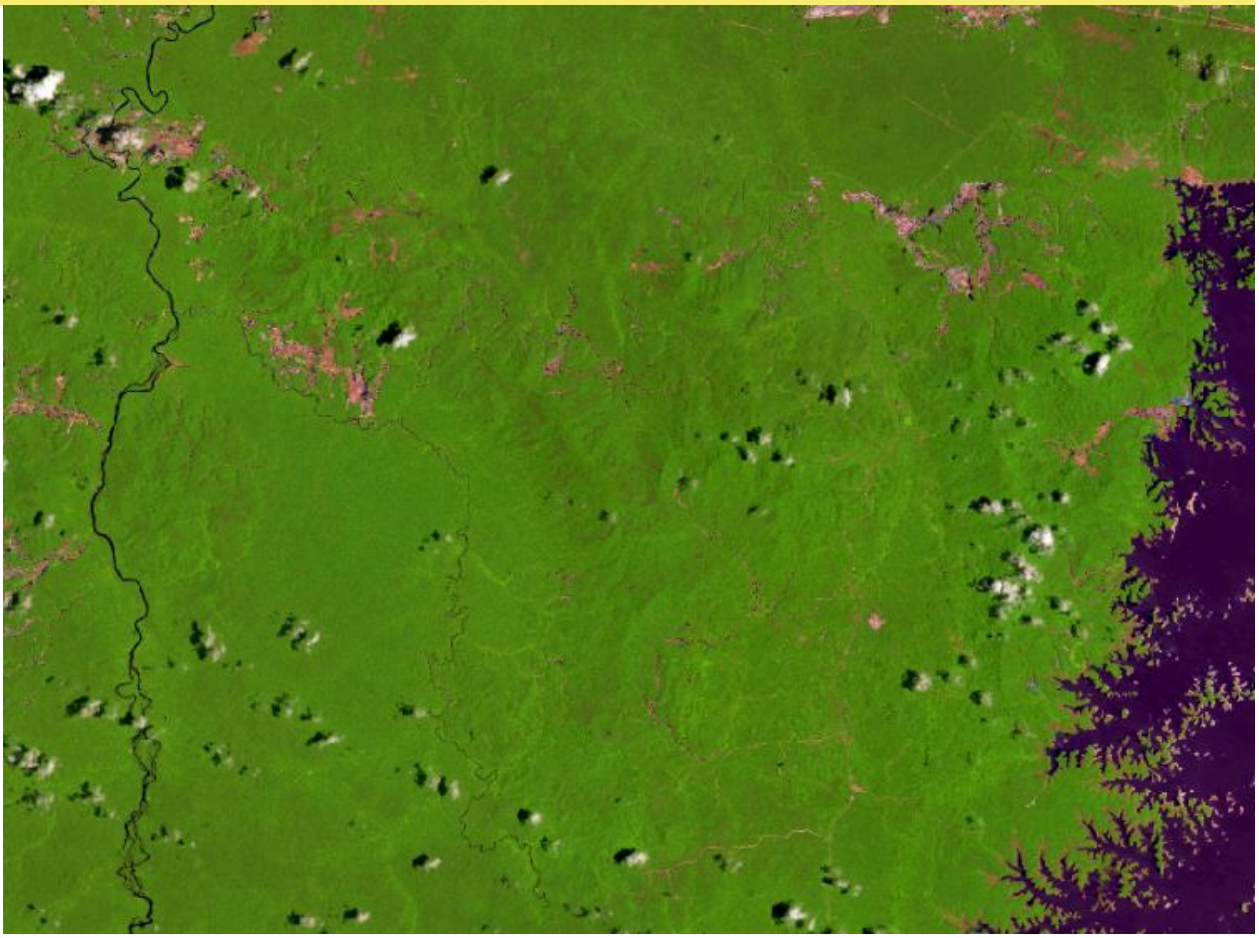
NFMS Roadmap

STATUS AND PLANS FOR SURINAME'S NATIONAL FOREST MONITORING SYSTEM



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Author

Foundation for Forest Management and Production Control (SBB)
Directorate of Research and Development

Acknowledgements

The Roadmap for Suriname's National Forest Monitoring System (NFMS Roadmap) was written in the course of 2016, mainly by the REDD+ team within Suriname's Foundation for Forest Management and Production Control (SBB). It builds upon the work done in 2014 when the National Plan for Forest Cover Monitoring (FCM plan) was developed mostly by the same core group of people. The authors of the NFMS Roadmap wish to thank other colleagues of the SBB and NFMS partners from other institutions for their crucial support and contributions, including the REDD+ partners, the National Institute for Environment and Development in Suriname (NIMOS) and the United Nations Development Programme (UNDP). Experienced international partners have been consulted and shared much appreciated advice reflected in the text. Stakeholders from multiple institutions in Suriname have provided invaluable support through workshop participation, bilateral meetings, reviewing parts of the text and other types of collaboration that progressed the development of the NFMS.

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SUMMARY

This document explains the path that Suriname has followed in the years leading up to 2016, to enable national monitoring of its forests on an increasingly regular basis. It also sets out the roadmap for how such activities will be continued, improved and institutionalized into a fully functional National Forest Monitoring System (NFMS) in the years to come.

The document includes seven chapters summarized below:

Chapter 1: Introduction
To place the need for an NFMS in its context, this document starts with an introduction explaining the general importance of forests and forest monitoring, the vision, planned functions and guiding principles of the NFMS in Suriname, the REDD+ mechanism and international requirements for an NFMS, and the process that was followed to formulate Suriname's NFMS roadmap.

Chapter 2: National circumstances related to the NFMS
The second chapter focuses on the national situation in Suriname that is crucial to understand in order to give shape and meaning to the NFMS in the unique context of the country. It explains that Suriname is, in terms of forest cover, the greenest country in the world, but that deforestation rates have increased in recent years compared to historical rates, mainly due to gold mining. An overview is given of current policies and measures, institutions and stakeholders in Suriname related to the forestry sector and forests.

Chapter 3: Current status and action plan for the NFMS
Chapter three explains the current status of forest monitoring systems in Suriname by December 2016. It gives strategic direction for the future by formulating in broad lines the action plan for NFMS. The chapter starts with a section on cross-cutting topics of consideration for the full NFMS. Other sections focus on the different components of the NFMS, namely the satellite land monitoring system, the national forest inventory and other monitoring functions. The final section in the chapter focuses on international reporting that needs to be done with data from the NFMS.

Chapter 4: Capacity strengthening plan and engagement strategy
In order to make the NFMS fully functional, there is need to strengthen institutional capacity, human resources, technical, financial and logistic, equipment and software capacity. The relevant stakeholders need to be engaged in all different activities and processes of the NFMS. Chapter four includes a capacity strengthening plan and an engagement strategy.

Chapter 5: Conclusions
The final chapter wraps up the document with a short summary of the status and plans for the NFMS.

ACRONYMS

ACR	Amazon Conservation Rangers
ACT	Amazon Conservation Team
ACTO	Amazon Cooperation Treaty Organization
AdeKUS	Anton de Kom University of Suriname
AFOLU	Agriculture, forestry and other land use
AGB	Above-ground biomass
AP	Action Plan
ASHU	Algemene Surinaamse Houtunie (Common Surinamese Wood Union)
AWP	Annual Work Plan
BBS	National Herbarium of Suriname
BSc	Bachelor of Science
BUR	Biennial Update Report
CabPres	Cabinet of the President of the Republic of Suriname
CATIE	Centro Agronómico Tropical de Investigación y Enseñanza
CBB	Centraal Bureau voor Burgerzaken
CBD	Convention on Biological Diversity
CBL	Centraal Bureau Luchtkartering
CBN	Capacity fund for Forest and Nature
CCCD	Cross-cutting Capacity Development
CELOS	Center for Agricultural Research in Suriname
CI	Conservation International
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMRV	Community-based Measurement/Monitoring, Reporting and Verification
CNE	National Standards Committee
COP	Conference of the Parties (UNFCCC)
CRA	INPE Amazon Regional Center
CSO	Civil Society Organization
DDFDB+	Drivers of Deforestation, Forest Degradation and Barriers to REDD+
DW	Dead Wood
EF	Emission Factors
ESA	European Space Agency
ESRI	International supplier of the ArcGIS Geographic Information System software, web GIS and geo-database management applications
FAO	Food and Agriculture Organization
FCM	Forest Cover Monitoring
FCMU	Forest Cover Monitoring Unit
FCPF	Forest Carbon Partnership Facility
FMU	Forest Management Unit
FRA	Forest Resources Assessment
FREL/FRL	Forest Reference (Emissions) Level
FUNCATE	A Fundação de Ciência, Aplicações e Tecnologia Espaciais (Brazilian Foundation for Science, Technology and Space Applications)
GBIF	Global Biodiversity Information Facility
GCCA+	Global Climate Change Alliance+
GCF	Green Climate Fund

GDP	Gross Domestic Product
GEF	Global Environment Facility
GEO	Group on Earth Observations
GHG	Greenhouse gas
GIS	Geographic Information System
GLIS	Grondregistratie en Land Informatie Systeem
GMD	Geologische Mijnbouwkundige Dienst
GOFC-GOLD	Global Observation for Forest Cover and Land Dynamics
GOS	Government of Suriname
GPS	Global Positioning System
HKV	Houtkapvergunning
INDC	Intended Nationally Determined Contribution
INPE	Instituto Nacional de Pesquisas Espaciais
IPCC	Intergovernmental Panel for Climate Change
IRD	French research institute for development
KLM	Royal Dutch Airlines
LIDAR	Light Detection and Ranging (a remote sensing method)
LKS	Lesser Known Species
LULC	Land Use Land Cover
LULUCF	Land Use Land Use Change and Forestry
LVV	Ministry of Agriculture, Livestock and Fisheries Suriname
MAS	Marine Authority Suriname
MEA	Multilateral Environmental Agreement
MI-GLIS	Management Institute Land Registration and Land Information System
MINOV	Ministerie van Onderwij en Volksontwikkeling
MOU	Memorandum of Understanding
MRV	Measurement/Monitoring, Reporting and Verification
MSc	Master of Science
NAMA	Nationally Appropriate Mitigation Actions
NARENA	Department of Natural Resources and Environmental Assessment (of CELOS)
NB	Natuur Beheer
NC	National Communication
NDC	Nationally Determined Contribution
NFI	National Forest Inventory
NFMS	National Forest Monitoring System
NGO	Non-governmental organization
NH	Ministry of Natural Resources
NIMOS	National Institute for Environment and Development in Suriname
NRTM	Near Real Time Monitoring
NS	National Strategy
NTFP	Non-Timber Forest Products
NZCS	National Zoological Collection Suriname
OGS	Commission for the Ordering of the Gold Mining Sector
OIS	Organization of Indigenous People in Suriname
ONF	Office National des Forets (French Forest Office)
ONFI	Office National des Forets International
OW	Ministry of Public Works
PAM	Policies and Measures

PhD	Doctor of Philosophy
PHS	Platform Hout Sector Suriname
PRODES	Gross Deforestation Monitoring Program in Amazonia
PRODOC	Project Document (for the REDD+ readiness FCPF grant)
QA/QC	Quality Assessment/Quality Control
R+A	REDD+ Assistants
R-PP	Readiness Preparation Proposal
REDD+	Reduced Emissions from Deforestation and Forest Degradation, conservation of forest carbon stocks, enhancement of forest carbon stocks and sustainable management of forests
RGB	Ministry of Physical Planning, Land- and Forestry
RS	Remote Sensing
SAFARI	Sustainable Forest Management approaches to foster Forest Law Enforcement, Governance and Trade and Reduced Emissions from Deforestation and Forest Degradation interactions
SAR	Synthetic Aperture Radar
SBB	Foundation for Forest Management and Production Control
SCF	Suriname Conservation Foundation
SCPAM	Suriname Coastal Protected Areas Management
SDG	Sustainable Development Goals
SES	Social and environmental safeguards
SESA	Strategic Environmental and Social Assessment
SFM	Sustainable forest management
SIS	Safeguards Information System
SLMS	Satellite Land Monitoring System
SMART	Specific, Measurable, Agreed upon, Realistic, Time framed
SOP	Standard Operating Procedure
SPS	Stichting Planbureau Suriname
SU	Sampling Unit
SVM	Support Vector Machine
TCT	Ministry of Transport, Communications and Tourism
TERRACLASS	Mapping Software
TOR	Terms of Reference
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UN-REDD	United Nations
UTSN	Twinningfaciliteit Suriname-Nederland project
VBH	Vereniging Binnenlandse Houtproducenten
VIDS	Vereniging van Inheemse Dorpshoofden in Suriname
VP	Vice President
VSG	Association of Saramaka Authorities
WLA	Hydraulic Research Division of the ministry of public works
WWF	World Wildlife Fund

INTRODUCTION

To place the need for an NFMS in its context, this document starts with an introduction explaining the general importance of forests and forest monitoring, the vision, planned functions and guiding principles of the NFMS in Suriname, the REDD+ mechanism and international requirements for an NFMS, and the process that was followed to formulate Suriname's NFMS roadmap.

1.1 General importance of forests

Forests are crucially important for all aspects of sustainable development, providing multiple ecosystem services including ecological, economic, social, cultural, spiritual, etc. Worldwide, an estimated 1.6 billion people or more depend on forests for their livelihoods and around 300 million people are living in forests. When it comes to other species, about two thirds of all species on earth have forests as their habitat.[1] As a source of economic growth and employment, the value contributed by the formal timber sector to the global economy is estimated at $600 billion[2].

The global forest cover is about 4 billion hectares, which equals 31% of the world's land surface. In the pre-industrial era, the forest cover was about 5.9 billion ha. The UN's Food and Agriculture Organization (FAO) estimates that every year 0.13% of the world's forests are lost due to deforestation[3]. The most common reasons for this loss of forested areas are conversion to other land use such as agricultural land, creation of human settlements, timber harvesting in unsustainable ways, and dysfunctional land management, governance and practices[4].

Deforestation is also a major cause of climate change. FAO estimates that the world's forests store at least 296 Gt carbon in their above-ground and below-ground biomass[1]. Different forest biomes contain varying amounts of carbon, with tropical forests containing the largest carbon stock at a global scale. According to the World Bank, deforestation accounts for up to 20 percent of the global greenhouse gas emissions that contribute to global warming[5].

With all of this in mind, it is urgently important from a global perspective to halt deforestation and forest degradation, improve forest management to be more sustainable, conserve remaining forests and also try to restore lost and degraded forest land when possible. This has been stressed by the global community for example by including it in the Sustainable Development Goals, where SDG 15.2 reads *By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally*.[6]

[1] United Nations (2011). Forests for people
[2] World Bank (2016). World Bank Group Forest Action Plan FY16-20
[3] FAO (2015). Global forest resource assessment (2015)- Doi: http://www.fao.org/3/a-i4793e.pdf
[4] Geist and Lambin (2002). What drives tropical deforestation? A meta-analysis of proximate and underlying causes of deforestation based on subnational case study evidence. Doi: http://www.pik-potsdam.de/~luedeke/lucc4.pdf
[5] IPCC (2014). Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
[6] http://www.un.org/sustainabledevelopment/sustainable-development-goals/

Suriname can continue making an important contribution to this global goal by keeping its high forest cover and low deforestation status, while enhancing the implementation of sustainable forest management.

1.2 General importance of forest monitoring

The general definition of "monitoring" applied in this document is: *'to observe something for any changes that may occur over time'*. In the context of institutional management, policy implementation, project management or similar, monitoring can be defined as *'supervising activities in progress to ensure that they are on schedule and on course for meeting the objectives and performance targets'*. In that sense, for governments, monitoring can fulfil the need for periodic information on the results obtained through national policies and measures. If negative trends are discovered through monitoring, the government has the possibility to take action to steer the development back on course. Forest monitoring is therefore a crucial tool for sustainable forest management.

The figure below shows how forest monitoring starts with an objective process of data collection about forests (quantitative and qualitative), how this data is processed into meaningful and understandable information, and how this data may be used by more policy-oriented stakeholders and change makers, to inform their action in light of forest related targets, policies and measures.

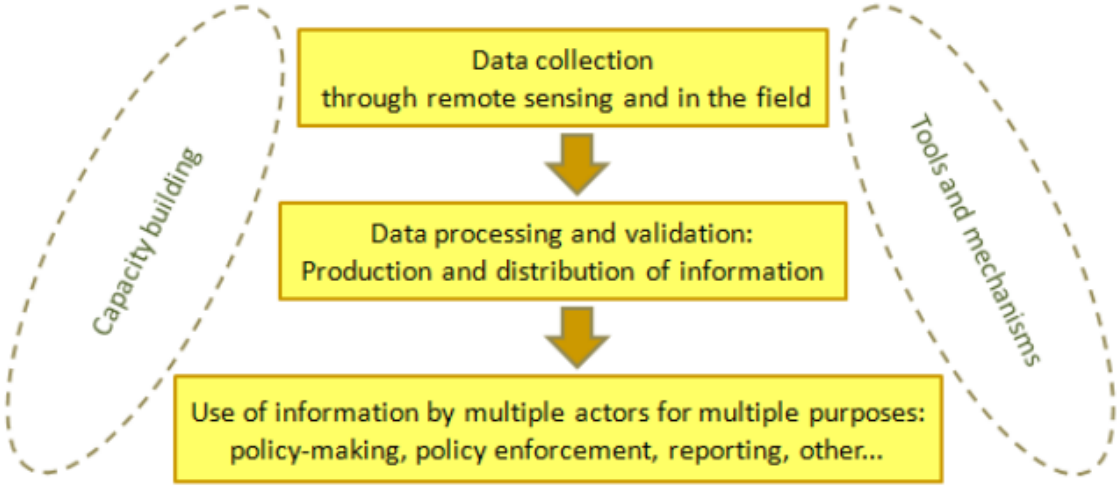

Figure 1: Monitoring process from data collection to information use (FCM-plan, 2014)

1.3 National Forest Monitoring System (NFMS) in Suriname

For Suriname, forest monitoring is important for many reasons, among others by providing overall support to national processes and international reporting. This includes but is not limited to Suriname's participation in the United Nations mechanism for reducing emissions from deforestation and forest

degradation, conservation of forest carbon stocks, enhancement of forest carbon stocks and sustainable management of forests (REDD+). A vision for the National Forest Monitoring System (NFMS) of Suriname was developed by multiple stakeholders in 2014, in the context of formulating a National Plan for Forest Cover Monitoring:

Vision:
Suriname monitors forest cover changes in the whole country in close collaboration with multiple stakeholders, using modern technologies and local community participation in a system that provides the national and international community with the most updated and reliable information about forest cover, which is used to enforce governance on deforestation, forest degradation, land tenure and land use (changes), to sustainably manage the forest resources while maintaining resilience of forest ecosystems.

With forest land covering more than 90% of Suriname's land area, the forest resource is an important natural resource that can support sustainable development of the country. This will be realized by enabling the implementations of Payments for Ecosystem Services (PES) through among others REDD+ (Green Climate Fund or similar), by further development of timber markets (through promotion of lesser known timber species and investment in the processing industry), but also by exploring and accessing new markets (Promotion of NTFP's, merchanting drinking water, etc.). To develop these strategies, knowledge about the forest resource needs to be collected, assessing not only the stock and status quo, but also allowing Suriname to monitor the impacts of anthropogenic interventions on the forest on a long term.

A purpose of the NFMS is also to inform interested citizens and stakeholders (including forest owners, forest based communities, environmental NGOs, forest-based industries, research organizations, academia etc) about the status and development of the forests and its many characteristics and services at the national level.

It is in the planning to formulate a broader vision for the NFMS together with stakeholders. Specific elements in this vision could be:

- Conserving the national patrimony
- Economic value of the forest- sustainable use, planning, development
- Participatory approach
- Embedded in national structures
- Scientific basis and innovative technology
- International reporting

→ Which elements should be included in the NFMS vision according to you?

1.3.1 Guiding principles for NFMS in Suriname

In order to make sure that the NFMS meets the national needs of Suriname, it is important to consider the national political, technical and management/operational context. To aim for an NFMS that is fully useful for and integrated in the national structures, a set of guiding principles have been identified and confirmed through different stakeholder workshops. Those are:

National ownership	Multi-purpose	Streamlined with context
Phased approach	Open data accessibility and transparency	Cost-efficiency

Figure 2: Guiding principles for NFMS in Suriname

National ownership of the NFMS in Suriname can be achieved through:

- Participatory approach: Multiple stakeholders will be involved in creating, implementing and using data from the NFMS;
- Strengthening national capacity: National capacity building should be an inherent component of the development and the implementation of the NFMS;
- Institutionalization: Institutional arrangements should be based where possible on existing institutions, with the eventual creation of new ones only if necessary.

The NFMS in Suriname can be **streamlined with the context** and with ongoing processes by:

- Building on existing (local, national, regional, global) systems;
- Be embedded in (existing) national institutions;
- Supporting Suriname to get ready for REDD+ implementation by meeting NFMS requirements of the UNFCCC, facilitating incorporation of REDD+ into national policies and legislation;
- Providing data needed to support national policies, policy design and enforcement;
- Supporting local initiatives

The NFMS in Suriname will be **Multi-purpose:**

- Data generated by the NFMS should comply with information needs of policymakers and practitioners (people in the field);
- The NFMS must go beyond carbon (only carbon monitoring is required by UNFCCC) and be a multifunctional instrument, aiming to serve as guide for social, economic and environmental policies and provide information in forestry-related fields such as biodiversity.
- The system should be flexible enough to serve different purposes, for example, reporting as required by donors as well as to UNFCCC.

The NFMS in Suriname should be implemented with a **Phased approach:**

- Process should be in line with the three phases of REDD+ (see 1.3.3);
- The system should be adaptive and easily adjustable (institutionally, technically and financially) to national and international developments;
- The NFMS will be adaptable to new technological developments;

Data accessibility and transparency should be granted for all stakeholders in Suriname:

- National data generated should be freely available for everyone, taking into account the national security;
- Data sharing between institutions and user groups is encouraged and facilitated.

Cost-efficiency of the NFMS in Suriname should be ensured:

- Activities should seek out the most cost-effective solutions at all stages and structural levels;
- Free and open source data and software will be preferred when possible;
- To be sustainable, the funds needed to run the NFMS should be guaranteed in the long term and not affect the objectivity of data.

1.4 REDD+ under the UNFCCC

As touched upon above, an NFMS is a requirement for implementation of REDD+, which is a concrete global instrument for reducing GHG-emissions from deforestation and forest degradation, conservation of forest carbon stocks, enhancement of forest carbon stocks and sustainable management of forests, developed under the United Nations Framework Convention on Climate Change (UNFCCC). REDD+ is a voluntary mechanism that developing countries can choose to participate in. Suriname is now in the process of REDD+ readiness.

REDD+ aims to strengthen the role of forests in mitigating climate change by making it possible for developing countries to access results-based payments/finance for demonstrating forest related reduction and removal of greenhouse gas emissions. As agreed during the 16th COP to the UNFCCC in Cancun, Mexico in Decision 1/CP.16, paragraph 70, there are five REDD+ eligible activities that developing countries can choose to implement to achieve this: (1) reducing emissions from deforestation, (2) reducing emissions from forest degradation, (3) sustainable management of forests, (4) conservation of forest carbon stocks, and (5) enhancement of forest carbon stocks.

REDD+ countries first proceed through a readiness phase where they prepare and demonstrate that everything is in place for being able to implement REDD+ successfully. Only in the third phase, when the NFMS is fully operational, countries may receive result-based payments:

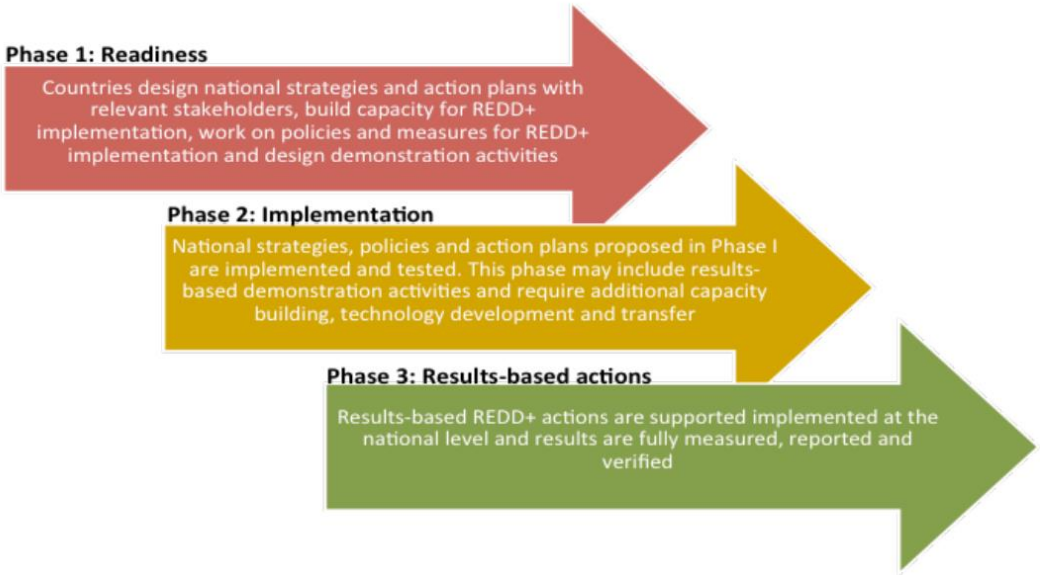

Figure 3: Phased approach to REDD+ (source: UN-REDD)

During UNFCCC COP-19 in December 2013, the Warsaw framework was adopted. This framework states that as a part of the REDD+ readiness phase, countries need to establish the following four elements that will support REDD+ implementation and results-based actions:

- National Strategy (NS) or Action Plan (AP),
- Safeguards Information System (SIS),
- Forest Reference Emissions Level /Forest Reference Level (FREL/FRL),
- National Forest Monitoring System (NFMS).

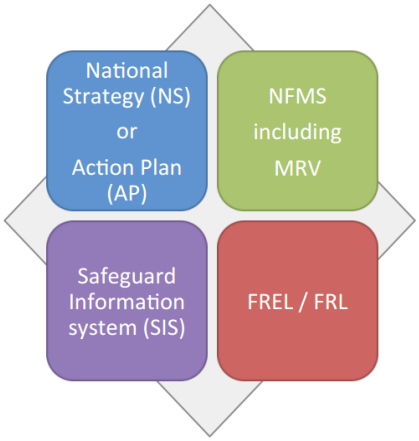

Figure 4: Four elements of REDD+ readiness (source: UN-REDD)

Under the Paris Agreement, article 5 (FCCC/CP/2015/L.9/Rev.1[7]), a framework was created for countries to receive result-based payment for the REDD+ related activities, emphasizing also the importance of non-carbon benefits like biodiversity and the protection of indigenous rights.

[7] https://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf

REDD+ in the Paris Agreement (UNFCCC COP-21, Article 5)

Paragraph 1: *Parties should take action to conserve and enhance, as appropriate, sinks and reservoirs of greenhouse gases as referred to in Article 4, paragraph 1(d), of the Convention, including forests.*

Paragraph 2: *Parties are encouraged to take action to implement and support, including through results-based payments, the existing framework as set out in related guidance and decisions already agreed under the Convention for: policy approaches and positive incentives for activities relating to reducing emissions from deforestation and forest degradation, and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries; and alternative policy approaches, such as joint mitigation and adaptation approaches for the integral and sustainable management of forests, while reaffirming the importance of incentivizing, as appropriate, non-carbon benefits associated with such approaches.*

1.4.1 REDD+ in Suriname

Suriname was one of the early supporters of REDD+ negotiations in the UNFCCC context. Together with other countries with similar circumstances, Suriname played an active role in steering the international negotiations in a direction that made the REDD+ mechanism relevant not only for countries with high deforestation rates, but also for countries with high forest cover and low deforestation rates.

Suriname first entered REDD+ readiness in 2009/2010, whereafter a break followed until 2012 when the national preparation process was taken up again. In March 2013, Suriname presented its Readiness Preparation Proposal (R-PP) to the World Bank's Forest Carbon Partnership Facility's (FCPF) Participants Committee meeting, and received approval for a US$ 3.8M grant to support some of the preparatory activities towards REDD+. This is used as to implement the national REDD+ Project Document (PRODOC) currently guiding the REDD+ readiness phase. The National Institute for Environment and Development (NIMOS) is the national Technical Focal Point and coordinating body for this project, in collaboration with the United Nations Development Program (UNDP) as delivery partner of the FCPF grant in Suriname. Other national institutes also play important roles in implementing the PRODOC. For example, the Foundation for Forest Management and Production Control (SBB) is responsible for developing the FREL/FRL and the NFMS.

The REDD+ readiness process offers an opportunity for the Government of Suriname (GoS) to leverage efforts and results towards sustainable development. Learning from past experience, REDD+ already fostered openness, participation and transparency, improved data collection and analysis, national and multi-sectoral dialogue and cooperation. Key factors for REDD+ readiness success are fully consistent with and supportive to the efforts of the GoS and the United Nations strategy to promote more inclusive, fair, well-informed and robust, climate-compatible and sustainable development. There is obvious win-win potential to be tapped in Suriname between REDD+ and the overall development process. REDD+ can be seen as a tool to support and foster national dialogue with indigenous and maroon peoples, to strengthen

the government's practice of democracy, to improve public effectiveness and accountability, governance, legislation and the business environment, to accelerate decentralization, and to enhance regional and international stance and diplomatic positioning.

1.5 National forest monitoring systems for REDD+

The importance of monitoring, as explained in section 1.2, is recognized by the UNFCCC. Parties of the convention are required to monitor and report on results of their efforts taken related to greenhouse gas (GHG) emissions reduction. In the context of REDD+, participating countries need to establish a National Forest Monitoring System (NFMS) to measure their REDD+ performance in terms of greenhouse gas emissions reductions, so that possible future access to results-based payments/finance can be motivated.

The NFMS was first introduced in UNFCCC decision 4/CP.15 from 2009, paragraph 1(d), where countries are requested:

> *To establish, according to national circumstances and capabilities, robust and transparent national forest[8] monitoring systems and, if appropriate, sub-national systems as part of national monitoring systems that:*
>
> > *(i) Use a combination of remote sensing and ground-based forest carbon inventory approaches for estimating, as appropriate, anthropogenic forest-related greenhouse gas emissions by sources and removals by sinks, forest carbon stocks and forest area changes;*
> >
> > *(ii) Provide estimates that are transparent, consistent, as far as possible accurate, and that reduce uncertainties, taking into account national capabilities and capacities;*
> >
> > *(iii) Are transparent and their results are available and suitable for review as agreed by the Conference of the Parties.*

It is important to note that while the NFMS is a requirement for REDD+, countries are also encouraged to design their systems in ways that support non carbon needs that they may have in terms of forest monitoring.

1.5.1 MRV function

UNFCCC decisions provide detail on three sub-items of the NFMS representing the functions of measurement/monitoring, reporting and verification. Regular measurement and reporting of emissions and carbon stocks have to be implemented at the national level, while validation is a process managed by the UNFCCC Secretariat. Measurement/monitoring is expected to be undertaken following the IPCC

[8] Taking note of, if appropriate, the guidance on consistent representation of land in the Intergovernmental Panel on Climate Change (IPCC) *Good Practice Guidance for Land Use, Land-Use Change and Forestry*.

Guidelines, while reporting and verification are described in UNFCCC decisions such as 1/CP.17 and 9-15/CP.19.

Figure 5 shows how measurement and reporting typically relate to each other. It should also be noted that this arrangement is not specific to the REDD+ mechanism but applies to the whole Agriculture, Forestry and other sectors (AFOLU)- activities. The NFMS can meet multiple purposes depending on the needs of each country, which can go far beyond REDD+.

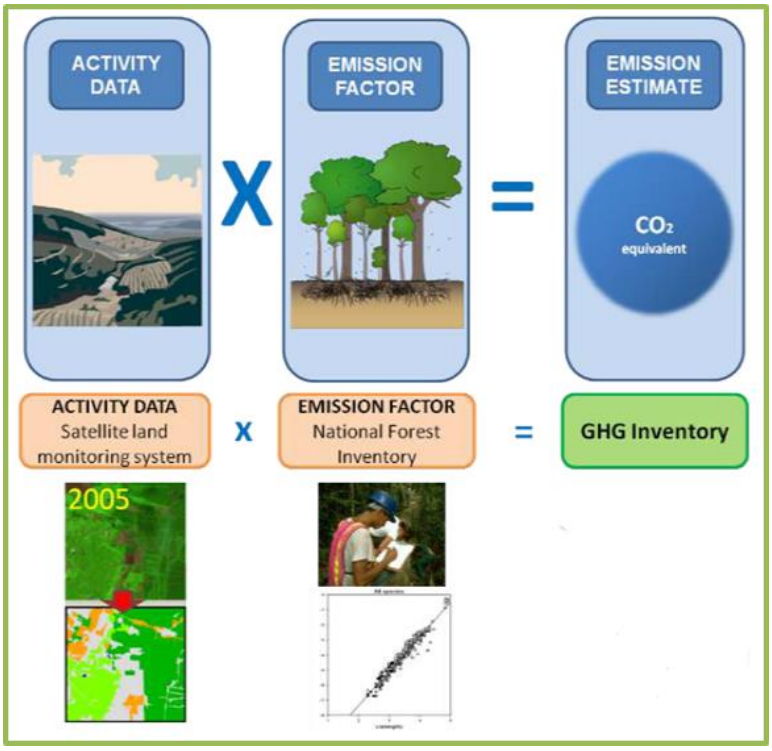

Figure 5: Measurement of AD x EF = GHG reporting (source: UN-REDD)

Measurement, reporting and verification (MRV) are the three main components of the NFMS required for REDD+, as defined by UNFCCC decision 4/CP.15. Of those three functions, verification is organized by the Secretariat of the UNFCCC. Suriname therefore has to set up its NFMS to support the functions of measurement and reporting. Of the two, measurement is by far the most complex to design and implement, while reporting requirements are largely determined by COP decisions and IPCC Guidelines (see chapter 3).

The measurement component of the NFMS can be broken down in two main blocks: The Satellite Land Monitoring System (for determining *Activity Data*) and the National Forest Inventory (for establishing *Emission Factors*). The reporting component corresponds with the forest sector component of the national GHG-inventory.

1.5.2 Other forest monitoring functions

The other monitoring functions of the NFMS refer to the country's assessment of a broad range of forest information needed. Except from its focus on forests, it is similar to other types of national data gathering and monitoring activities already carried out by governments, either permanently or on a regular basis. For example, most nations have a population census at fixed time intervals that informs the government about social and economic characteristics of the population. Forest related monitoring can also be very relevant for multiple purposes.

Based on the national circumstances, a variety of methods can be used for forest monitoring, and multiple purposes can be aimed for. This might include but is not limited to information related to REDD+ activities. A notable example is the set of Social and Environmental Safeguards (SES) for REDD+ specified in decision 1/CP.16, mentioned in the previous section. Three of the seven safeguards can be reported upon using data collected for the GHG inventory reporting, while the other four are more qualitative in nature.

One of the four requirements of the National REDD+ Programme readiness phase is the development of a National REDD+ Strategy[9]. This is currently an ongoing process in Suriname, planned to be completed in 2017. The monitoring system shall be set up to monitor all of the elements in this logical framework of the REDD+ Strategy.

1.5.3 Phased implementation of the NFMS

In accordance with UNFCCC decision 1/CP16, the development of an NFMS for REDD+ is generally implemented over three key phases:

> 73. *Decides* that the activities undertaken by Parties referred to in paragraph 70 above 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;

1.6 Formulation of the NFMS roadmap in Suriname

This document aims to provide an overview of the status and plans for the NFMS in Suriname, as understood by the end of 2016. Initially, this document was envisioned as a roadmap that would guide the process of establishing the NFMS. However, it is important to realize that the process was already ongoing and kept moving forward throughout 2016 as a fast-going train. The same people who wrote this document over a period of several months in 2016, were responsible to coordinate a large team effort to implement a work programme with many NFMS related parallel activities, within the national REDD+ readiness project and beyond. These activities all contributed to further development of the NFMS,

[9] Decision 1/CP.16, paragraph 71 (a), calls for "a national strategy or action plan"

brought the system to new levels and made it increasingly concrete. Consequently, the draft roadmap document constantly had to catch up with a changing reality. This obviously affected the design process and this is not a static document but a living one.

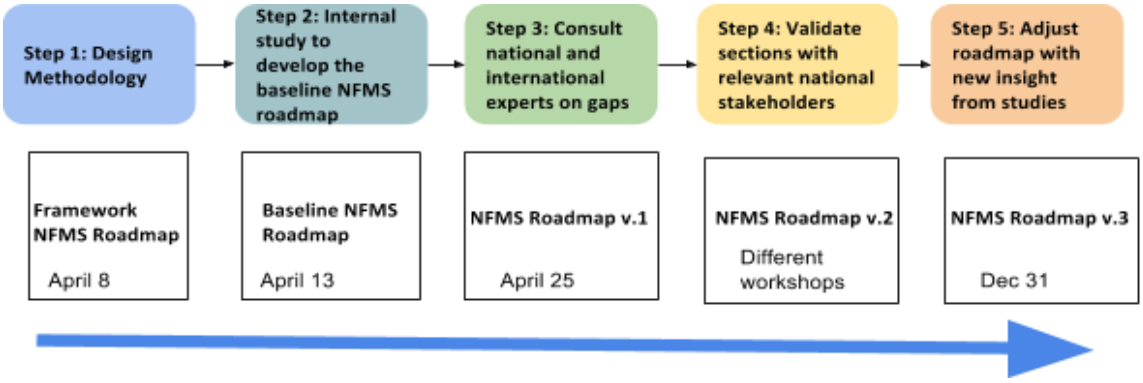

Figure 6: Process to develop NFMS roadmap

Step 1: Design the methodology

Through literature review, internal sessions and guidance from the UNDP, a structure for the NFMS roadmap document was developed by the REDD+ team in SBB, who will be responsible for implementation of the NFMS according to the PRODOC. Throughout the process, the national REDD+ focal point, NIMOS, was consulted at multiple times. Steps needed to ensure a robust roadmap were determined and agreed upon with NIMOS and UNDP:

- *Determining the level of detail*

The team considered that the objective of this document is to serve both planning and communication purposes. Keeping in mind that some elements of the NFMS in Suriname are already being developed, existing and/or performing well, it seemed appropriate to choose a level of detail in the roadmap that is closer to the implementation end of the spectrum.

- *Determining the information needs (structuring the roadmap)*

This is a stocktaking exercise, based on consultation, experience, and literature studies. *Where is it we want to go, how do we get there?* Decision was taken to integrate the process of the state-of-the-art with the roadmap/action plan.

- *Review of guiding documents*

Guiding documents that have been produced on this topic have been reviewed. This included:

- COP decisions
- Other countries NFMS roadmaps
- Guiding international documents (like FAO voluntary guidelines, MRV manual, GOFC-GOLD Sourcebook).

- *Review of prior work*

Prior work conducted in Suriname for the analysis and assessment of the NFMS components was reviewed in detail. In fact, much of the analysis and the recommendations in this NFMS roadmap were collected from such previous work. The most important sources of information that were available are listed in the Annex on literature consulted.

- National documents (FCM plan, etc.).

Step 2: Internal study to develop the baseline NFMS roadmap
SBB develops a baseline document guided by the framework, that includes the review of the previous work done so far on the different components of the NFMS. It also includes the vision of national stakeholders on the next steps to develop the NFMS. Gap assessment and needs for external input have been also identified preliminary.

Step 3: Consult national and international experts on gaps
Gaps were identified during the development of the baseline NFMS roadmap. These gaps were either based on input about the vision from national stakeholders necessary for design choices, or insights from external (international) experts in the implications of different design choices based on their experiences.

Consulting national experts (overview in Annex):
Brainstorm sessions or bilateral meetings

- Involvement from the R+A parallel with the REDD+ Assistants Capacity Building Plan developed by Tropenbos International
- Multiple brainstorm sessions with experts from national institutions on the development of collaborative Satellite Land Monitoring System[10]
- National Workshop on the development of a multipurpose and participatory National Forest Inventory (NFI) on August 31st to Sept 1st 2016. During this workshop, national experts from different disciplines presented their perspective on the NFI, where after working sessions on following topics took place:
    - Objectives of the NFI based on a matrix listing all national and international topics for reporting.
    - Design of the NFI
    - Participatory approach of the NFI
    - Institutional arrangements of the NFI
    - Data and information systems
    - Parallel programs related to the NFI

  The conclusions of these working sessions can be found in Annex 1, and where relevant they are integrated in this document.
- Bilateral and multilateral consultations during the mission to design the geoportal.

Consulting international/external experts:
International/ external experts were consulted for following subjects:

- The overall roadmap was reviewed by Jenny Hewson, senior MRV-expert of Conservation International, and partner at the Silvacarbon-program.
- Establishment of a geoportal/ NFMS database: A Terms of Reference was shaped together with FAO. (Annex)
- While we carried out the study: "*best estimates of carbon stocks and emission factors for Suriname"* CATIE supported us by providing recommendations on the design of the full National Forest Inventory by carrying out statistical operations on the database with all the forest inventory data.
- For the NFI sampling and plot design, we get support from Stephane Guitet from IRD, Olaf Banki, previously working in Suriname with the University of Utrecht.

[10] http://sbbsur.com/wp-content/uploads/2016/05/Rapport_LULC_werksessie.pdf

- For overall insights in linking FLEGT and REDD+ processes the University of Hamburg provided input.
- Guidance on strategic decisions was provided CATIE.
- Overall support was provided by UNDP expert Danae Maniatis.

Step 4: Validate with relevant stakeholders
This document is shared via email, asking feedback from relevant stakeholders on specific questions. It will also be presented during a workshop in December 2016 and presented during the REDD+ Project Board meeting in January 2017.

Step 5: Adjust roadmap with new insight from studies and activities
During the course of 2016, several studies and activities (DDFDB+, EF, Geoportal, FREL/FRL) are executed that give more insights in how the NFMS could be shaped. These insights will be used to adjust the v.3 of the NFMS roadmap, updating the current status and design choices, and making the actions more complete and concrete.

2. NATIONAL CIRCUMSTANCES RELATED TO NFMS

This chapter focuses on the national situation in Suriname that is crucial to understand in order to give shape and meaning to the NFMS in the unique context of the country. It explains that Suriname with more than 90% of forest cover is the greenest country in the world, but that deforestation rates have increased in recent years compared to historical rates, mainly due to gold mining. An overview is given of current policies and measures, institutions and stakeholders in Suriname related to the forestry sector and forests.

2.1 Background about Suriname's forest

The Republic of Suriname covers a surface area of 163 800 km^2, of which 93% is covered by forest (2016). While the forest in Suriname has a long history of being relatively undisturbed, current trends point at possible changes in the future. Deforestation monitoring efforts have shown that deforestation has increased from ca. 0.02% per year to ca. 0.1% over the last fifteen years.

Suriname is a multicultural country with just above half a million inhabitants, of which about 50% live in the capital city Paramaribo, 90% in the coastal plain in the north of the country. There are approximately 62 000 inhabitants in the interior of Suriname, mostly considered forest dependent communities.[11]

[11] ABS 2010

2.1.1 Ecology and physical characteristics

From a geographical perspective, Suriname can be divided into four main regions that each have unique ecology. They are, from south to north: The Interior, the Cover Landscape, the Old Coastal Plain, and the Young Coastal Plain.

The Interior covers about 85% of Suriname, or 136 000 km^2. It is part of the Guiana Shield, which is a geological formation from the Precambrian era that covers part of Suriname, Guyana, French Guiana, Brazil, Venezuela and Colombia. The Guiana Shield is covered by a large area of undisturbed tropical rain forest and is one of the regions with the highest biodiversity in the world. In Suriname, the interior landscape ranges from steep and mountainous highland to hilly or undulating land. The highest mountain is about 1200 meters. The most common forest type is high dryland forest, but there are many different forest types. Most of the interior is only accessible by rivers and creeks or by plane or helicopter.

The Cover Landscape (also called the savannah belt) is lower than the interior and reaches 10-100 meters above the mean sea level. It covers approximately 10 000 km^2 with coarse bleached white sand, yellowish brown sands and clay loams that were deposited by rivers during the Pliocene epoch. It is covered with grasslands, palms, bushes and other low dispersed vegetation. The savannah belt contains freshwater aquifers that are the only rechargeable ones in Suriname. Parts of the area is also covered with rainforest known as the forestry belt. Most of the logging and selective timber harvesting has taken place in this part of the forest because of easier access, but this is now shifting to the interior.

The Old Coastal Plain is also about 10 000 km^2 in size and its height varies from 4-10 meters above sea level. It originates from deposits made during the Pleistocene geological epoch that were split by small rivers and creeks and then filled up again. This has created a structure of densely forested clay flats and ridges mixed with grass covered swamps and gullies. Open pit bauxite mining and deforestation has taken place here since the beginning of the 20th century. Large amounts of soil have been reallocated and soil structures are damaged since older clays become irreversibly compacted when exposed.

The Young Coastal Plain has height variations between 0-4 meters above mean sea level and ranges in width from about 100 km in the west to 20 km in the east of the country. It has mangrove forest, freshwater swamps with fertile clay soils, and sandy and shell ridges. About 90% of the population lives here, which makes it worrisome that the area is vulnerable to sea level rise due to climate change. The land is used for a variety of economic activities. Many swamps have been converted to residential areas, farms, road infrastructure and industrial areas. Crude oil has been exploited since 1983. The coast itself is 386 km long and has extensive mud flats, sandy shell beaches and mangrove forest. The mangrove provides spawning grounds and protects the marine ecosystem and defends the shoreline from the effects of wave erosion. Natural land loss and land acquisition takes place here.

2.1.2 Drivers of deforestation and forest degradation

While the forests in Suriname have a long history of being relatively undisturbed, current trends point at possible changes in that situation in the future. Drivers and pressures on Suriname's forests, in other words the underlying and direct causes of deforestation and forest degradation, are becoming increasingly pertinent. In the Suriname Readiness Preparation Proposal (R-PP) for REDD+, the main direct causes of deforestation and forest degradation were identified as mining, logging, infrastructure development, agriculture, and energy production. Building agreement around what should be recognized

as drivers and pressures on forests is a challenging exercise since it may have possible political consequences. In 2016 a study is carried out in Suriname to improve the understanding of drivers of deforestation, forest degradation and barriers to REDD+ activities, through analytical work from many different perspectives including compilation of community perceptions. This *"Background study to REDD+ in Suriname: Multi-perspective analysis to drivers of deforestation, forest degradation and barriers to REDD+ activities"* will be published in January 2017.

Gold mining is the largest driver of deforestation in Suriname and the rest of the Guiana Shield region. A regional study[12] carried out in 2015 by the forest services of Suriname, Guyana, French Guiana and Amapa showed that deforestation due to gold mining has doubled in the study area between 2008 and 2014 (+92,406 ha) compared to 2001-2008 period (+46,144 ha). Also if looking at Suriname alone, the area deforested due to gold mining doubled (from 27254 ha in 2008 to 53668 ha in 2014).

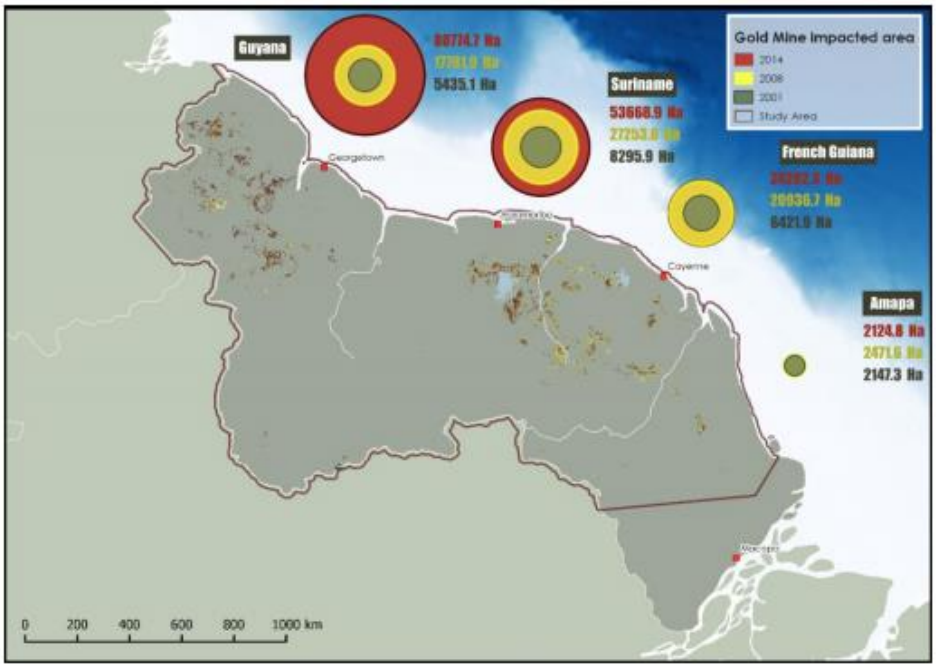

Figure 7: Gold mining impacts in the Guiana Shield (source: Rahm et al, 2015)

During a recent study carried out for historic assessment of the drivers of deforestation for the period 2000-2015 (SBB, in press)[13], in collaboration between FCMU and the partner institutions, it was found that mining contributes 73 % to the total deforestation, Infrastructure (roads) 15%, Urbanization 4%, and all other drivers less than 4% (Table 1).

[12] https://reddguianashield.files.wordpress.com/2015/09/gold_mining_final_report_en.pdf
[13] SBB (2017 – in press). Technical report forest cover monitoring for Suriname. By Forest Cover Monitoring Unit Suriname.

Table 1 - Drivers of deforestation (LULC) for the period 2000-2015 (SBB, 2017 – in press)

Driver of deforestation	2000-2009 (ha)	2000-2013 (ha)	2000-2015 (ha)	% 2000-2015
Cropland	1163	1294	2024	3%
Burned areas	324	2065	2289	3%
Infrastructure	3772	7544	11859	15%
Mining	25996	42052	56811	73%
Other land	226	102	257	<1%
Pastures	199	230	417	1%
Secondary vegetation	0	946	1103	1%
Urban	1370	1724	3132	4%

Logging has increased substantially over the last few years and is expected to still increase in the future. Despite the very high percentage of forest cover, the contribution of the forestry sector to the national income of Suriname was only about 1,3% of the gross domestic product (GDP) in 2014 and is now 1,7% (Bosbouwsectoranalyse 2014[14] and 2015 - in press). The government believes that the forest has higher potential to generate long-term income for the country and aims to increase economic gains from forestry, through sustainable logging and management[15].

2.2 Current Policies and Measures (PAMs)

Suriname has an existing legal framework with policies and measures related to forests, starting with the Timber Act of 1947, regularizing how to use forests by giving communal wood cutting licenses (Houtkapvergunning, HKV) to captains. Within this system many captains rented out their licenses to the private sector. Through the Forest Management Act from 1992, a new system of community forests (Gemeenschapsbos) was developed in parallel with the existing one. Communities were encouraged to opt for the newer system, in which the traditional authority manages the use of the forest.

2.2.1 Constitution of Suriname

The Constitution of the Republic of Suriname (1987) provides the overall legal framework for the country. It is also the legal basis for policies related to environmental sustainability. Article 6G of the Constitution reads *"The social objective of the State is focused towards the establishment and stimulation of conditions*

[14] www.sbbsur.com
[15] Jaarrede of President Bouterse, October 2016 (http://www.dna.sr/media/106047/Jaarrede_President_Rep_Suriname_2016_final.pdf)

required for the preservation of nature and the safeguarding of the ecological balance."[16] In accordance with the Constitution, all forests, except for those on privately owned land, belong to the state. The government grants land tenure for various purposes to private individuals, private enterprises and organizations, and to communities, but coordinated land use planning is missing. Article 41 reads: *"Natural riches and resources are property of the nation and shall be used to promote economic, social and cultural development. The nation shall have the inalienable right to take complete possession of the natural resources in order to apply them to the needs of the economic, social and cultural development of Suriname."*

In response to Article 40 of the Constitution, the Government of Suriname releases a National Development Plan of Suriname for the duration of its term. The National Development Plan of Suriname for 2012-2016 was adopted by the National Assembly in December 2011. A new governmental election was held in Suriname in 2015 and the new government is expected to release a new National Development Plan will be released in 2016 where REDD+ will be integrated as an instrument for Climate Compatible Development.

2.2.2 Forest related laws

In addition to the Constitution, several laws exist that relate to the environment, drivers of deforestation or for other reasons are relevant to the monitoring of forests. The ones directly focused on the forest sector are the Forest Management Act (Wet Bosbeheer - SB 1992 no 80), Game Act (1954) and the Nature Conservation Act (1954).

The website www.milieuwetten.com[17] is a platform where updated legal information is compiled and made available for the environmental sector to use. It provides a comprehensive overview of existing environmental legislation in Suriname, including national laws, regulations and policy, international treaties that Suriname has committed to, and institutional arrangements for law enforcement that exist within the country and on the international level.

2.2.3 Policies and action plans

Within the forest sector, the National Forest Policy (2003) and the Strategic Action Plan for the Forest Sector (2009-2013), provide a clear and holistic insight in the forest related policies.

The main policy objective of the National Forest Policy is *'Enhancing the contribution of the forests to the national economy and the welfare of the current and future generations, taking into account the preservation of the biodiversity'*. The policy further includes objectives and strategies for specific thematic areas, including land use planning and land tenure, contribution to the economy and social development of timber production, non-timber forest products and ecological functions of the forest. One of the strategic action items of the objectives linked to ecological functions is to *'do research and make use of the possibilities provided by the Kyoto Protocol and the market for generating income from CO2 sequestration'.* This refers to what later became REDD+ under the UNFCCC.

[16] http://www.constitution.org/cons/suriname.htm

[17] The website is a result of the project *"National Environmental Legislation - Legal Framework for Nature Management"* conducted by the Schurman Lawyers in the period 2009-2013 and financed by the Suriname Conservation Foundation (SCF).

Additionally, the National Climate Change Policy, Strategy and Action Plan for Suriname (2015) and the National Biodiversity Action Plan 2012-2016[18] provide an overview of the Climate change and biodiversity related planned activities.

2.2.4 National laws under review

The following laws related to forest management and environment and are currently under review:

- Coastal Protection Act
- Environment Act
- Law to install the Forest and Nature Authority Suriname (BOSNAS).

2.2.5 International commitments

In addition to creating its own legislation, Suriname is a member of the United Nations (UN) and has signed several Multilateral Environmental Agreements (MEA)s. The list below provides an overview of some of the most relevant international conventions and treaties that Suriname has committed to follow in the framework of the UN or through other international organizations or collaboration structures:

International agreements on forest, environment and other relevant topics	Ratified
Amazon Cooperation Treaty, ACT[19]	1978
Convention on International Trade in Endangered Species of Wild Fauna and Flora, CITES[20]	1981
Ramsar Convention (sustainable use and protection of wetlands)[21]	1985
Convention on Biological Diversity, CBD[22]	1996
Vienna Convention (ozone layer)[23]	1997
Montreal Protocol (ozone layer)[24]	1997
United Nations Framework Convention on Climate Change, UNFCCC[25]	1998
World Heritage Convention (preserving cultural and natural heritage)[26]	1998
Rotterdam Convention (chemicals and waste management)[27]	2000
United Nations Convention to Combat Desertification, UNCCD[28]	2000
Kyoto Protocol (climate change)[29]	2006
United Nations Declaration on the Rights of Indigenous Peoples[30]	2007
Cartagena Protocol on Biosafety[31]	2008
Stockholm Convention (persistent organic pollutants)[32]	2011
International Tropical Timber Agreement, ITTA of the ITTO[33]	2013

[18] https://www.cbd.int/doc/world/sr/sr-nbsap-v2-en.pdf
[19] http://otca.info/portal/admin/_upload/tratado/The_Amazon_Cooperation_Treaty.pdf
[20] http://www.cites.org/
[21] http://www.ramsar.org/
[22] http://www.cbd.int/
[23] http://ozone.unep.org/new_site/en/vienna_convention.php
[24] http://ozone.unep.org/new_site/en/Treaties/treaties_decisions-hb.php?sec_id=5
[25] http://unfccc.int/
[26] http://whc.unesco.org/en/convention/
[27] http://www.pic.int/
[28] http://www.unccd.int/
[29] http://unfccc.int/kyoto_protocol/items/2830.php
[30] http://www.un.org/esa/socdev/unpfii/documents/DRIPS_en.pdf
[31] http://bch.cbd.int/protocol/
[32] http://pops.int/
[33] http://www.itto.int/itta/

Within the Amazon Cooperation Treaty Organization (ACTO), the eight member countries have developed the Amazonian Strategic Cooperation Agenda (2010)[34], where countries agreed on following vision:

> "Achieve sustainable development in the Amazon region reconciling use, protection and conservation of its resources, with equitable conditions that ensure integral sustainable development, effective presence of the State in its different levels of Government and Amazonian populations that fully exercise their rights and obligations in the framework of the national laws in force and international agreements". One of the main strategic topics is: "Conservation, protection and sustainable use of renewable natural resources".

The first strategic collaboration topic within ACTO is: "Conservation, protection and sustainable use of renewable natural resources". The formulated objective is: C*ontribute to sustainable development and sustainable livelihoods and to keeping the environment clean and healthy.* Conservation, protection and sustainable use of renewable natural resources is one of the subtopics.

Within the UNFCCC, developing countries may define Nationally Appropriate Mitigation Actions (NAMAs). Suriname has not yet submitted a NAMA. However, leading up to the Paris agreement subsequently adopted in COP-21 in 2015, Suriname submitted an Intended Nationally Determined Contribution (INDC) document[35], which should be transferred into an NDC to be submitted with the ratification of the Paris agreement.

2.3 Institutions/Stakeholders engaged in the forest sector

An assessment of institutions and stakeholders engaged in the forest sector is an important part of sketching the national circumstances related to NFMS. Suriname has a rich range of stakeholders who in different ways are engaged and involved in the forest sector who have a role and/or stake in the NFMS. This includes government actors, the private (forestry) sector, forest-dependent communities, civil society groups, academia, the general national public and international partners.

In the preparation for the REDD+ Readiness Preparation Proposal, a first stakeholder inventory and mapping exercise was done for the REDD+ planning process[36]. Furthermore, a stakeholder assessment was done for the Forest Cover Monitoring Plan in 2014. Also, an overall engagement strategy within the REDD+ program is in the process of being developed[37]. Based on the experiences and work already done, an initial overview of the different stakeholders involved in the forest sector and/or NFMS

[34] http://www.otca.info/portal/admin/_upload/apresentacao/AECA_eng.pdf
[35] http://www4.unfccc.int/submissions/INDC/Published%20Documents/Suriname/1/INDC-2-Suriname%20300915.pdf
[36] Attune Development, Consultation and Participation Plan for the Finalization of the REDD+ Readiness Document for Suriname Early Information Sharing and Dialogue REPORT 29 October 2012
[37] Gwendolyn Smith, Mini workshop REDD+ Stakeholder Engagement, 1 November 2016; Gwendolyn Smith, Draft Design Chapter Engagement Plan, September 2016.

preparations/other relevant activities in Suriname is attempted below, using an initial categorization of stakeholders:

Category	**Sub-category**	**Stakeholder**
Forest-dependent communities	Indigenous tribes:	Wayana, Trio, Arowak, Caraib
	Maroon tribes:	Matawai, Kwinti, Aluku, Ndyuka, Saamaka, Paamaka
Government	Decision-making:	Cabinet of the President (including NIMOS) Cabinet of the Vice President (including SPS) Parliament
	Facilitation:	Ministry of Regional Development Ministry of Foreign Affairs, Ministry of Finance, Bureau of Statistics, Ministry of Transport, Communication and Tourism (DataSUR), Ministry of Education, Ministry of Defense
	Sector specific:	Ministry of RGB (Department of Spatial Planning, Department of Forest Management, Department of Nature Management, SBB, MI-GLIS, Stinasu, JSOOC) Ministry of Natural Resources (GMD, Grassalco, Bauxietinstituut) Ministry of Transport, Communication and Tourism (MAS) Ministry of Public Works (Department of Spatial Planning, Meteorological Service and WLA) Ministry of LVV, National Planning Office, Ministry of Trade and Industry, Cabinet President (OGS)
Civil society organizations	NGOs:	- Tropenbos International Suriname - Conservation International (CI) - World Wildlife Fund (WWF) - Amazon Conservation Team - Suriname Conservation Fund - Green Heritage Fund
	Umbrella organizations:	Communities/indigenous/maroon umbrella organizations: VIDS, VSG, OIDS.
Private sector	Companies:	Logging companies, mining companies, tourism operators Others: (GUMAIR and CNE), companies engaged in large scale development projects in the interior

	Umbrella organizations:	ASHU (Algemene Surinaamse Hout Unie), PHS (platform houtsector), VBH (Vereniging binnenlands houtproducenten)
Academia and educational institutes		Anton de Kom University of Suriname, National Herbarium of Suriname, CELOS, NZCS, Natin, IOL, ...
International partners	Technical:	ACTO, UNDP, ONFI, UN-REDD, UNEP, FAO, GEO, SILVACARBON, SELPER, CATIE
	Academia	University of Hamburg, University of Florida, University of Utrecht, University of Ghent, Alterra, Naturalis, ...
	Facilitating (finance and capacity building):	UNDP, FCPF, UN-REDD, GEF, GSF, GCF, NUFFIC, IDB, WB, EU, SEMIF, ACTO/BNDES, KfW, ICI, FFEM, USAID, GIZ,...
	Bilateral:	Brazil, Guyana, Mexico, Colombia, French Guiana, Peru, Norway, Austria, Germany, Sweden…
	Providers of datasets:	Global Forest Watch (GFW), University of Maryland, ASTRIUM, JAXA, etc) Providers of satellite images (ESA, NASA, INPE etc) providers of software (ESRI, Clark Labs etc)
General public	Facilitating	MGC, Youth, Women, Trade Unions, BINI, Global Shapers Paramaribo, schools
	Individuals	Individual experts Others

3. CURRENT STATUS AND ACTION PLAN FOR NFMS

This chapter explains the starting point for the NFMS roadmap by clarifying the status of forest monitoring systems in Suriname by December 2016. It also gives strategic direction for the future by formulating in broad lines the action plan for the NFMS. The chapter starts with a section on cross-cutting topics of consideration for the full NFMS. Other sections focus on the different components of the NFMS, namely the satellite land monitoring system, the national forest inventory and other monitoring functions. The final section in the chapter focuses on international and national reporting that needs to be done with data from the NFMS.

3.1 Cross-cutting NFMS activities

A system is *'an interconnected set of elements that is coherently organized in a way that achieves something'*. This definition suggests that the internal structure of systems include three kinds of components: elements (parts), interconnections (flows), and functions (purposes).[38]
Figure 8 shows the different components of the NFMS that will be discussed in more detail:

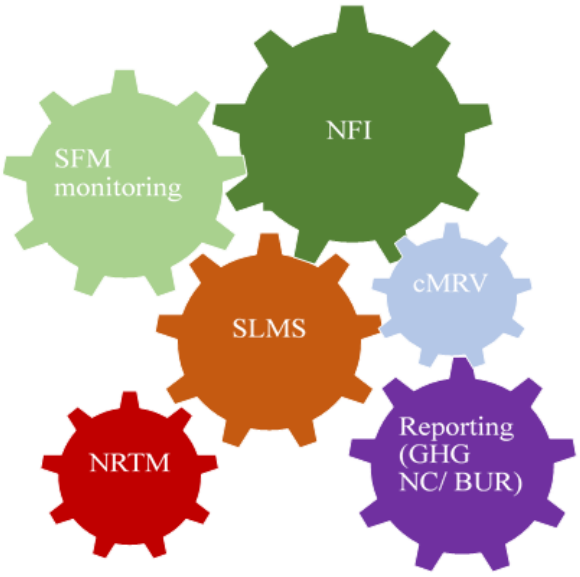

Figure 8: Visualization of how NFMS subcomponents are related

Components identified: National Forest Inventory (NFI); Sustainable Forest Management (SFM) monitoring; Satellite Land Monitoring System (SLMS); Community-based Measurement, Reporting and Verification (C-MRV); Near Real Time Monitoring (NRTM); National & international reporting (inspired by the NFMS design of Colombia).

In order to be a fully functional system, the NFMS needs to be defined and organized in terms of function/purpose (e.g. objectives and information needs), elements/parts (e.g. institutional arrangements), and interconnections/flows (e.g. flows of robust and comparable data, information and dissemination of results to the relevant users and stakeholders, reliable funding flows). Cross-cutting activities need to be planned and carried out in ways that ensure good coordination between these components.

[38] Meadows 2001

The following sub-sections of this chapter address the objectives and definition of classes, information needs, institutional arrangements for implementation of the NFMS, data management and dissemination, funding, and cross-cutting NFMS actions.

3.1.1 Definition of classes

While multiple concepts of 'forest' and forest-related definitions coexists[39], it is important, within the framework of the NFMS and the UNFCCC-reporting Suriname has to do, to clarify which definitions are used. This will ensure the data generated by the NFMS to be robust and comparable. The rationale behind these definitions is further clarified in a national concept note[40].

Definition of forest
Land mainly covered by trees which might contain shrubs, palms, bamboo, grass and vines, in which tree cover predominates with a minimum canopy density of 30%, a minimum canopy height (in situ) of 5 meters at the time of identification, and a minimum area of 1.0 ha.

This definition is in line with the criteria defined by the UNFCCC in decision 11/CP.7.

Definition of deforestation
Deforestation is defined as the direct and/or induced conversion of forest cover to another type of land cover in a given timeframe (DeFries et al., 2006[41]; GOFC-GOLD, 2009[42]).

Definition of forest degradation
A human-induced or natural loss of the goods and services, provided by the forest land, in particular the forest carbon stocks, not qualifying as deforestation, over a determined period of time.
This definition is currently being reviewed nationally, but corresponds with the definition proposed by the IPCC (2003) and the definition of FAO (2002)[43]

Managed land
The whole land area of Suriname will be considered as managed land, with the exception of the land accretion in the coastal zone, which is induced by coastal dynamics.

Within the context of the United Nations Framework Convention on Climate Change (UNFCCC), Land-Use, Land-Use Change and Forestry (LULUCF) refers to land-use change or persistence among the six broad types of land use/cover classes defined by the IPCC: Forest Land, Cropland, Grassland, Wetlands, Settlements, and Other Land (IPCC 2006, Vol.4; see Chapter 2). Possible types of land-use change among,

[39] Chazdon, R.;Brancalion,P; Laestadius, L.; Bennett-Curry, A.; Buckingham,K.; Kumar, C.; Moll-Rocek, J.; Vieira,I. & Wilson S. (2016). When is a forest a forest? Forest concepts and definitions in the era of forest and landscape restoration. Ambio. 2016 Sep; 45(5): 538–550.
[40] SBB (2016 in press).Forest and forest-related definitions in the concept of the NFMS for Suriname
[41] DeFries, R., Achard, F., Brown, S., Herold, M., Murdiyarso, D., Schalamadinger, B., & De Souza, C. (2006). Reducing greenhouse gas in temperate forests. Remote Sensing Reviews, 13, 207– 796 234.Emissions from Deforestation in developing countries: Considerations for monitoring and measuring, report of the Global Terrestrial Observing System (GTOS) Number 46, GOFC-GOLD report 26 (p. 23). Roma, Italia.
[42] GOFC-GOLD (2009). Reducing Greenhouse gas emissions from deforestation and degradation in developing countries: A sourcebook of methods and procedures for monitoring, measuring and reporting, GOFC-GOLD Report version COP14-2. (F. Achard, S. Brown, R. De Fries, G. Grassi, M. Herold, D. Mollicone , Pandey, D. &C. J. Souza, Eds.) (p. 185). Alberta, Canada.
[43] FAO (2002). Proceedings: second expert meeting on harmonizing forest-related definitions for use by various stakeholders. Rome.

or persistence within, these six broad uses are called Categories. Sub-categories can be defined within a category to more precisely define changes and emission sources.

Within the ACTO context, the following definitions of land use land cover classes are used:

• Secondary vegetation: Areas that, after the total removal of forest vegetation, are in the process of regeneration of shrubs and/or trees. Mostly they have been used for the practice of forestry or permanent agriculture with the use of native or exotic species.

• Agriculture: Extensive areas with predominance of annual cycle crops, mainly grains with high presence of technological standards, such as certified seeds use, pesticides, mechanization, and others.

• Pasture: Land with high presence of pasture cover.

• Populated Centers: Urban spots that arise through the populations concentration, such as villages, towns or cities, exhibiting differentiated structures if compared to rural areas, such as streets, houses, buildings and other public structures.

• Mining: Mining Areas with clear and exposed soils presence, containing deforestation mainly in the vicinity of water courses.

• Others: Different class pattern from those mentioned.

• Clouds/No information: Areas without information or unobserved due to the presence of cloud cover.

3.1.2 Objectives and information needs

By developing its NFMS, Suriname aims to fully integrate all forest-data collection activities in the NFMS in a harmonized way. Therefore, the design of the NFI, the SLMS and the other monitoring functions is done in parallel.

Based on FAO (1998)[44], the following three aspects should be taken into consideration when designing a forest inventory, which also can be seen as applicable criteria for the design of the NFMS as a whole:

- The users (decision/policy makers, field practitioners, reporting agencies etc.) define the information needs of the NFMS. This needs to be done in a participatory process;
- The information needs with the highest priority will be used for the statistical design of the forest inventory and the NFMS as a whole. Because the NFMS is designed with the framework of REDD+ reporting, the desired precision and accuracy of the carbon stock change will drive the statistical design at this stage;
- An NFMS should be practical and achievable. In summary, all objectives should be SMART[45]:

[44] FAO (1998) Guidelines for the management of tropical forests 1. The production of wood. FAO Forestry Paper. FAO, Rome

[45] Kohl, M & Marchetti M. (2014). Chapter: Objectives and planning of forest inventories - Tropical forestry handbook.

Specific	Well defined
	They are clear to anyone that has a basic knowledge of the project
Measurable	They provide quantifiable measures of achievement and variance from set objectives
Agreed upon	Have agreement between the users and the project team on what objectives should be
Realistic	Looking at the resources, knowledge, and time available, can the objective be accomplished?
Time framed	How much time is needed to accomplish the objective?
	Having too much time can affect the project performance

During the NFI workshop on 31 August - 1 September 2016, a matrix listing possible objectives of the NFMS was shared with the following groups of stakeholders:

- Governmental institutions
- Academia and research institutions
- NGOs
- Private sector
- Youth (students)

These groups were shaped based on the nine "Major Groups" adopted in Agenda 21[46]. The same exercise could be done with representatives from women's organizations, local authorities, unions and local communities.

Within the workshop the indicators were listed within seven broad information objectives based on the criteria of SFM used by the Global Forest Resource Assessment (FAO, 2010):

1. Extent of the forest resource
2. Forest ecosystem health and vitality
3. Biological diversity
4. Productive function
5. Protection function
6. Socio-economic function
7. Legal and institutional framework.

The matrix included questions referring to the SMART guidelines. The input received from the different stakeholders will be the guideline for the determination of the objectives.

3.1.3 Institutional arrangements for the implementation of the NFMS

The establishment of institutional arrangements is essential in order to establish a national system for long-term forest monitoring. Since this includes clearly defining the roles and responsibilities of various identified stakeholders, institutional arrangements need to be established in close consultation and coordination with all these stakeholders.

The figure 9 below, first published in the FCM plan 2014, visualizes a possible institutional arrangement for the NFMS in Suriname. It shows the links with many national stakeholders, but also exemplifies the importance of regional and international partnerships, because Suriname's forest is part of a larger ecosystem.

[46] https://sustainabledevelopment.un.org/outcomedocuments/agenda21

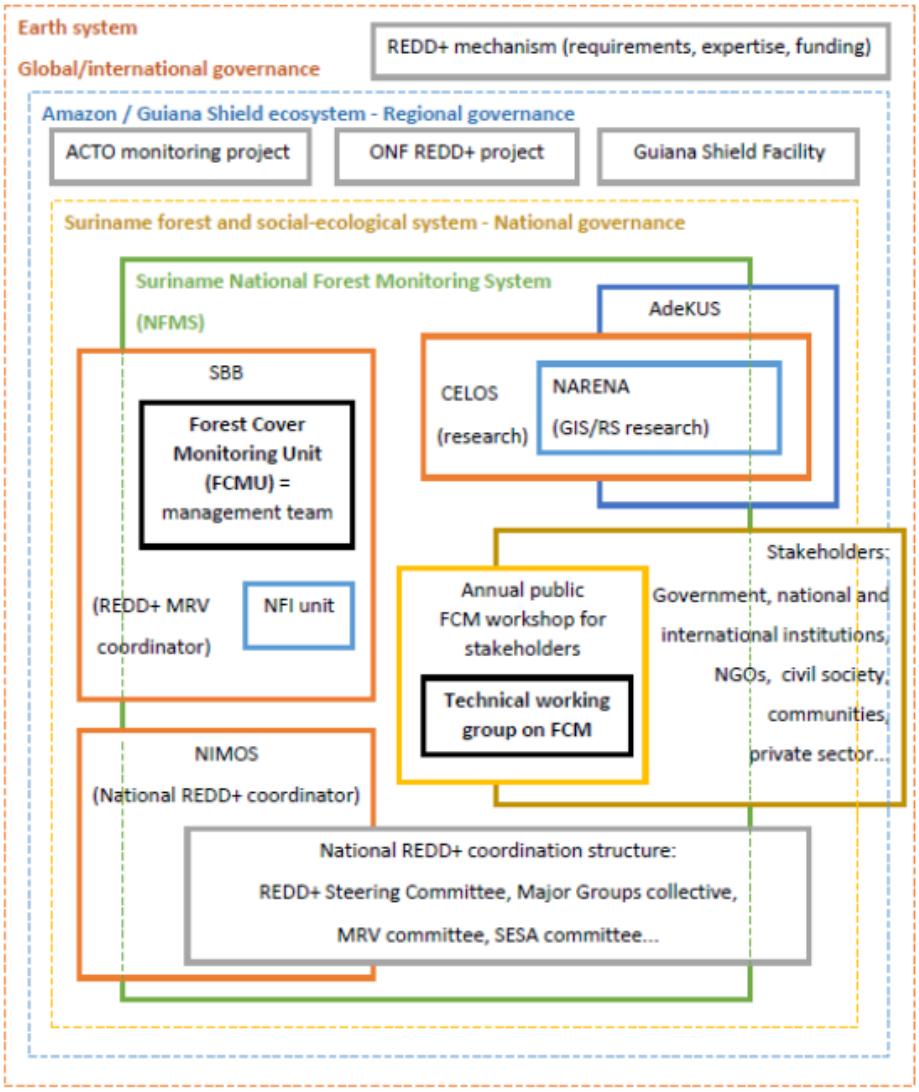

Figure 9: Visualization of NFMS institutional arrangements

To show the flows of information through the NFMS towards the REDD+ and GHG-reporting, the figure 10 shows a bit more detail. This proposal needs to be validated by the assigned authorities.

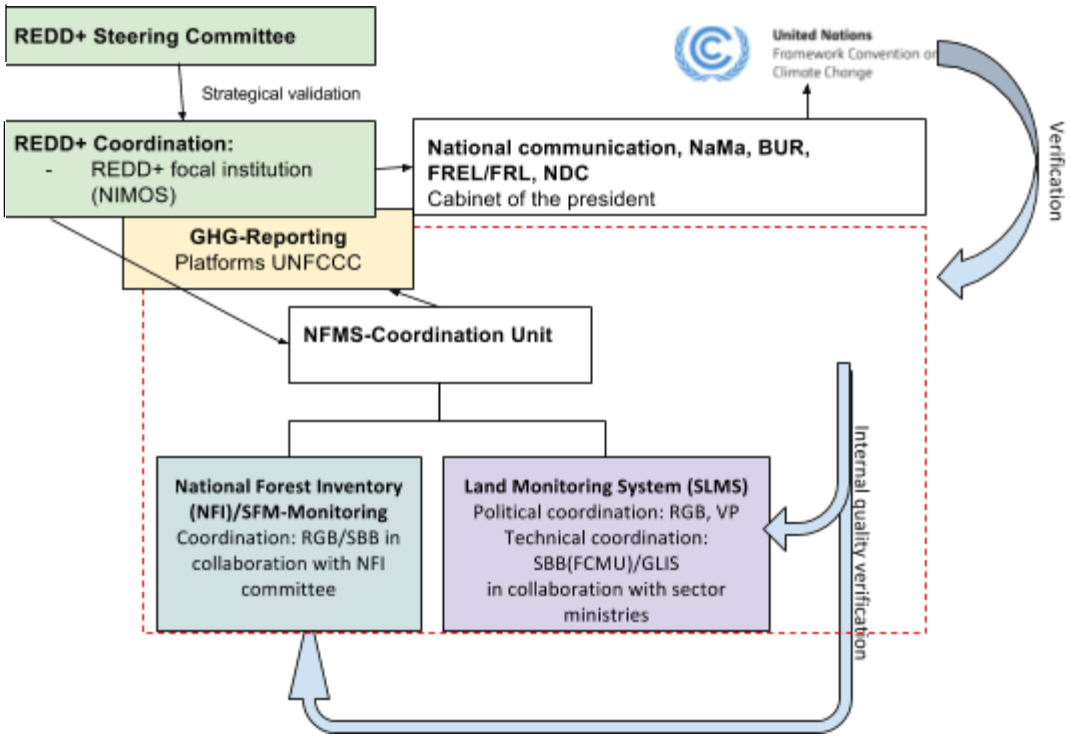

Figure 10: Flows of information through NFMS to GHG reporting

The roles of actors in different boxes in figure 10 are explained below:

REDD+ Coordination:
REDD+ Focal point: NIMOS is responsible to oversee the complete national REDD+ program. For international reporting they could be the link between the NFMS and the Cabinet of the President.
REDD+ Steering committee: The REDD+ R-PP envisions a Steering committee that has not been established yet, but when it is in place, it would have an important role to bridge the NFMS with the broader policy context and decision-making.

NFMS Coordination Unit:
This unit is housed at the SBB, since SBB is mandated to pioneer the establishment of an NFMS in Suriname in coordination with relevant stakeholders.

Greenhouse gas (GHG) Inventory/LULUCF reporting:
To meet Suriname's reporting requirements under the UNFCCC, until now financing has been guaranteed every four years to compose an ad hoc GHG inventory working group, bringing together relevant national experts. Considering that Suriname will report to the UNFCCC on a more frequent basis after the Paris Agreement, it might be considered to establish a permanent unit at the Cabinet of the President or at NIMOS, allowing for consistency in the subsequent reporting.

Satellite Land Monitoring System (SLMS):
The SLMS can be carried out by a multidisciplinary team composed of GIS/field experts from the different sectoral ministries. Because currently the SBB has already enrolled a forest cover monitoring system, SBB

could initiate the technical development of the SLMS. For strategic guidance SBB will partner with the Ministry of RGB, NIMOS, the Cabinet of the President and/or the Planning Office. The SLMS institutional arrangements and workflows are illustrated in the figure below:

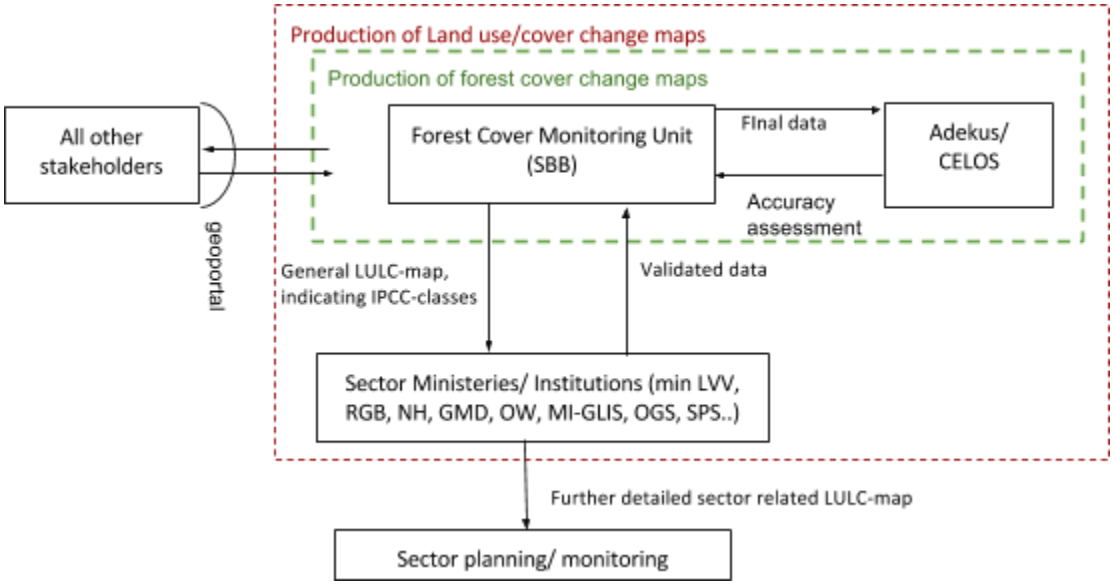

Figure 11: SLMS institutional arrangements and workflows

National Forest Inventory (NFI):

The NFI will be implemented through a collaboration between SBB, CELOS, the Herbarium and other relevant stakeholders and expert groups, as illustrated in the figure below:

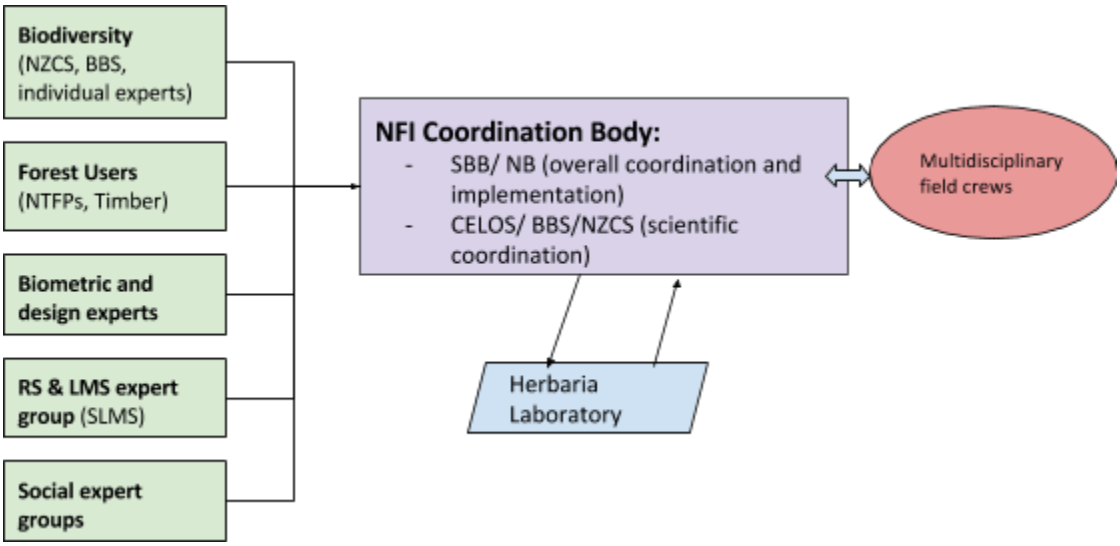

Figure 12: NFI institutional arrangements and workflows

3.1.4 Data management and dissemination

The immediate outcome of an NFMS is data, collected on scientific grounds at subsequent occasions, from which targeted information for decision-making is derived both regarding the current status and regarding changes (FAO, 2016).

Improved access to information and opportunities reduces the risk of marginalization and enhances the access to justice in environmental matters. Citizens actively involved and empowered are in the position to hold their government accountable for action or inaction. This increases the likelihood that forest cover monitoring will be more than merely data production and passive observation of facts, but linked to policy enforcement against unplanned deforestation and sustainable forest management in a fully functional NFMS (FCM Plan, 2014).

While setting up the structures for implementation of the NFMS, it is important to take provision for a long-term data management and storage, creating a basis for repeated analysis and time series. To assure the accessibility of NFMS related data, a first step will be the establishment of a NFMS geoportal which was initiated with the support of the FAO/ UN-REDD remote sensing unit who have a lot of experience in developing this kind of portals[47]. The TOR for this activity is in Annex 2. Within the TOR the different aspects and overall vision on data management and data sharing are communicated in more detail. It is important that data sharing policies, standardization of cartographic data, and quality standards are being agreed upon as a parallel process.

Figure 13: Geoportal for Suriname (www.gonini.org)

The National Forest Information System should be looked at in a very holistic way, linking and bringing together the data from SFM, the SLMS, the NFI, the NRTM, C-MRV and provide harmonized datasets that can be used in an efficient way for reporting purposes. The NFMS established for REDD+ should have clear links with e.g. the system used for the legality of timber.

[47] www.slms4redd.org

To access the geoportal launched on 28 December 2016, visit http://www.gonini.org.


Figure 14: Photos from the Gonini Geoportal launch

3.1.5 Research Program

Parallel with the operational activities within the NFMS, it is very important that research in forest monitoring is encouraged and research institutions are strengthened. This will provide the necessary scientific basis for the methods developed and operationalized within the NFMS.

In this behalf SBB has already established Partnership Agreements or joint work programs with Anton de Kom University of Suriname:

- Center for Agricultural Research Suriname (CELOS) - an MOU has been signed in 2016
- National Herbarium Suriname
- National Zoological Collection Suriname
- MSc. in Sustainable Management of Natural Resources
- BSc. in Environmental studies
- BSc. in Agrarian production

Also collaboration with international universities was given shape:

- The University of Hamburg - an MOU has been signed
- The University of Florida
- The University of Utrecht

To date, most research activities were carried out by national and international BSc., MSc. and PhD students doing research on NFMS related subjects.

	# national students linked to NFMS	# international students linked to NFMS
BSc. Students	3	
MSc. Students	6	2
PhD Students	2	4

As this contributes significantly to the capacity strengthening, we will continue to stimulate and provide an enabling environment for students to graduate on NFMS-related topics.

Nevertheless, to make sure that the methodologies used within the NFMS are based on scientifically sound methods, a number of structural research programs/ subjects were identified and/or identified. This list is not exclusive, and will be further completed while moving forward:

Research topic	Status	Potential partners
Assess the uncertainty of local tree names	Not yet started	CELOS, BBS, …
Validate existing allometric equations	TOR formulated	CELOS, CATIE
Assess the dynamic coastline	Finished	ADEKUS
Test methodologies to assess forest degradation	Not yet started	
Test methodologies to monitor mangrove forest	Formulated now	CELOS, UNDP, AdeKUS, university of Utrecht
Test use of Sentinel 1 vs. 2 for NRTM	Formulated now	ADEKUS, ONFI
Compare EF for different types of logging	Formulated now	University of Florida, CELOS, CATIE, private sector
Assess carbon fluxes in shifting cultivation areas	Not yet started	CELOS, NGOs (e.g ACT), ...
Establish estimation design for the NFI	Formulated now	University of Hamburg, NFI Brazil
Test HABITAT methodology for Suriname	Ongoing	IRD, NIMOS, CCCD, Kaplan
Sustainable Forest Management approaches to foster Forest Law Enforcement, Governance and Trade and Reduced Emissions from Deforestation and Forest Degradation interactions (SAFARI-project)	Ongoing	University of Hamburg

3.1.6 Funding

The NFMS will provide broad forest related information, and therefore support national and subnational and in some cases even local planning processes. It will be the basis for the calculation of the REDD+ results based payments. Additionally, the information will be available for enforcement of policy in the field, and as a basis for reporting to UNFCCC, FRA, CBD, Ramsar, CITES etc. Nevertheless, to keep it

running, it will require a sustainable financial planning. A business model should be created. Also setting up strong institutional arrangements could help to manage the available resources in the most effective way. Ideally the NFMS is set up by means of supporting more efficient development and sectoral planning, lower dependency on international consultants and being able to receive payment for ecosystem services.

The annual operational costs during the implementation phase would ideally be fully integrated in the national government structure with adequate funding, and through alignment with expected flows of Results Based Payments for REDD+. Until now (2016), the emerging NFMS has been greatly dependent on funds from projects of the Amazon Cooperation Treaty Organization (ACTO), which enabled the establishment of a Forest Cover Monitoring Unit (FCMU) from scratch in 2012 and covered almost all costs such as staff salaries, state-of-the-art equipment and capacity building activities for almost 5 years. This allowed for the creation of a solid foundation before the start of the REDD+ program.

Suriname's REDD+ R-PP estimated that the creation of the NFMS would cost 3.3 million USD in the readiness phase planned for 2014-2018. Only a small part of the R-PP has been funded so far, through an ongoing initial FCPF grant of 3.8 million USD for the REDD+ program including the NFMS. However, the R-PP anticipated in total 8.6 million USD from FCPF, 6 million USD from UN-REDD, and 1.5 million national government contribution.

The following budget and funding sources were proposed for the NFMS in the R-PP:

Table 4A. NATIONAL FOREST MONITORING SYSTEM ACTIVITIES AND BUDGET

Activity	Sub-Activity	Estimated Cost (in thousands)					
		2014	2015	2016	2017	2018	Total
4.a.1 Design and establish an institutional framework for monitoring REDD+	Establish MRV REDD+ coordination unit	20					**20**
	Establish systems and structures required for monitoring and review		50	10	10	10	**80**
4.a.2 Development and setting up of a standardized remote sensing and forest inventory methodology (for monitoring activity data and emissions factors)	Selection of satellite data for national monitoring based on component 3		50				**50**
	Stratification and sampling design (national design) based on component 3	30	70	50			**150**
	Design QA/QC protocols for activity data and emissions factors based on component 3		30	30			**60**
	Establish permanent plots and conduct field measurements based on Component 3 / National Forest Inventory	300	300	350	350	350	**1650**
4a.3 Capacity building for implementing monitoring system	In-depth assessment of capacity needs	25	25				**50**
	Develop institutional capacity for monitoring	120	120	120	120	120	**600**
	Develop capacity for remote sensing techniques	60	60	60	60	60	**300**
	Training of forest dependent communities	40	40	40	40	40	**200**
4.a.4 Reporting and Verification	Establish and implement reporting protocol				50	50	**100**
	Define and implement verification strategy				20	20	**40**
Total		**395**	**545**	**460**	**450**	**450**	**3300**
Government		100	100	100	100	100	**500**
FCPF		**207**	**312**	**252**	**245**	**245**	**1261**
UN-REDD Programme (if applicable)		88	133	108	105	105	**1539**

3.1.7 Cross-cutting NFMS Actions

The following table provides a summary of cross-cutting actions that need to take place to further develop the NFMS, what is planned to happen when and who needs to be involved.

	Who?	**AWP 2016**	**Up to 2018**	**After 2018**
Reach agreement on forest-related definitions	CabPres, NIMOS, SBB	Prepare concept note and have discussions	Formalize definitions	
Institutional arrangements for the NFMS	CabPres NIMOS SBB Other partners	Propose structure in roadmap; Adapt proposed structure	Embed NFMS in the operational structures	
Store NFMS data in a centralized manner	SBB FAO Other interested stakeholders	Bring forest related data together	Create remote access points for entrance, edition and consultation of NFMS data Create official layers	Improve NFMS database
Share NFMS data with Broader public	SBB FAO Other relevant stakeholder	Establish geoportal Strengthen capacity in data management Launch the geoportal	Continue to update and improve the geoportal Develop data sharing policies Generate reports out of the geoportal	
Develop and implement research program	SBB CELOS ADEKUS	Have yearly meetings to streamline the NFMS-related topics with national research activities (defined in MOU with CELOS)		
Stimulate research scholarship opportunities for NFMS related-topics	SBB MINOV? AdeKUS etc			
Support financial sustainability of the NFMS	Min Finance UNDP SBB			

3.2 Satellite Land Monitoring System

3.2.1. Current status

Land cover and land use data that are up-to-date and spatially explicit are very valuable for feeding national land use (zonation) planning and policy making processes. Forest cover maps provide the first basic information when making national or local forest management plans. Satellite images frequently cover large land areas at little or no costs, making these images a practical tool to develop and update Land Use Land Cover (LULC) maps on a regular basis. The GoS could strengthen its technical capacities to use satellite images through the ACTO project *"Monitoring the Forest Cover in the Amazon Region"*. Within this project, the Forest Cover Monitoring Unit (FCMU) at the SBB was established in 2012 and equipped. The activities of the FCMU are described in "The national plan for forest cover monitoring" (June, 2014).

The last years the FCMU has produced five national forest cover/deforestation maps: a forest cover map of 2000, and four deforestation maps for the periods 2000-2009, 2009-2013, 2013-2014, 2014-2015. Recently a *Post Deforestation Land Use Land Cover map for 2000-2009* was produced in a collaborative effort with the sector ministries and the research institutions[48]. This exercise is repeated for 2000-2013 and 2000-2015.

Within the "*REDD+ for the Guiana Shield project"* the FCMU contributed to following studies:

- Monitoring the impact of gold mining on the forest cover and freshwater in the Guiana Shield for 2014.
- Analyzing and modeling deforestation in the Guiana Shield.
- Testing the potential of SENTINEL 1A to monitor the forest cover in the Guiana Shield.

Currently, with the capacity built over the last years during regional and national projects, Suriname is capable to carry out a number of activities in-country:

- Generate up-to-date national statistics on forest and land cover change.
- Establish the MRV for REDD+ from the existing structures using Approach 3[49].
- Model potential spatial explicit policy scenarios.
- Develop and share GIS/ RS methodologies within Suriname.
- Near real time monitoring of forest fires, logging and unplanned deforestation.

3.2.2. Strengthening existing (national) forest cover monitoring systems

1) Benchmark map

When monitoring change, it is important to have a basis the "change" can be compared with. The forest cover map for 2000 can be used as the benchmark map to assess historical deforestation for the FREL/FRL. This map was produced using semi-automatic classification procedures on Landsat 5 and 7 images. The final check of the classes was done manually in TerraAmazon, a software developed by FUNCATE. FCMU received trainings in the use of TerraAmazon, provided by CRA/INPE through the ACTO project. The Landsat-images were combined with: high resolution imagery (Google Earth, Bing Maps), old maps (ecosystem map of the Northern part of the country, 1978 and CBL-maps based on a national aerial campaign in the 50-70s by KLM aerocarto), field data and expert knowledge.

[48] http://sbbsur.com/launch-post-deforestation-land-use-land-cover-lulc-kaart-2000-2009/, http://sbbsur.com/rapport-3-daagse-land-use-land-cover-lulc-werksessie/

[49] IPCC guidelines (2003)

To make the map cloud-free, the results were combined with the global tree crown cover map of 2000, applying the same definition of forest (crown cover of 30% and minimum area of 1ha), produced by Maryland University (Hansen, 2013[50]), and verified manually by using the Landsat mosaic created by the greenest pixel algorithm through Google Earth Engine.

2) (Annual) deforestation monitoring

Four maps have been produced, assessing the national deforestation that took place between the following years: 2000-2009, 2009-2013, 2013-2014 and 2014-2015. All these maps were created using the forest mask of the benchmark map of 2000. Currently Suriname is planning on updating the deforestation maps on a yearly basis. The four change maps, produced within the regional ACTO-workplan, will be used for the historic assessment of the activity data, as a keystone for the FREL/FRL. Monitoring year 1 will be 2015-2016.

Figure 15 is a flowchart that gives an overview of the different steps taken to produce the deforestation maps. The methodology is based on PRODES (INPE, 2013[51]), and adjusted to the national context. The method can be divided into three main stages: Pre-processing, core-processing, and post-processing. Each stage is further subdivided in processing steps. The output (results) of all steps are stored in a folder structure containing Pre-processing, Core-processing and Post-processing folders. Figure 16 shows the resulting deforestation maps.

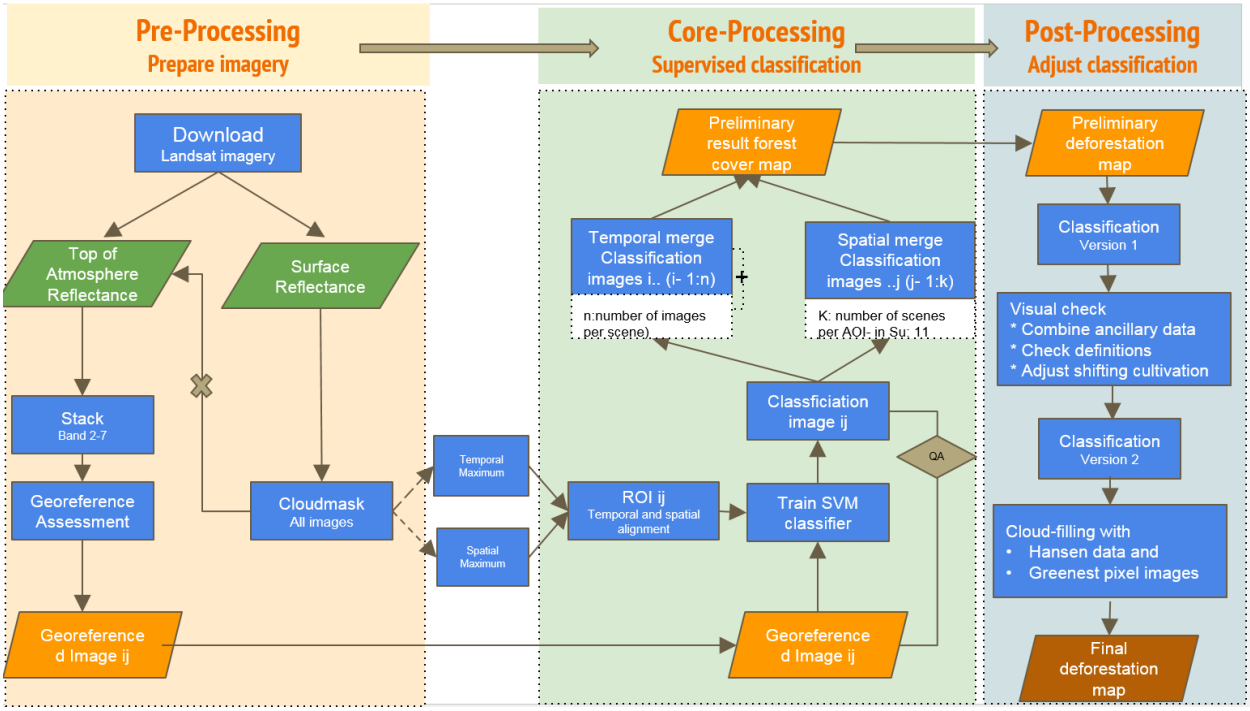

Figure 15: Methodology to produce deforestation maps

[50] Hansen, M. C., P. V. Potapov, R. Moore, M. Hancher, S. A. Turubanova, A. Tyukavina, D. Thau, S. V. Stehman, S. J. Goetz, T. R. Loveland, A. Kommareddy, A. Egorov, L. Chini, C. O. Justice, and J. R. G. Townshend. 2013. "High-Resolution Global Maps of 21st-Century Forest Cover Change." Science 342 (15 November): 850–53. Data available on-line from: http://earthenginepartners.appspot.com/science-2013-global-forest.

[51] INPE (2013), Metodologia para o Cálculo da Taxa Anual de Desmatamento na Amazônia Legal, Coordenadoria Geral de Observação da Terra Programa Amazônia – Projeto PRODES (http://www.obt.inpe.br/prodes/metodologia_TaxaProdes.pdf)

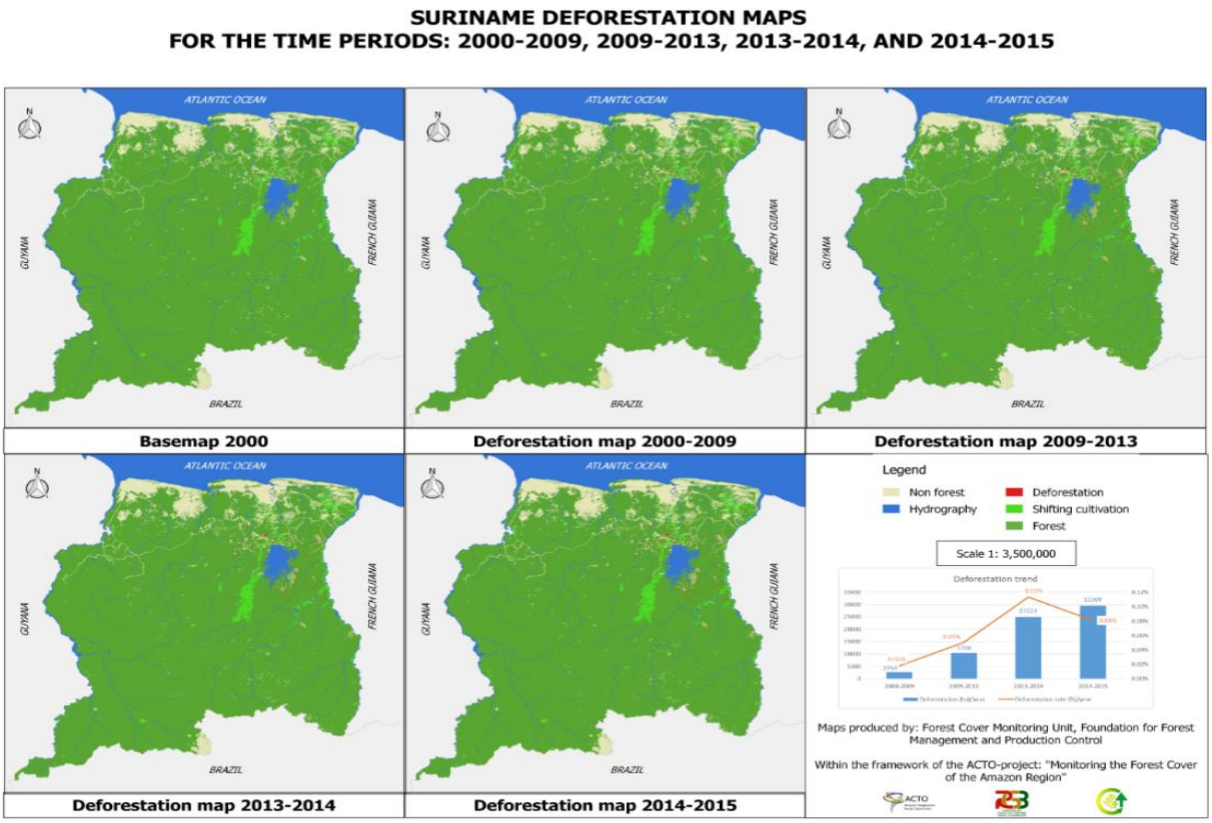

Figure 16: Suriname deforestation maps

3) Forest degradation monitoring

Forest degradation is seen as the loss of goods and services over a determined time period. This might be very complex to monitor because it implies indicators related to biodiversity, production, ecological protection and threats. These indicators will be included in the further design of the multipurpose NFMS, including the NFI. Within the SLMS as a component of the MRV-system, the focus here is on a persistent loss of forest carbon stocks (Figure 17).

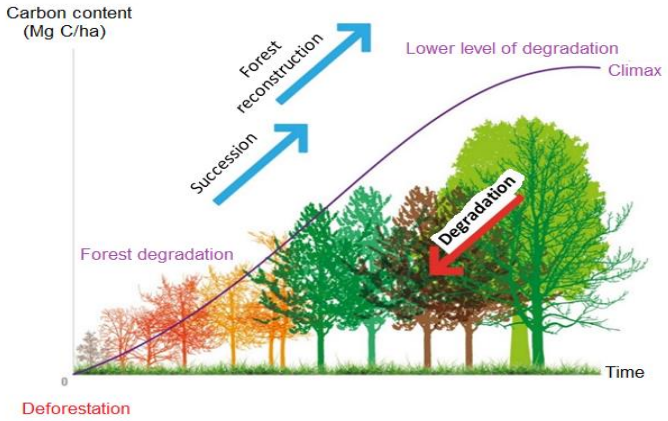

Figure 17: Visualization of forest degradation in terms of carbon loss
(Adapted from Eckert et al. 2011 and Morales-Barquero et al. 2014)

While deforestation has been historically low, forest degradation might be a more significant source of carbon emissions. Assessing forest degradation will be one of the main priorities throughout the coming period. Specifically, the following methods will be compared:

- Spectral Mixture Analysis (Souza et al, 2005) [52]
- Time series of medium resolution imagery (De Vries et al, 2015[53]; Holden et al 2015)
- Visual interpretation of high resolution image (e.g. Sentinel 2, Rapid Eye) (Guyana Forestry Commission, 2012)
- Assessing canopy disturbance using LIDAR
- Assessing canopy disturbance using RADAR (e.g. Sentinel 1A and 1B). Some experience has already been built within the country and the Guiana Shield region[54]
- Identifying an Intact Forest Landscape for Suriname (GOFC-GOLD, 2015)
- Analyzing the fragmented landscape based on the forest cover change maps (Haddad et al, 2015)[55].

Suriname is not the only country in the region trying to find solutions for this subject. During a regional ACTO-seminar on November 3 & 4th, 2016, in Bogota, Colombia the eight ACTO countries expressed the interest in exchanging experience they have with the different methodologies[56]. Suriname will build on the lessons learnt within the different countries, and identify the most relevant methodology to monitor its forest degradation.

Monitoring forest degradation is an area where more research is necessary. Within the *"Background study to REDD+ in Suriname: Multi-perspective analysis of drivers of deforestation, forest degradation and barriers to REDD+ activities"* carried out in 2016, a first step was taken to qualitatively describe forest degradation, and to understand the direct and indirect causes. Direct drivers of degradation already identified are: mining, forest fires, expansion for shifting cultivation areas, conventional selective logging. This list will become more extensive in the publication of the results of this study.

Rotational shifting cultivation is seen as forest land with lower carbon content. Therefore, pioneer shifting cultivation can be seen as a type of forest degradation. The expansion of rotational shifting cultivation (and thus pioneer shifting cultivation) was monitored within the deforestation monitoring for 2000-2009, 2009-2013, 2013-2014 and 2014-2015, and can be reported upon.

[52] Souza Jr., C.; Roberts, D.; Cochrane, M (2005). Combining spectral and spatial information to map canopy damage from selective logging and forest fires. Remote Sensing of Environment 98, p.329 – 343

[53] DeVries, B.R.; Decuyper, M.; Verbesselt, J.; Zeileis, A.; Herold, M.; Joseph, S. (2015). Tracking disturbance- regrowth dynamics in tropical forests using structural change detection and Landsat time series. Remote Sensing of Environment 169, p. 320-334

[54] Rahm, M.; Lardeux, C.; Frison, P.; Crabbe, S.; Hardjoprajitno, M.; Smartt, T.; Totaram, J.; Funi, C.; Farias, P.; Lauger, A.; Bedeau, C. (2016)- Towards a system combining SAR and optical data to monitor gold mining in the Amazon forest- ESA Living Planet Symposium 2016.

[55] Haddad et al (2015). Habitat fragmentation and its lasting impact on Earth's ecosystems, Science Advances 20 Mar 2015: Vol. 1, no. 2.

[56]Regional meeting on monitoring forest degradation in the member countries of ACTO, Meeting Report, Bogota Colombia. November 03rd and 04th, 2016.

4) Independent accuracy assessment

To guarantee the quality of the maps, before publishing the official statistics, an independent accuracy assessment needs to be carried out. Additionally, the map will be shared through the geoportal, allowing national experts and institutions to provide their feedback.

National capacity has been built during the REDD+ for the Guiana Shield project where ONFI trained staff from SBB and CELOS in the principles of a statistically sound accuracy assessment.

The accuracy assessment was carried out in collaboration with CELOS, using Collect Earth-software developed by the FAO[57].

3.2.3 Towards a multipurpose SLMS

In Suriname, where there is still a forest cover of more than 90%, the data delivered by the NFMS is an important source of information about the whole country. Therefore, the data is of importance for allocation of *Preferred Dominant Land Use,* serves as basic information for the national development plan, it can be a starting point for more detailed sectoral plans, and it can be one of the main inputs for creating a sustainable spatially explicit land use planning (Figure 18).

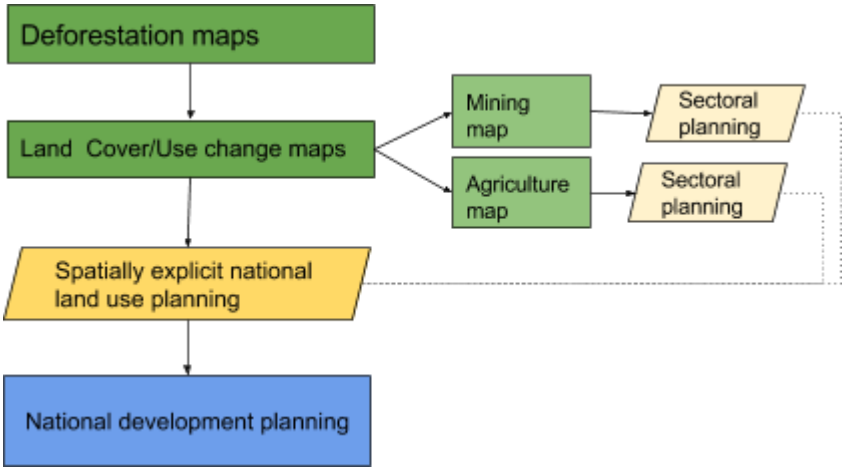

Figure 18: SLMS maps for multiple purposes

The FCMU, in collaboration with the sectoral ministries/institutions and CELOS, has been assessing land use/ land cover changes using the TERRACLASS method[58] to assess the LULC after deforestation for the periods 2000-2009, 2000-2013 and 2000-2015. The map for 2000-2009 was launched on August 3, 2016, and data has been shared with all partner institutions for further detailed use. All maps are available on the geoportal.

The data between the sector ministries could be shared on a frequent basis through the (staging area of the) geoportal. The collaborative mapping exercises have shown the potential of joint monitoring and planning efforts on a national level, and will continue on a regular basis.

[57] FAO (2016). Map Accuracy Assessment and Area Estimation: A Practical Guide. National forest monitoring assessment working paper No.46/E

[58] Almeida, C.A.; Coutinho, A.C.; Esquerdo, J.C.D.M.; Adami, M.; Venturieri, A.; Diniz, C.G.; Dessay, N.; Durieux, L.; Gomes, A.R. (2016). High spatial resolution land use and land cover mapping of the Brazilian Legal Amazon in 2008 using Landsat-5/TM and MODIS data. In: Acta Amazonica, Vol 46 (3): 291-302.

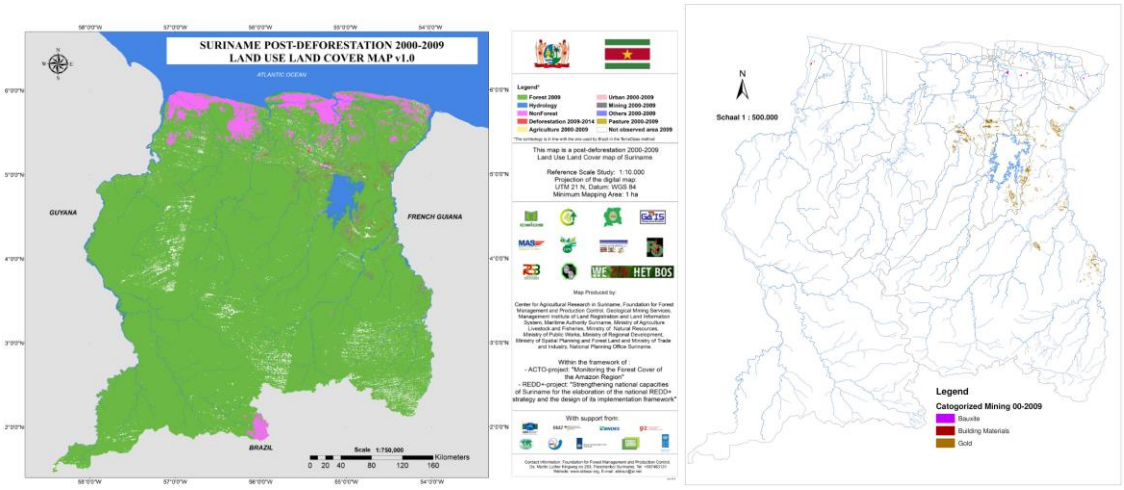

Figure 19: Post-deforestation LULC map 2000-2009 (This map was launched on Aug 3, 2016 and an example of a more detailed sectoral (mining) map, created by GMD, building on the first map)

The data created within the Satellite Land Monitoring System can be combined with other information on land use/ land cover. An example is the map of land cover/ land use produced during the "National Masterplan for Agricultural Development" (GOS, 2016). This plan contains an updated Atlas of Land Use for the Coastal Zone of Suriname, including the classes shown in Figure 20 (left). When combining this baseline map for the coastal zone, with the updated forest/non forest/deforestation drivers' maps produced by FCMU, it would be possible to get a more frequent and complete image on the national land use and land cover (change).

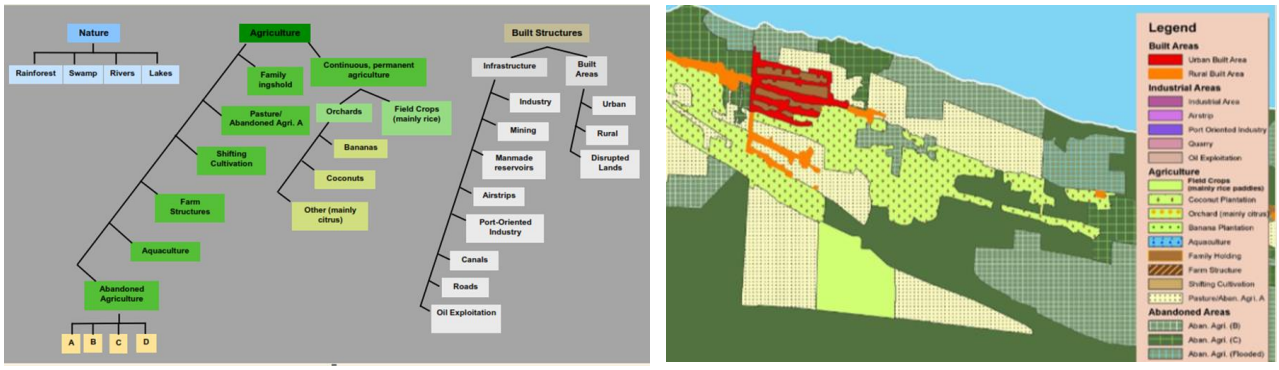

Figure 20: Classification tree and map showing amount of detail on LULC map of coastal zone (2016)

3.2.4 Improving other national cartographic data

While structuring and developing the NFMS, it was identified that a number of cartographic layers need to be improved. This resulted in new collaboration projects and can contribute to a new basemap for Suriname. Specifically following layers were identified and sub-projects were identified:

- River shapefile which is currently improved in collaboration with WLA and MAS
- Road shapefile which is improved in collaboration with MI-GLIS, CBB and the Ministry of Public Works
- Protected areas shapefiles which will be improved in collaboration with the Ministry of RGB

This list will be completed while further developing the activities.

3.2.5 Next steps

LMS:		Who?	AWP 2016	Up to 2018	After 2018
a.	Deforestation monitoring	SBB	Finalize historic assessment of deforestation and post-deforestation LULC. Update of deforestation map for 2014-2015	Continue to monitor deforestation annually and post-deforestation LULC biannually Publish reports on annual deforestation	
b.	Forest degradation monitoring	SBB AdeKUS CELOS	Identify options for forest degradation monitoring using existing data	Pilot on forest degradation monitoring using RS	Operational system for forest degradation monitoring
c.	Accuracy assessment	CELOS AdeKUS SBB FAO	Accuracy assessment of change maps	Strengthen internal accuracy assessment	Internal verification system in place
d.	Spatially explicit LULC monitoring	GLIS SPS Sector ministries SBB	Collaborative production of LULC after deforestation	Collaborative production of national LULC map	Operational LULC monitoring system
e.	Agreement on national cartographic standards and production of national data layers	GLIS MinOW MinRGB SBB WLA CBB All other ministries	Identify protocols for development, improvement and publication of geographic features (roads, rivers, administrative borders, settlements...)		

3.3 Estimations of Emission factors: National Forest Inventory

This chapter provides an overview of the current stage of forest inventory, the approach to be followed to develop the multipurpose NFI for Suriname and the Action Plan Suriname will follow in the coming years. The capacity gap assessment and the capacity building plan is included in Chapter 4.

For multiple purposes and for the estimation of the emissions caused by deforestation a national forest inventory will be applied, the *stock change* method will be applied. To calculate changes, from small changes in biomass e.g. selective logging and fuelwood extraction, at least in the initial stage, the *gain-loss* method will be applied[59]. This will be further discussed in Section 3.4.

While establishing a NFI is not obliged under the IPCC guidance, a NFI can provide carbon stock and carbon stock change measurements. Additionally it provides information that can support non-carbon benefits e.g. biodiversity, timber stock distributions, distributions of NTFP's.

Based on the voluntary guidelines for a NFMS[60], the following steps towards the NFI were identified:

Figure 21: Steps towards the NFI

3.3.1 Preparations

a) Definition of the population of interest and sampling frame

Based on national discussions held (amongst other during the workshop of August 31st-September 2016), following conclusions on the land cover types to be included in the NFI can be made:

Land cover types	Actions
Forest	Will be included
Mangrove forest	Included with adjusted methodology
Shifting cultivation	Included with in dialogue with communities
Savannah forest	Will be included
Specific ecosystems e.g. Coronieswamp, Nannieswamp, Sipaliwini savannah.	Included with adjusted methodology
Other non-forest types	Excluded based on SLMS

[59] Pearson, T.R.H., S. Brown and F.M. Casarim. 2014. Carbon emissions from tropical forest degradation caused by logging. Environmental Research Letters 9: 034017-034028.
[60] FAO (2015). FAO guidelines on National Forest Monitoring- Section III.

b) Identification and specification of the desired outputs and the variables to be collected

Based on the information needs, the desired outputs for the NFI are established. In the next step, these outputs will need to be translated to variables, which will be measured in the field.

Objectives	***Desired output***	***End uses***	***Scale/resolution***
1.Forest resource extent	*Biomass and carbon stock (changes)* *Soil characteristics* *Growing stock* *Forest dynamics* *NTFP distribution* *Forest cover area* *Forest degradation* *LULC-classes*	*GHG-Reporting* *Mapping, management* *Adjusted SFM* *Improved forest use* *Cross check results* *SLMS*	*Per strata?* *Per FMU* *Per region* *National (for NFI)*
2. Ecosystem health and vitality	*Forest health and vitality* *Invasive species and plagues*	*Reporting* *Management*	*National* *Per region*
3. Biological diversity	*Species composition and distribution* *Biodiversity*	*Management* *Reporting* *Merchanting LKS*	*National*
4. Productive function	*Forest management* *Forest resource accessibility*	*Improving SFM*	*Per FMU*
5. Protective function			
6. Socio-economic function	*Local use and value of forest products and services* *Forest users' perceptions on the forest resources*	*Improved understanding of the value of the forest for the local communities*	*National*
7. Legal regulations	*Not in NFI*		

To make sure the NFI is fit to achieve the required precise estimates for the forest carbon stocks and stock changes, a **key category** analysis needs to be carried out. With this analysis we prioritize the estimation using Tier 2 or 3 approaches when the category contributes 95% to the national emissions or emission trend. Within these categories, subcategories (or pools) are included if they contribute 25-30% of the emissions in the category where they belong.

Forest Carbon Pools	Different scenario's	Measurements
Aboveground biomass	Significant for all species- always included	Minimally all tree species from dbh 10cm Tier 2- 3
Belowground biomass	Not cost effective compared to the contribution	Never measured, Tier 1
Dead Wood	Low contribution, but easy to include	Standing DW is measured along with AGB Lying DW is measured in nested plots Tier 2-3
Litter	Low contribution but relatively easy to include	Tier 2
Soil Organic Matter	**Depending on the Land use/cover change in the area** 1. Areas with no deforestation 2. Areas with high/medium threats to be deforested 3. Peatlands and mangroves	1. Tier 1 2. Up to 30 cm (conversion to Agriculture) Up to 1m (conversion to mining) 3. Up to several meters (if possible)

c) Select desired precision/ allowable uncertainty for priority indicators

Before designing the NFI, it is important to decide on the desired precision. The higher the precision of the forest carbon stock estimates aimed for, the more accurate small forest carbon changes can be captured, but also the more expensive the costs of the NFI will be. A trade-off needs to be made between potential carbon credits and the operational costs of the NFMS, specifically the NFI. The more variables we include (based on the desired outcome) the higher the cost will be.

As a rule of thumb it could be said that the **desired precision for carbon stocks and carbon stock changes will be minimally 10% within a 95% confidence interval**. This could be increased for specific areas, when LIDAR-images could be used.

d) Review existing information

Within the Forest Management Act (1992), a National Forest Inventory Program is described, but due to resource constraints and governmental priorities, no full national forest inventory was completed. Nevertheless, many field plots spread over the country have been established for multiple purposes, such as timber stock assessments, biodiversity assessments, scientific

purposes etc. This information was brought together in a database and in a collaborative effort with CATIE, CELOS, and the Adekus, as a basis to calculate the *best estimates for emission factors for Suriname* (Figure 22). The database will also be used as a basis for developing the design of the complete NFI.

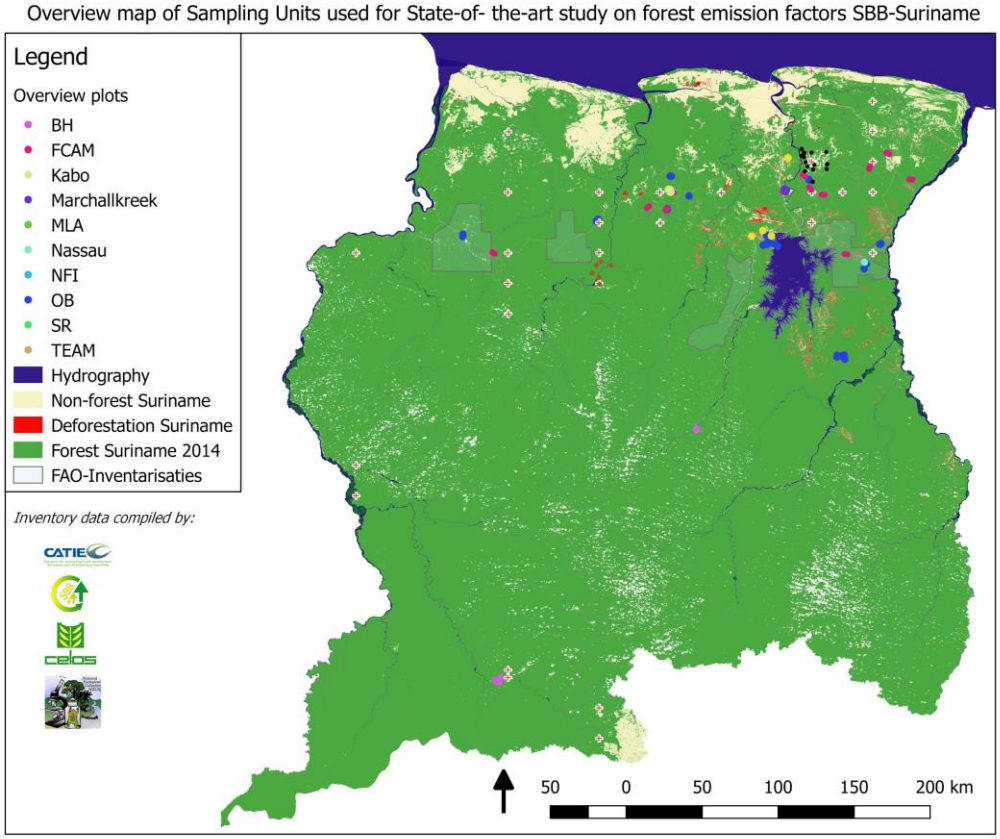

Figure 22: Overview of sampling units included in EF study

This dataset was build, amongst others, based on a number of data collection projects carried out during the last years in the preparation phase of the NFMS:

1. A baseline study *Towards a Carbon Balance for Forests in Suriname*[61] carried out by Alterra (2010-2011), with support of Tropenbos International-Suriname.

2. The *Forest Carbon Assessment and Monitoring project*[62] carried out in the period 2010-2011. Capacity was built amongst personnel from SBB, the ministry of RGB, the National Herbarium of Suriname (BBS) and the CELOS. The study was done with funding from Tropenbos International Suriname, CBN and WWF Guianas. Data was collected on all carbon pools, except for belowground biomass. The plots were mainly situated in the forest belt.

3. During the period 2012-2014, a *pilot National Forest Inventory* was initiated in a partnership with the Austrian Consortium ANRICA. Within this collaboration a pilot National

[61] http://content.alterra.wur.nl/Webdocs/PDFFiles/Alterrarapporten/AlterraRapport1977.pdf
[62] http://sbbsur.com/wp-content/uploads/2015/06/FINAL-Carbonreport.pdf

Forest Inventory was initiated. Data was collected in 32 Sampling Units (SU) spread over the country (including the far south and the coastal area). Partners within this project were CELOS and the Amazon Conservation Team (ACT)-Suriname. Parts of the fieldwork was funded by WWF-Guianas, KfW/CI-Suriname, the SCPAM-project and the UTSN-project.

4. In a regional project, *REDD+ for the Guiana Shield*, an overview of all allometric equations used in Suriname, Guiana, French Guiana and Brazilian Amapa was produced and published in 2015[63].

e) Expertise and manpower

The implementation of a NFI requires a multidisciplinary team. Because the capacity in Suriname is limited, we strongly suggest composing multidisciplinary teams by strengthening existing institutions and the collaborations between these institutions. As shown in section 3.1.3 we suggest the establishment of ad hoc expert groups which guide the NFI coordination body.
Following groups have already shown interest during the NFI-workshop:

- **SBB:** Overall coordination and implementation.
- **CELOS:** Scientific coordination, and implementation specifically within specific ecosystems. Guide establishment of protocols.
- **BBS:** Expand the plant collections, expand the herbarium, strengthen capacity of tree spotters. Contribute to formulation of protocols.
- **NZCS:** Interested to collect information about wildlife in the vicinity of the NFI plots.
- **Private sector (FSC-certified):** Want to support the national government by establishing or contributing to the establishment of NFI-plots in their concessions. They will embed these Sampling Units in the monitoring activities they are required to do within the FSC-process.
- **NGOs:** Can support the overall NFI, and they can also be the bridge between local communities and the national government
- **University and Natin:** Students should be involved in this process as much as possible. This will support the sustainability of the NFI/NFMS.

3.3.2 Statistical design

While the NFI design will be extensively discussed in another document *"Sampling Strategy and design"*, we touch the different steps we will need to consider. The three basic principles to be followed are: cost-effectiveness, results need to be corresponding to the required precision and the methods need to be scientifically sound.

a) Integration of Remote Sensing and field data collection

- Use of the same definitions

To make sure that it is possible to upscale the NFI-results to the national level, it is important that the same definitions for the land cover classes (e.g. forest, forest types) are used for both the SLMS and the NFI.

[63] https://reddguianashield.files.wordpress.com/2015/09/allometric-equations-in-the-guiana-shield.pdf

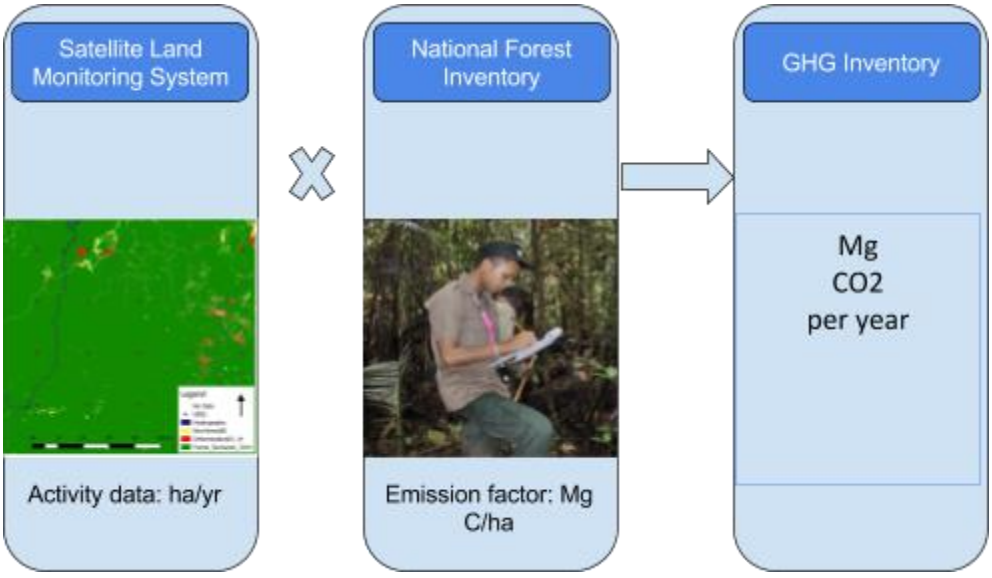

Figure 23: Integration of remote sensing and field data for reporting

- Use of Remote Sensing products for stratification

To carry out the sampling in the most efficient way, stratification of the country using available maps and data is recommendable. Firstly, this stratification will group four larger zones, with comparable characteristics:

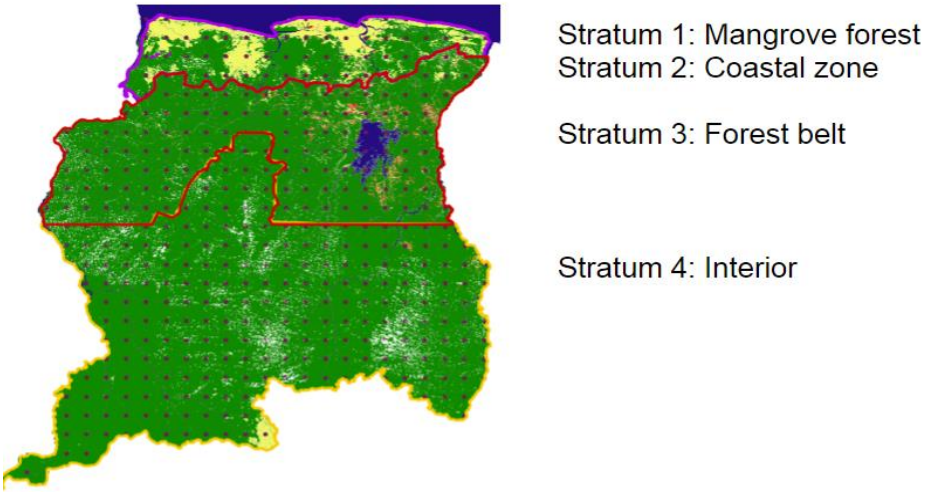

Figure 24: Stratification of Suriname

- Use of Remote Sensing for predicting carbon stocks (and carbon stock changes)

Research (also in Suriname during the pilot NFI) has shown that aerial images and LIDAR images can be used to predict carbon stocks and carbon stock change. This technique can, amongst others, be used in areas where a lot of deforestation takes place (and establishing PSP's can be dangerous) or in inaccessible areas.

b) Sampling design

The sampling design refers to the way how sampling units are distributed over the country, allowing a statistically sound analysis. Because of the high costs that come together with field visits, it is recommended to spend extra time in optimizing the design.

- **Stratification** is dividing the population (forest) in subunits/strata which are as homogeneous as possible. By sampling each stratum independently aiming for the required precision, the overall efficiency of the inventory might increase (Kohl and Magnussen, 2015). A proposal for four roughly delineated strata was made in Figure 23:
  - ➢ **Stratum 1:** Mangrove forest - the extent of the mangrove forest is estimated to be between 50000-150000 ha. (Moe Soe Let, 2016) Based on satellite images, an up-to-date delineation of this area will be the first step
  - ➢ **Stratum 2:** Coastal plain- this is a highly variable stratum including savannahs, swamps, and most urbanization and agricultural activities. This might need to be split up further
  - ➢ **Stratum 3:** Forest belt- here all the forestry activities are taking place. It is a more accessible part of the forest, with as a dominant forest type high dryland forest mixed with marsh/ creek forest. In the east of the forest belt, gold mining rights/ activities are overlapping with forestry concessions.
  - ➢ **Stratum 4:** Interior- here hardly any anthropogenic activities are taking place, except for the east where small scale gold miners are active and a limited number of villages where forest dependent communities are developing their livelihood.

  This will be further refined by distinguishing accessible and extremely difficult to access areas. The current proposal for stratification will be further investigated. A methodology that seems promising is the method used in French Guiana (Guitet et al, 2015)[64]. Based on this methodology, collaboration was initiated with IRD and throughout 2016 a first geomorphological map will be created for Suriname. This might provide a better understanding of homogeneous landscapes within Suriname and especially in the interior. Within the CCCD project this first geomorphological map will be combined with the geological, ecosystem and LULC change maps. The final result will be division of the country in landscape units, with description of all the units.

  Another approach could be a stratification based on the thread for deforestation (as applied in Guyana[65]). Nevertheless, during the NFI-workshop, the multipurpose character of the NFI was emphasized, focusing more on the physical characteristics of the forest and the current policies than only on its MRV-function. Therefore, a method based on threats is not considered recommendable in this context.
- Random sampling vs. **systematic sampling:** while statistically only a random sampling approach allows for exact estimators of the population totals, often a systematic sampling or a grid is used during NFI designs (e.g. during the NFI of Brazil). Systematic sampling ensures a full coverage of the population. The variance estimators might be biased compared to the random sampling design, especially because neighbouring sampling units are not

[64] Guitet, S.; Brunaux, O; Richard-Hansen ·C.; Gonzalez, S. (2015) Catalogue des habitats forestiers de Guyane.
[65] http://www.forestry.gov.gy/forest-carbon-monitoring-system/

independent. This might be a problem in areas with geographic features that follow a specific orientation (e.g. a river or mountain flank) but on a national scale, this does not play a significant role. The estimators to be used are the same as for a random sampling design.

- **Multiphase inventory**: During the pilot NFI project, the use of direct biomass monitoring with aerial images (first phase) combined with a limited number of field plots (second phase) was tested in collaboration with the Austrian Consortium ANRICA. This resulted in high R-Square values, indicating that this technique might be promising. Nevertheless, including LIDAR could improve the R-Square values significantly. The application of LIDAR will be tested in the dry season of 2016. When this technique proves to be ready for operations, the number of field plots could be reduced significantly. In this way the same precision can be achieved for reduced costs. Because of its innovative character, this technique will be evaluated carefully.

c) Plot design

Traveling to a sampling unit inquires high costs, resulting in the need to collect as much information on the variability of the forest area within the SU as possible. SU's can be individual plots, or can be clusters of a number of plots. In Suriname travel costs are extremely high. Therefore, a proposal for an NFI design for Suriname by Cox (1998) presents a cross-shaped cluster of a total of 32 plots (4x8) of 20x 100m each.

During the pilot NFI project, this design was simplified to a cross-shaped cluster of 8 (4x2) permanent sample plots, including nested plots where specific components would be measured (Manual pilot NFI for Suriname, 2015).

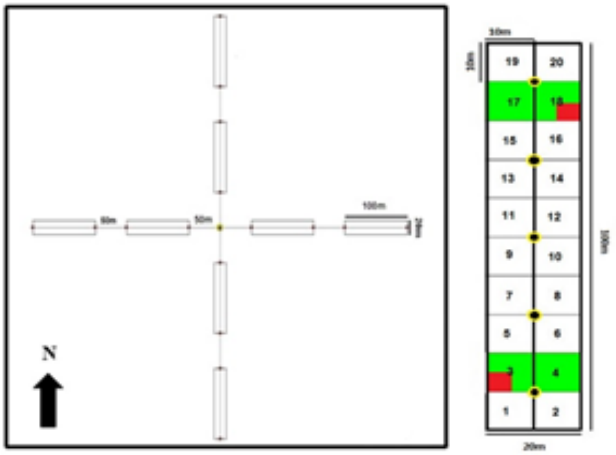

Figure 25: Design of the sampling unit applied during the pilot NFI project

When analyzing the pilot dataset (cfr. 3.1.2), not only the optimal sampling intensity, but also the optimal number of 20x100m plots will be determined. The plot size will also be evaluated, keeping in mind the advantage that the field teams are familiar with this plots design.

d) Estimation design

It is of a great importance that the estimation design, which is based on sampling and plot design is clear and straightforward. Because the sampling and plot designs envisioned are quite complicated, it is absolutely recommended to formulate a scientifically sound estimation design before starting the large scale data collection (section 3.1.4).

e) Selection of Allometric models

The selection of an inappropriate allometric equation might insert an unknown uncertainty to the carbon stock estimations. Therefore, a parallel research needs to be carried out to test the performance of the pantropical allometric (and volumetric) equations for Suriname's conditions (see section 3.1.4). In the meanwhile, the widely used pantropical allometric equation from Chave (2005) which also includes data from and is tested within the Guiana Shield is used.

f) Quality assurance procedures

Because there are many possible sources of error in the implementation of a NFI, it is important to embed a quality assurance procedure within the NFI-design. Following errors need to be assessed:

- Measurement errors - controlled by having clear Standard Operational Procedures (SOP), adequate training and mobile data forms. Remeasurement of a determined number of SU's is necessary.
- Model errors (see earlier paragraph)
- Standard errors: controlled by selecting the optimal sampling and plot design.

If the errors can be quantified, they should be reported.

g) Design of control measurements

To quantify the measurement errors, a recommended 10% of all field measurements need to be carried out again. This provides direct feedback and supervision to the field teams. It is also important that Measurable Quality Standards (MQS) are defined within the NFI design.

h) Other variables to measure

This is dependent on the objectives and the desired outputs of the NFI agreed upon. Nevertheless, to optimally use the resources spent to reach the often remote field plots, the NFI team should try to capture a wide spectrum of information, considering the available budgets. Table 2 provides some explanation for specific variables.

Table 2- Overview of extra variables

Variables	Comments
Variables to include almost certainly include (based on feedback)	
Timber stocks	Will be included- no additional measurements needed
Tree species names	Will be included minimally to the level of the local tree

	name. In collaboration with the National Herbarium of Suriname and CELOS a database will be developed with all tree species found in Suriname (based on the checklist of the flora of the Guianas) and all relevant associated information (density, trade name, local name in different languages etc.). The accepted names provided by the Taxonomic Name Resolution Service [66] will be used. In preparation towards the implementation of the full NFI, a protocol for plant collection needs to be formulated, and the tree spotters need to be trained on recognition of plant families. More information can be found in a regional study on tree species identification[67].
Socio-economic parameters	Socio-economic parameters will be collected in the vicinity of the villages. The MLA-protocol can be used as a guideline.
Non Timber Forest Products	To develop innovative markets and promote the use of NTFPs, it is important to get good estimates on the national occurrence of NTFPs. These parameters should be included in the NFI, but is specifically of a high importance when developing C-MRV-systems in collaboration with the communities.
Ecosystem descriptions	On a long term it would be recommendable to have a country-wide ecosystem map. Because of the high costs, the NFI will provide gradual input for such a map, and the collected field data will be combined with GIS-information on terrain characteristics. Protocols to record the information in the field and to store this information need to be agreed upon with relevant experts and the research institutions.
Variables to possibly include	
Wildlife	This will be included by or in close collaboration with the National Zoological Collection Suriname and the Nature division of the Ministry of RGB.
Water quality	This can be included in specific areas in collaboration with the responsible institution
Macrofungi, Plant diversity	This can be included in collaboration with the National

[66] http://tnrs.iplantcollaborative.org/
[67]https://reddguianashield.com/studies/improving-knowledge-sharing-on-tree-species-identification-in-the-guiana-shield/regional-workshop/

	Herbarium of Suriname (BBS)

3.3.3 Operational design

Before starting the implementation of the NFI, a design on how the operations will take place need to be formulated. Table 3 shows the components of this design, but this will be further shaped within the NFI project proposal.

Table 3- Components of the operational design

Actions (based on MRV-manual)	Comments
Define inventory organization/administration	The administration of the NFI will be done by the SBB under the strategical guidance of the ministry of RGB
Select and acquire measurement technologies/equipment	- The laboratory of CELOS should be in charge of the soil analysis, and the oven to dry fresh biomass - Plant collection material should be included. A place to locate the collection should also be included in the proposal - Field registration will be done using a digital device (e.g. tablet or handheld computer)
Develop field measurement and data management protocols, field forms etc	This will be done in close collaboration with national partners CELOS, BBS, NZCS with support from international partner organisations.
Set up inventory database	The inventory database will be part of the NFMS database
Organize and train field and administrative personnel	- Include capacity building plan for tree spotters (this could be broader than NFI) - Include tree climber training - Include local people to the field crew where possible - Work in multidisciplinary teams
Produce tactical plans to guide deployment of field teams and equipments	Possibly the NFI can be done per region. This would allow for regional reports to be generated before the complete NFI has been finished.
Awareness plan about NFI and stakeholders involvement, in particular the local communities, in the field measurement (these	This will be done in parallel with the national REDD+ program. The REDD+ assistants are key partners when it comes to involving the

should be an integral part of the awareness building/engagement plan)	communities. This needs to be discussed in detail during the implementation of the REDD+ assistants capacity building program.
Develop QA/QC protocols	

3.3.4 Action plan towards an NFI for Suriname

NFI:		**Who?**	**AWP 2016**	**Up to 2018**	**After 2018**
1	Best estimates for forest carbon stocks and emission factors related to logging	SBB CELOS, Tropenbos CATIE Private sector others	Develop ToR for study Proxies based on available data Establish inventory database	Update proxies/ Emission factors with new field data	
2	Evaluation of pilot NFI protocol	SBB CATIE ANRICA UNDP	Third party review carried out Report finished	Decide if the multiphase approach will be included in the NFI protocol	
3	Develop National Forest Inventory for Suriname	SBB CELOS IRD ADEKUS others	Prepare geomorphological map	Formulate estimation design Determine stratification and sampling design	Improve stratification and sampling design
		All stakeholders	Identify objectives of the NFI Identify key categories to be included	Prepare required subnational outputs	Prepare 1st estimates for national outputs
		SBB NB CELOS NZCS BBS	Formulation of Project proposal for NFI (draft project	Initiate implementation first measurement cycle	First measurement cycle implemented

		Private sector Communities	proposal) including the operational design		
4	Harmonize NFI with other forest inventory procedures	SBB		Overall forest inventory approach and data management (link with LogPro, cMRV, monitoring needs of certified concessions.)	
5	Build capacity on Tree species identification Field measurement	BBS CELOS SBB	Update national tree species list Create tree spotters capacity building plan	Operational plan for updating tree species list and capacity building of tree spotters. Operational system for tree species identification.	
6	Validate pantropical allometric equations	CELOS CATIE SBB	Formulate TOR	Carry out study	

3.4 Monitoring the EF of logging using the gain-loss method

3.4.1 Assessing the EF

While Emission Factors from deforestation and carbon conservation and SFM will be monitored through the multipurpose NFI, for forest degradation due to logging the gain-loss method will be applied to determine the EF.

Within the above-mentioned study *"Best estimates for emission factors in Suriname"* the EF related to logging were assessed using the method from Pearson (2014). This provides a more accurate estimation compared to the forest inventory plots, because detailed information on logging is available, and because the Emission Factors related to selective logging and sequestration from tree growth might be small, it could be hard to assess the impacts of improved practices with only the NFI. Therefore, for these practices, the gain-loss method could be more appropriate. The activity data will be based on the annual production, registered in the log tracking database LogPro.

Figure 26 which is based on the national statistics shows a significant increase in timber production over the last years.

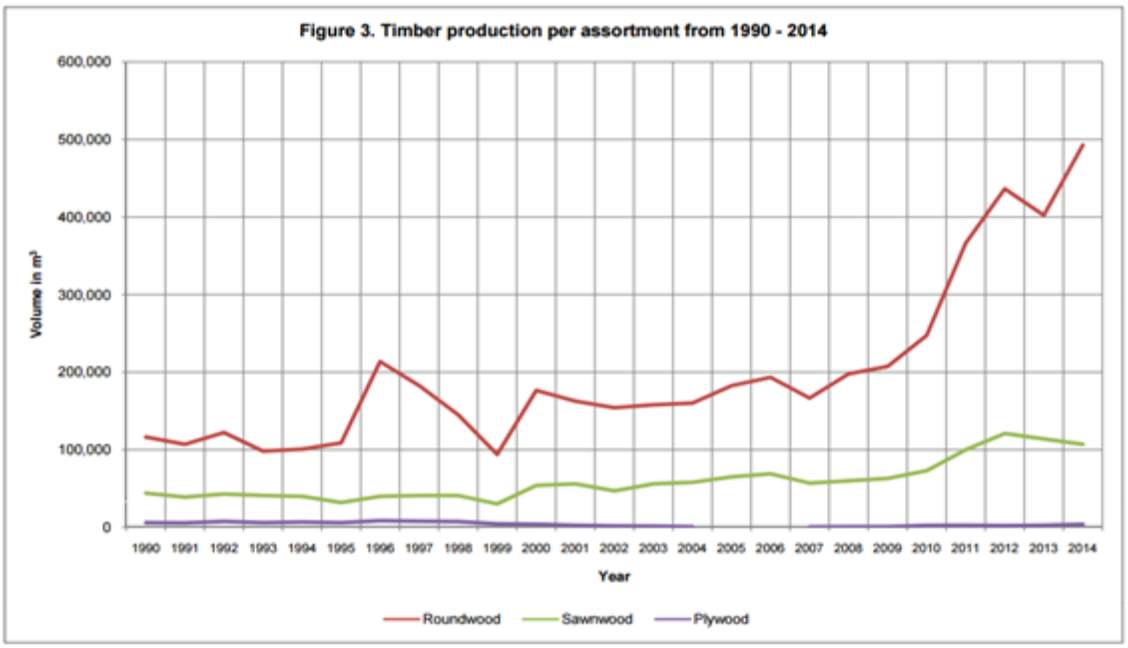

Figure 26: Timber production per assortment from 1990-2014 (source Forestry Sector Analysis 2015)

Pearson (2014) states that the total emission related to timber harvest (TEF) is:
TEF= (Extracted Log Emission +Logging Infrastructure Fraction + Logging Damage Fraction)

Only sufficient national data was available for:

- Extracted logs: LogPro-database
- Parts of logs left behind: Difference between Extracted logs and calculated total tree biomass using the LogPro-database and the allometric equation from Chave (2005)

For all the other parameters, default values (from the region) were used, because no sufficient national field data were available to allow for an accurate determination of national values. Therefore, in the coming period a project will be carried out to collect new field data that will allow us to assess more accurate EF for Suriname. The method used by Griscom et al (2013) will be used, and the different management types (Figure 27) will be evaluated:

1) Community forest management (ca. 750.000 ha)
2) Conventional forest management on concessions (ca 1.000.000 ha)
3) Reduced Impact Logging on certified concessions (ca 400.000 ha anno 2016).

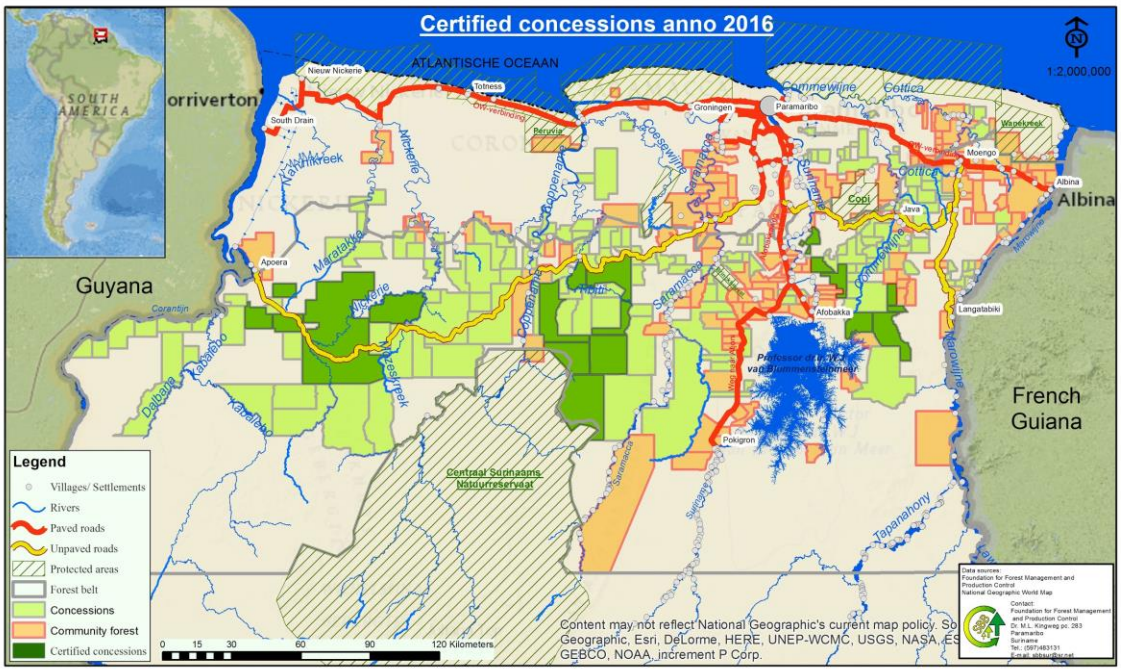

Figure 27: Concessions, certified concessions and community forests

The differences between the emission factors of these different management types will be assessed. If the EF related to the certified concessions would be significantly lower than for the other management types, this could be an argument to include promotion of certification, or full enforcement of the Code of Practice for SFM (which is comparable with the certification requirements) within the national REDD+ strategy.

3.4.2 Creating an integrated monitoring framework for SFM indicators and emission factors

While the assessment of the EF's for logging will be done based on a scientific research, we envision to integrate the operational procedures to monitor logging with the information required to improve and monitor the EF on a more regular and large scale basis. This is explicable because data to calculate the emission factors can also provide insights in the level a logging company is respecting and complying with the Code of Practice. SBB can use the results to guide and monitor the overall logging practices taking place in the field. This means that the current control procedures need to be optimized, stimulating the use of technology (e.g. mobile data collection/consultation) and shifting the focus of the field checks to a smart and well planned assessment of the quality of the delivered measurements, the level of correspondence between harvest information and pre-harvest information, and the damage to the remaining forest land. Modalities will be created to improve the data provision (and possibly SFM compliance score) to the private sector and forest based communities. This integrated monitoring framework will as much as possible be used to promote SFM initiatives and developments.

Synergies will be sought with FLEGT- initiatives and/or other frameworks that can support the development and parallel capacity building of a modern fully-fledged information flow (Figure 28) focused on legality checks, setting clear priorities, improving information availability and SFM-indicators (supporting the calculation of emission factor).

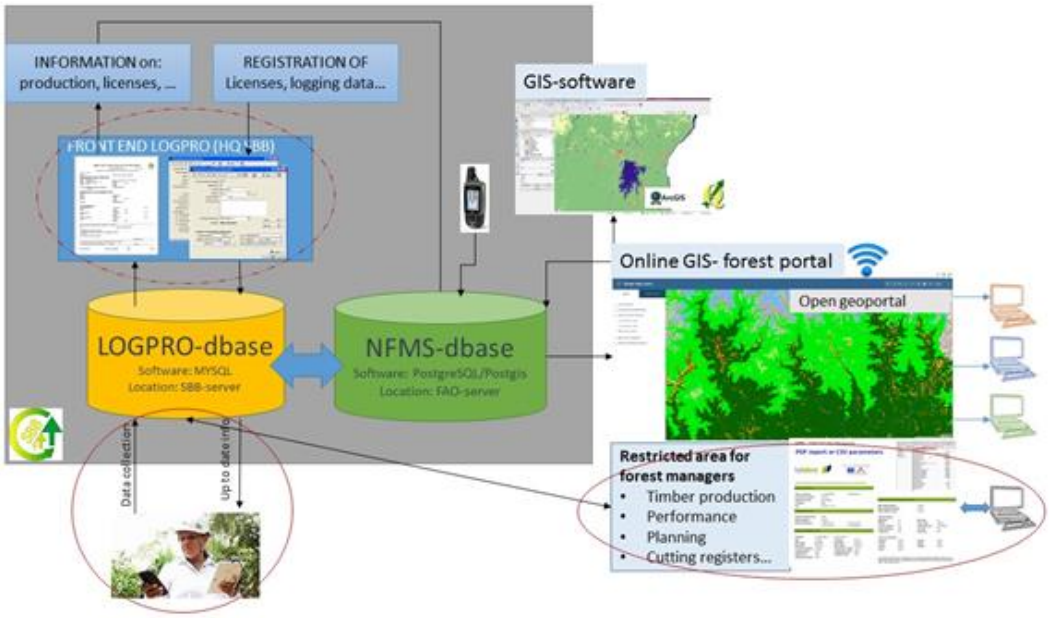

Figure 28: Monitoring framework for logging emission factors

Additionally, new technology will be tested and investigated that could support this monitoring framework (e.g. the use of drones, LIDAR etc).

Monitoring logging		Who?	AWP 2016	Up to 2018	After 2018
1	Assess the EF related to logging	SBB, CELOS, CATIE, Adekus University of Florida Private sector University of Hamburg	Created best estimates based on available data	Improve estimates based on newly collected field data for the different forest management types	
2	Embed monitoring EF in the SFM	SBB CELOS, CATIE, IDB,	Write concept note	Strengthen operational procedures	Continue to improve operational procedures based

	operational procedures	Private sector FAO/ FLEGT			on research related to new technology

3.5 Other monitoring functions

In addition to the above-mentioned MRV functions, Suriname's NFMS will include aspects that are not required by the UNFCCC but are added voluntarily for meeting national needs. This will start with Community-based MRV (C-MRV), Near Real Time Monitoring (NRTM), fire monitoring and a specific focus on mangrove monitoring.

3.5.1 C-MRV

The national REDD+ program of Suriname is envisioned as an inclusive and participatory process. The implementation of community-based monitoring, reporting and verification (C-MRV), is one promising approach to encourage an active role for forest dependent communities. C-MRV is based on three key-pillars: it should be local, participatory and there needs to be a community interest or at least a common cause between stakeholders in monitoring. The C-MRV acronym is not officially mentioned in UNFCCC decisions, but the concept took shape on the international level in the context of ensuring compliance with the REDD+ Cancun safeguards. It is meant to be an opportunity to actively engage indigenous peoples and local communities (IP&LC) in national programs for monitoring forests, and also making efforts more holistic by enabling monitoring of other issues relevant to communities.

It is important that C-MRV is not a top-down process defined by the government alone. It needs to grow as a voluntary undertaking by communities who see the value and relevance of local monitoring, and who want to use the data coming out of the process. Communities themselves should define the monitoring objectives, which could include input to government programs such as national REDD+ MRV obligations, but also monitoring all aspects of village/community development that matter to the communities themselves. Monitoring is a tool for keeping track of changes, so it may be useful for the community to start with developing a local vision for the future, and then define indicators to monitor for checking whether or not they are steering on course towards their vision. In addition to aspects related to forests, indicators can be for example the number of children who learn different aspects of the culture, people's health and food habits, work opportunities and interactions with the city, the number of houses built with modern vs traditional materials, how much fish there is in the river, etc.

C-MRV in support of national REDD+ MRV

C-MRV provides local level data on key REDD+ related indicators such as forest carbon stocks, drivers of deforestation and forest degradation. To support REDD+ effectively, C-MRV data collected by local communities needs to be harmonized with national level MRV data. Some concrete examples of how this can be done include:

- Using comparable field protocols, based on the IPCC-guidelines, as for the NFMS (NFI) but adapted to local languages and contexts. If in agreement, forest-based cultures could participate directly in the NFI and collect information in national grid Sampling Units near their villages.

- Using the same definitions of land cover classes and supporting exchanges between local- and national-level maps. Participants could complete the national maps with local information and other roles or approaches could be defined as deemed relevant.
- Organizing community trainings by or in collaboration with the GOS.
- Linking C-MRV to the Safeguard Information System (SIS).
- The NFMS-unit would ensure standardized data collection methods for C-MRV, support data processing, and provide mobile data collection and processing applications.
- Communities could actively monitor and upload "alerts" of unexpected deforestation activities in forests adjoining villages.
- Any other possible collaboration and support that comes out of brainstorm sessions with the communities leading to more effective collaboration.

Following FPIC principles, it will be important to sort out agreements related to ownership of information and what internal data community members want to share and not with the outside world.

Table 4 shows different levels of external vs. local data collection in national monitoring processes. In most contexts, the level of community involvement was very limited (Danielson, 2013), but research has proven the advantages of increasing the level of local involvement:

- The efficiency of MRV data collection can be greatly increased when local communities are engaged through a C-MRV process. (Danielson 2011, SE Asia; Butt et al, 2014, Guyana).
- Facilitates large-scale temporal and spatial data collection (Luzar et al. 2011), by allowing more frequent remeasurements.
- It supports inclusion of traditional knowledge and practices, making communities more resilient.
- It empowers communities by strengthening their capacities, involving them in PES-systems, generating a (limited) income and building trust and active engagement in the national program.
- Generates transparency in information flows between governments and communities.

Table 4 - different levels of community involvement in national monitoring processes (Danielsen et al,) which was presented by ACT during the NFI workshop on 31 August 2016:

External (E) Local (L)	Data Collection / Analysis/ Use	Characterization
E	All External	No direct role for community No capacity building, no engagement
E (L)	Local Collection, External Analysis/Use	Local people employed to collect data, some capacity building
E ↔ L	Local Collection, External Analysis/Use	Partnership, long-term training to collect data, better capacity-building
E ↔ L	Local Collection, Local or Collaborative Analysis/Use	Partnership, long-term training to collect and analyze data, strong capacity-building
L, L(E)	Local	Autonomous, full engagement, more risk

Already existing initiatives and structures

Although C-MRV linked to an NFMS has not yet formally been carried out in Suriname, there are some existing structures and past or ongoing initiatives that can be seen as a starting point to build upon. Some have been initiated by the government, civil society, the private sector and/or communities themselves and could contribute to an effective C-MRV system, among others:

- The Amazon Conservation Team (ACT) has trained indigenous park guards (IPGs) (now known as Amazon Conservation Rangers – ACRs) in different indigenous villages of the interior through a project that could be continued and scaled up. The rangers are trained to collect diverse ecological and biological field data from their respective home regions and could be directed to collect alternative data specifically to C-MRV purposes. Additionally, the ACR's download data from local weather stations and send them to the Meteorological service. This climate data can be linked with the NFMS. ACT also is actively involved in community mapping exercises.
- ACT-Suriname also initiated the UTSN-project in collaboration with the University of Utrecht, SBB, the National Herbarium of Suriname, and the ministries of RGB and CELOS. Within this project the IPG's (ACR's) and students from the University of Utrecht, ADEKUS and NATIN were trained in field protocols carried out during the pilot NFI-project. Three NFI sampling units were established and socio-economic and biodiversity data was collected. This was a positive experience we can build on in the future to establish effective C-MRV-systems.
- Tropenbos International-Suriname has collaborated with Saramaka communities in the Upper-Suriname river area on participatory 3D-modelling (P3DM) of land-use and important cultural sites around their villages. The World Wildlife Fund has used the same methods in Brownsweg, where gold mining is impacting the Brownsberg nature park.
- The Ministry of Regional Development (RO) has set up administrative structures for information and communication flows within districts, resorts, villages and communities in the interior.
- A communication infrastructure is set up within the Civil Aviation (Luchtvaart dienst) to collect and transmit information about the airstrips.
- A REDD+ Assistants Collective was set up in 2012, composing focal points from the different indigenous and maroon groups, selected by their own communities to be trained in conceptual understanding of REDD+. In 2016 they are paid to organize meetings and activities related to REDD+ in their communities, and in the coming period they could play an important role in introducing and explaining C-MRV and NFMS projects within specific cultural contexts.

3.5.2 NRTM

Near-real-time monitoring (NRTM) is helpful for discovering new deforestation or forest degradation earlier than what is possible with wall-to-wall mapping of change. The purpose of introducing such a system in Suriname is to provide early warning to institutions in charge of policy enforcement, so that they can respond quickly and put a halt to unplanned deforestation through interventions in the field. Forest dependent communities and people who go often to the field (certain NGOs, logging companies etc) can collect information on changes that are not easy to detect through remote sensing. NRTM in

Suriname will be designed to meet the needs of relevant partners and institutions responsible for controlling the sectors and activities linked to different drivers of deforestation. It is important to mention that the use of satellite images can improve the efficiency of field checks drastically and also allows for a third party to have a complete and regular overview of the field situation.

The Sentinel-program from the European Space Agency (ESA) that was recently launched provides free, and frequent Sentinel-1 C-band SAR data and Sentinel 2A that provides every 20-days a 10m-resolution optical image. These images have supported a lot on the work related to NRTM. Sentinel 2A captures logging very well, providing an instrument to detect illegal logging activities. Currently tests are carried out with Sentinel 1A and 1B, and a solid system based on Sentinel 2A is being built within the operation structures of SBB.

In the FCM-plan (2014), output 2.7, also the possibility to establish a tool enabling crowd-sourcing of information about what is going on in the forest was mentioned. This possibility could be a functionality of the geoportal and/ or a concrete activity within C-MRV.

3.5.3 Forest fire monitoring

One possible cause of deforestation is natural or anthropogenic forest fires. This has not been a big problem in Suriname so far, but fires are becoming more frequent in parts of the Amazon mainly due to increasing drought. For some ACTO countries the problem is already acute and it could possibly become an issue also in Suriname in the future. For that reason, it is relevant to stay informed about fire occurrence and analyse whether the frequency seems to increase. The US National Aeronautics and Space Administration (NASA) provides a free information tool for near-real-time monitoring of forest fires, the Fire Information for Resource Management System (FIRMS). FIRMS provides global fire maps and active fire location alerts using MODIS 250m x 250m resolution satellite data. It is possible to sign up to receive free e-mail alerts when fires are detected in the area of interest.[68]

The FIRMS data will be monitored on an annual basis to make sure that no increasing trend in forest fires is taking place. The spatially explicit data will be shared through the geoportal (FCM-plan, 2014). Additionally, field data on forest fires through the NFI, C-MRV and NRTM will be kept track of.

3.5.4 Mangrove monitoring

While mangrove forest is an inherent part of Suriname's forest cover, it does deserve some special attention within this document, amongst others for following reasons:

- Based on the proposed definition of managed land (see section 3.1.1), parts of the mangrove forest are outside the managed land. Nevertheless, because of their importance for climate adaptation and their economic and ecological value, they need to be included completely within the NFMS.
- The difficulties to access the mangroves and their specific characteristics require an adjusted methodology.

Within a concept note developed within the Global Climate Change Adaptation (GCCA+) project, a collaborative project concept was formulated, proposing the idea that mangrove monitoring will be embedded in the existing structures of the multipurpose NFMS, looking not only to the MRV-component but also the biodiversity and ecosystem services. By building on these structures, and further strengthening them, information can be collected and monitored in the future in a more harmonized way.

[68] FIRMS alerts signup page: https://earthdata.nasa.gov/data/near-real-time-data/firms/fire-email-alerts

Accessibility of solid information on the extent of mangrove forests, their ecosystem services and biodiversity will be key in further development and implementation of relevant policies such as the Mangrove Strategy.

3.5.5 Action Plan for other monitoring functions

Monitoring functions		Who?	AWP 2016	Up to 2018	After 2018
C-MRV					
1	Create awareness and strengthen capacity on C-MRV	NIMOS Min RO TBI SBB RAC NGOs	Develop Training and Guidance Plan for the REDD+ Assistants Collective; Have training with RAC in the principles of NFMS and C-MRV; Work with RAC on national maps created for their areas.	Support exchange between communities (national and international); Create communication material on C-MRV; Support capacity strengthening on C-MRV.	
2	Work on methodologies to carry out C-MRV	Min RO Min RGB ACT Communities BBS TBI SBB CELOS VIDS VSG WWF RAC University of Utrecht	Carry out the UTSN project in collaboration with ACT, BBS, SBB, CELOS in Kwamalasamutu	Keep on supporting initiatives that can help to shape C-MRV in e.g.: Select pilot communities; Improve the methodologies; Establish some data-sharing agreements;	C-MRV is embedded in the NFMS.
Near Real Time Monitoring					

3	Test the possibilities of using satellite images for NRTM	SBB CELOS ADEKUS	Test with Sentinel 1 & 2 images if they can be used for NRTM for logging, gold mining		
4	Implement an NRTM system	SBB Min RGB Min NH OGS GMD	Establish a NRTM for logging Identify the possibilities for NRTM system for mining	Continue to carry out NRTM for logging Establish an NRTM for protected areas, mining, mangrove (where necessary)	
Fire monitoring					
5	Keep track of the fire alerts to monitor the general trends	SBB	Link FIRMs data to the geoportal Keep track of annual number of fires and geographical distribution	Keep track of annual number of fires and geographical distribution	Keep track of annual number of fires and geographical distribution
Mangrove monitoring					
6	Create a platform to share information on mangrove forest	Min RGB Min LVV SBB CELOS NIMOS ADEKUS BBS NZCS Experts NGOs Others	Establish mangrove section on NFMS portal	Keep updated the information on mangrove forest on platform Strengthen the online platform for involvement of civil society in monitoring by using mobile data collection tools	Keep on updating the information on mangrove forest on the platform
7	Monitoring the extent of the mangrove forest and/or land		Monitor the dynamic coastline from 1985-2015	Establish a methodology to monitor mangrove forest using RS	Regular (to be agreed) monitoring of mangrove forest

	use changes in the coastal area			Ground truthing campaign to verify the Methodology Carry out historical assessment of the changes in the mangrove forests using RS and produce report	
8	Execution of the National Forest Inventory in the mangrove forest		Reach an agreement on the objectives and variables of the NFI within the mangrove forest Establish the sampling plan for the mangroves	Adjust field protocols for mangrove forest Carry out field work in the NFI plots in the mangrove stratum (estimated #:30) Process botanical and soil samples in the laboratory	Publish results of the full NFI in the mangrove stratum.
9	Include mangrove forests in the NRTM	Min RGB SBB		Establish and implement Near Real Time Monitoring System in the Mangrove area (monthly alerts)	

3.6 NFMS contribution to international and national reporting

As explained in earlier chapters, one of the central functions of the NFMS is to support Suriname's international and national reporting by providing reliable and up-to-date data and information related to forests and land use change, as required by multilateral environmental agreements and similar. The NFMS needs to be set up in such a way that it facilitates the necessary reporting, ensuring that the relevant data is produced with the time intervals needed, and that all capacities are in place for compiling and submitting the reports. For example, the United Nations Framework Convention on Climate Change (UNFCCC) needs information from the NFMS as input to GHG inventories, which include reporting on REDD+ results, and for FREL/FRL development for REDD+. The NFMS can also contribute to improved reporting to the Forest Resources Assessment (FRA) of the FAO, etc.

3.6.1 GHG inventory reporting for the UNFCCC

Suriname ratified the UNFCCC on 14 October 1997 and is required, like other parties of the Convention, to report on their implementation of the UNFCCC through regular GHG inventories. A GHG inventory estimates and reports anthropogenic emissions and removals of greenhouse gases (GHG) from all sectors in the country. As mentioned before, the basic equation for estimating GHG emissions from land use related activities is to multiply activity data (AD) with emission factors (EF). In addition to activity data on land use and land use change (supplied by the SLMS) and data on forest carbon stocks, carbon stock changes and emission factors (provided by the NFI), specific measures of emissions and removals of GHG as well as uncertainty estimates are compiled in the GHG inventory. In terms of REDD+, the GHG inventory will be the key tool to assess whether the implementation of REDD+ activities produces measurable climate change mitigation.

Reporting requirements for the UNFCCC differ between developed and developing countries. Developing countries can submit national GHG inventories, including land use data, forest related data and results of REDD+, to the UNFCCC in national communications (NC) and biennial update reports (BUR). For preparing the GHG inventory, developing countries are required to use guidelines developed by the Intergovernmental Panel on Climate Change (IPCC). UNFCCC decisions refer to the Revised IPCC Guidelines from 1996, while it is also encouraged to use the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (GPG 2000) (IPCC, 2000), the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry (GPG-LULUCF) (IPCC, 2003), and the IPCC 2006 Guidelines for National Greenhouse Gas Inventories (IPCC, 2006). Internationally accepted quality criteria are set out in these guidelines. According to these, national GHG inventories must be transparent, complete, consistent, comparable and accurate:

- Transparent: There must be sufficient and clear documentation to understand how the inventory was compiled and to confirm the quality of the data;
- Complete: Estimates should be reported for all relevant activities and gases (where data are missing, their absence should be clearly documented);
- Consistent: Estimates for different inventory years, gases and categories should be made in such a way that differences in the results between years and activities reflect real differences in emissions;
- Comparable: The GHG inventory should be reported in a way that allows it to be compared with GHG inventories from other countries; and

• Accurate: The GHG inventory should contain neither over- nor under-estimates, so far as can be judged, and uncertainties are reduced as much as possible (e.g. undertaking all efforts to remove bias from the inventory estimates).

3.6.2 National Communications and Biennial Update Reports

Developing country parties to the UNFCCC are required to submit a National Communication (NC) every four years.[69] These reports should include the following information:

- National circumstances
- Vulnerability assessment
- Financial resources and technology transfer for climate change
- Education, training, public awareness
- National GHG inventory.

Suriname submitted its first NC with a GHG inventory to the UNFCCC in 2006.[70] A second NC was prepared for the period 2008-2012, and formally submitted to the UNFCCC and placed on their website in 2016 in 2016.[71]

In 2012, COP-17 took the decision to make developing countries report to the UNFCCC more frequently, by introducing the requirement for Biennial Update Reports (BUR). The first BUR was to be submitted by December 2014 and every two years thereafter. Flexibility is given to Small Island Developing States (SIDS) to which Suriname is counted, and to Least developed countries (LDCs), who may submit the BURs at their own discretion. In the years that the NC is submitted, the BUR could be a summary of parts of the NC, while in the years in between, the BUR should be a stand-alone update report. The aim is to provide a recent update in the following areas:

- National circumstances and institutional arrangements
- National GHG inventory
- Mitigation actions and their effects, including methodologies
- Constraints and gaps and related financial, technical and capacity needs
- Level of support received to prepare and submit the BUR
- Domestic measurement, reporting and verification.

If countries want to access REDD+ finance, the BUR may contain a Technical Annex based on results from the implementation of REDD+ activities.

Suriname has not yet submitted a BUR. The first comprehensive GHG inventory report of Suriname for the REDD+ purpose is planned to be performed in 2018. It might be included in the 3rd National Communication if relevant institutions are ready for that.

3.6.3 FREL/FRL

Countries that wish to participate in REDD+ need to submit a Forest Reference (Emissions) Level (FREL/FRL). The UNFCCC Conference of the Parties has issued three decisions that provide guidance on the development of a FREL/FRL in line with international requirements and national circumstances. The REDD+ Project Document for the FCPF readiness grant establishes that SBB is responsible for the FREL/FRL

[69] http://unfccc.int/national_reports/non-annex_i_natcom/items/2716.php
[70] http://unfccc.int/resource/docs/natc/surnc1.pdf
[71] http://unfccc.int/national_reports/non-annex_i_natcom/submitted_natcom/items/653.php

preparation for Suriname and that it will be done in a step-wise approach. The process includes updating of the national forest definition and the gathering and analysing of historical activity data and available emission factors data. In order to guide the preparation of a suitable FREL/FRL, an assessment of national circumstances for Suriname as a country with high forest cover and low deforestation (HFLD) is also needed. Technically, the data needed for the FREL/FRL has been generated for Suriname and compiled in 2016 with support from the emerging NFMS.

Before the FREL/FRL can be submitted to the UNFCCC, it needs to be coupled with political guidance and strategic national decisions backed by the government and national stakeholders. A process to link the technical aspects of the FREL/FRL with political aspects will be carried out in 2017, and official submission to the UNFCCC is scheduled for January 2018.

3.6.4 Forest Resources Assessment of FAO

The Committee on Forestry of the Food and Agriculture Organization (FAO) has adopted a long-term strategy for *"supporting sustainable forest management through the global forest resources assessment"* 2012-2030.[72] The strategy includes to carry out an assessment of forest resources (including information on the goods and services provided by forests) on a global basis every five years and to estimate the changes in forests and their uses that have taken place since the previous assessment. The FAO has been working on worldwide assessments of forest since the 1940s with increasing quality over time. The methodology for the Global Forest Resources Assessment (FRA) includes that each country is responsible for submitting data and information about their own forest resources by responding to a standardized questionnaire provided and explained by the FAO. Suriname has participated in previous FRAs and most recently the SBB (Dept. of Forestry Economics and Dept. of R&D) submitted data in 2013 for the FRA 2015. Preparations for the FRA 2020 are expected to start in 2018.

3.6.5 Contribution to national reporting

Besides for international reporting, the data generated by the NFMS is also used for national reporting.Two reports that the NFMS is currently providing input to are:

- The environmental statistics which are published every two years (and shared through the online platform www.devinfo.org)
- The forestry sector analysis which are published every year by the department of Forestry Economies of the SBB and shared through the website www.sbbsur.com.

It is important that the numbers published for national and international purposes are consistent at all times.

[72] http://foris.fao.org/static/data/fra2010/FRALongTermStrategy_En.pdf

3.6.6 Action plan for NFMS contribution to international reporting

Reporting		Who?	AWP 2016	Up to 2018	After 2018
1	FREL/FRL	SBB, NIMOS, CabPres, others	SBB prepare technical data and information for the FREL/FRL	Link technical aspects with political choices for a complete and nationally accepted FREL/FRL, to submit to UNFCCC in January 2018	Prepare and submit an improved FREL/FRL
2	REDD+ reporting/ LULUCF data for GHG inventory	SBB, NIMOS, CabPres, working group or new unit	Explore concepts and plan in the NFMS roadmap	Raise awareness of reporting needs, formalize institutional arrangements, prepare data for next reporting period	NFMS contribute regularly with reliable and up-to-date data with relevant intervals for reporting
3	Other international reporting (FRA and similar)	SBB and others as relevant	Explore concepts and plan in the NFMS roadmap	Identify needs and prepare data for next reporting period	NFMS provide data and reports as needed for all relevant international reporting
4	National reporting	ABS SBB	Continue to provide input for the yearly forestry sector analysis and the biannual environmental statistics		

4. CAPACITY STRENGTHENING PLAN AND ENGAGEMENT STRATEGY

In order to make the NFMS fully functional, there is need to strengthen institutional capacity, human resources, technical, financial and logistic, equipment and software capacity. The relevant stakeholders need to be engaged in all different activities and processes of the NFMS. Chapter four includes a capacity strengthening plan and an engagement strategy.

4.1 Capacity strengthening plan

To achieve a fully functional NFMS, there is need to strengthen many aspects of capacity including institutional, human resources, technical, etc.

4.1.1. Institutional capacity

Existing capacities	Capacity gaps	Planned Capacity strengthening
• Existing regional and global technical network (ACTO, Guiana Shield, UN-REDD, CFRN, FAO) • REDD+ coordination unit • NFMS-coordination unit • GHG-focal point	• No assurance yet of a next regional project • Clear overview of crosscutting topics (between pillars) REDD+ steering committee • Not formally embedded in GOS/SBB's structures NFMS-working group(s) • GHG-reporting unit	• Support the development of regional NFMS-related projects, active networking with partner organizations • Participate in REDD+ management meetings, support national REDD+ program • Assess the possibilities to establish a WG(s) • Meeting(s) with CabPres and NIMOS
• Coordination point for implementation of the NFI • MOU with CELOS for research program • Good collaboration with partner institutions, NGOs and private sector for NFMS/NFI	• Clear internal structures and capacity needed • Scientific coordination of the NFMS/NFI • No formal agreements yet with all involved partners	• Propose suitable structures • Meeting(s) on the role of CELOS/Adekus to result in a stronger scientific coordination • Develop MOU's or partnership agreements

● FCMU is installed and can technically coordinate the SLMS ● Great interest from the institutions to play an active role in the SLMS ● Lots of data is available	● FCMU is not formally embedded in GOS/ SBB structure Need for a strategical coordination point for the SLMS ● No formal structure for the SLMS and the way how it will feed into National Development Planning ● Little data is formal and standardization is sometimes missing	● Institutionalization of the FCMU in the SBB (GoS) Identify strategical coordination point ● Discuss with strategical coordination point and institutions how to formalize a SLMS structure ● Establish working groups on specific topics (e.g. hydrography, settlements). Establish data sharing agreements

4.1.2 Human Resource capacity

Number of staff at the different units

Existing capacities	Capacity gaps	Planned capacity strengthening
• NFMS unit (~ the Directorate of R&D at SBB) with knowledge about REDD+, MRV, SLMS, RS/GIS, NFI, dbase management,	• Fundraising expert Administrative support Communication expert Field teams dedicated to NFMS Specific Experts Senior technical experts	• Strengthen collaboration with REDD+ Strengthen embedding in SBB-structures Strengthen international and national collaborations Continue to organize tailor made trainings, exchange, work with backstopping experts
• Strong GIS/RS experts at a number of partner institutions	• Different levels of GIS/RS at partner institutions involved in the SLMS	• Active involvement of partner institutions within the work of FCMU and external trainings, to support knowledge transfer. Carry out joint mapping activities.
• Broad knowledge of forest and forest inventory related topics at SBB and partner institutions • Great interest with the RAC and good capacity with the ACR	• Limited knowledge on IPCC-guidelines and NFMS/MRV related topics within SBB and some partner institutions • Limited knowledge about REDD+, C-MRV and NFMS in the communities	• Organize tailor made trainings and involve a broader group in the NFMS-decision making process • Build on the existing capacity and support capacity building activities at the communities and with the RAC
• Strong capacity and great interest with the FSC-certified companies	• Limited capacity and involvement of other logging companies	• Organize training related to REDD+ and SFM for the forestry sector. Promote exchange and capacity transfer
• Students are interested and engaged in the NFMS program.	• NFMS/ REDD+ is not sufficiently included in the curricula	• Establish collaboration and structural dialogue with educational institutions Stimulate scholarship opportunities for specific

• Students are graduating on NFMS related topics	• Structural commitment to provide the necessary guidance	topics • Collaboration with ADEKUS/ CELOS/ SBB/BBS/ NGO's/ private sector

4.1.3 Technical capacity

Technical capacity for the NFMS is needed for its four components (land monitoring, field-based forest inventory, the national GHG inventory, and reference-level setting). Technical capacities include the skills of the individuals involved in the components of the NFMS. The availability of appropriate equipment is also relevant. Technical capacity is to be understood to also cover the ability to develop, analyze, and manage data in a sound, scientifically rigorous manner, particularly with a view on the time series that the NFMS requires for reference level setting.

1) Existing data

Existing capacities	Capacity gaps	Capacity strengthening plan
• Baseline forest inventory dataset	• No completed NFI cycle • Tree species list not up-to-data	• Implement NFMS-roadmap
• Forest/ land cover/use (change) maps	• Official national geodata	• Continue to collaborate with the relevant institutions
• RS-data archive with free images and some commercial images	• Valuable old maps only in hardcopy	• Facilitate digitizing hardcopy maps
• Spatially explicit timber production data	• Not fully integrated yet with NFMS	• Look for synergies with SFM-promotion and FLEGT related activities. Harmonize data flows

2) Archiving system

Existing capacities	Capacity gaps	Capacity strengthening plan
• Professional hardware (NAS and servers) at SBB-office	• No sufficient safeguards and security provisions No optimal use of the existing structure	• Work with FAO (within geoportal activity) on improved structure
• National data	• Agreement to collaborate	• Meeting(s) with relevant

warehouse capable to store data following high standards • Many databases on NFMS related topics	• Poor connectivity and data exchange	company to come to an optimal solution (high priority) • Implement the geoportal in a multifunctional way.

3) QA/QC procedures

Existing capacities	Capacity gaps	Capacity strengthening plan
• Available SOP's for pilot NFI, GIS-work, FCM-work	• Not all SOP's are finalized and approved	• Work on finalization and approval of all SOP's
• Field verification takes place throughout a number of the NFMS-related activities	• Not all SOP's are complete and very solid (with clear sampling instructions)	• Improve SOP's using also international criteria
• FCM maps are made using solid SOPs	• No Accuracy Assessment has been carried out on all maps	• Implement roadmap

4.1.4 Financial sources

Existing capacities	Capacity gaps	Capacity strengthening plan
• There are a number of large ongoing projects (REDD+, GCCA+, GEF-project on gold mining, CCCD, IDB…) and funding possibilities (GCF, private sector...)	• Need for a focal point to identify the opportunities and formulate project proposals Not always a clear overview for external partners how the NFMS is related to all these activities	• Closer collaboration with UNDP/NIMOS and Ministry of Finance Team member dedicated for this task (currently the coordination unit is doing this) Improve understanding of NFMS by sharing roadmap and showing clear results and impact of these results
• Before and during the REDD+ projects many other financial sources have supported the	• Currently many of these projects are ending • Only a very limited number of	• Support possible extensions of these projects

NFMS. [73] • NFMS can reduce costs of field checks significantly and improve capturing illegal activities	staff are enrolled within the GOS-structures (sustainability not guaranteed)	• Assess the financial benefits and include at least the minimal number on GOS payroll

4.1.5 Logistic, equipment, software

Existing capacities	Capacity gaps	Capacity strengthening plan
• Laboratory facilities of CELOS • Collections present in national Herbarium	• The collections are not digitized	• Support the GBIF project proposal that will allow digitizing the collections
• Commercial and open Source software (ODK, QGIS, PostGRESQL/POSTGIS, R, TerraAmazon …)	• Uncertainty about funding for maintenance commercial software	• Establish operational systems based on open source. Get support from ESRI for non-commercial purposes
• Good central equipment for SLMS	• Uncertainty about equipment at some of the other institutions	• Integrate SLMS within the institutions structures
• Number of tablets available	• Not sufficient tablets for fully automatic information flow from the forest/ communities/ mangrove to the database	• Increase the number of tablets through different projects- replace the GPS-es with tablets

4.2 Engagement Strategy

In anticipation of the National REDD+ Engagement strategy, currently in development, a general vision on engagement related to the NFMS is sketched. As already introduced in parts accross chapter 3 describing the current situation and next steps, this section focuses on synthesizing the general engagement vision for the different components, focusing on the most advanced components SLMS and NFI. Within the crosscutting topics, an enabling environment for the NFMS is created. This is done through the formal structures, and therefore no engagement strategy is needed for these topics.

[73] ACTO-project phase 1 and phase 2 have supported the establishment of the FCMU, REDD+ for the Guiana Shield-project, KfW-project implemented by CI, funding from WWF, TBI to carry out fieldwork, collaboration within UTSN-project

To answer the ***who***, ***what***, ***when*** and ***how*** questions of involving the stakeholders in the implementation of the NFMS, the following dimensions are taken into consideration:

- NFMS components
- Stakeholder category
- Time frame
- Type of engagement

Stakeholder category

The categories as mentioned in chapter 2:

- Forest-dependent communities
- Government: Decision-making, Facilitation, Sector specific
- Civil society organizations: Umbrella organizations, NGO
- Private sector companies
- Academia
- International partners: Technical, Facilitating (finance and capacity building), Bilateral, Providers of datasets
- General public

NFMS components

- NFMS cross-cutting
- National Forest Inventory
- Satellite Land Monitoring System
- GHG inventory reporting
- Other Monitoring Functions

Time frame

Looking at the time frame and next steps, three phases are identified which correspond to the periods of REDD+ phases. The first phase (AWP 2016) mostly represents what has been done regarding engagement this past year and to date. The second phase (up to 2018) represents the end of the REDD+ readiness phase for which the design of the NFMS will be shaped. The last phase moves towards the operational phase which is envisioned after 2018.

Type of engagement

A. Information sharing
   A.1 Awareness raising (sensitizing to the topic, share information)
B. Consultation
   B.1 Strategy development (scope, formulation/design, approach)
   B.2 Information processing (technical analysis, social analysis, economic analysis)
   B.3 Validation results (presentation of results, approval with or without amendment)
C. Decision-making
   C.1 Decision-making (endorsement by multi-stakeholder bodies)
   C.2 Support (raise political awareness, lobby)

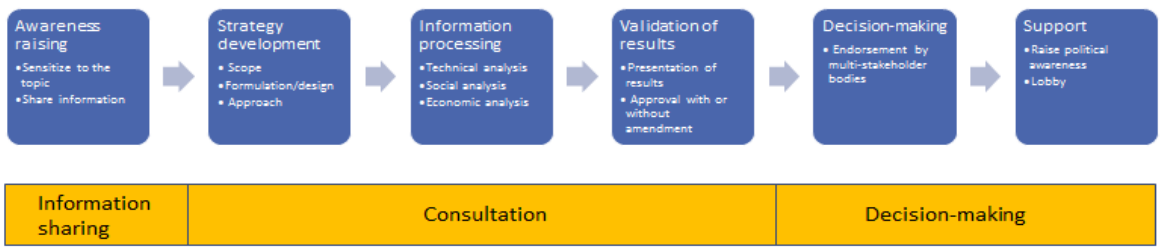

Figure 29: Types of engagement

Satellite Land Monitoring System

As basic principles, it is believed that the government should be responsible for the operational SLMS. This mean, the SLSM should be streamlined and embedded in the existing structures and institutional responsibilities. While the SBB is responsible for setting up and facilitating this process, the different sector ministries and institutions play a crucial role in developing and sustaining the system. This requires a phased approach in which SBB takes the lead, but involves these stakeholders (land-use specific sectors) gradually until the system as collaboratively designed is fully functional. The government facilitating institutes are identified to either be involved in sustaining the system, or facilitating the engagement of other stakeholders. Therefore, they will be informed to the level that the message can be amplified. The government decision-making group has been introduced to the topic as well as the proposed plans and design. In the coming phase, they will continue to be involved in exchanging results and giving guidance, which will result in lobbying and creating support for the use at the broader platform.

The forest-dependent communities are a primary stakeholder in REDD+, and the NFMS. The aim is to have an inclusive approach, taking into account their vision. Therefore the engagement strategy is to first focus on information sharing, allowing the forest-dependent communities to be informed and be able to decide how they envision their role in the SLMS and how the engagement should be developed from there on.

The private sector has not been engaged in a structural way for the SLMS so far. Much of the engagement was based upon request, case by case. The aim is to keep the private sector informed about the development and functionality of the SLMS, so they can in a later stage be involved in the validation of results and make full use of the SLMS in their operations and planning.

Academia have been informed and involved along the way, preparing their specific involvement in the validation of results in a later stage.

Stakeholder category	AWP 2016	Up to 2018	From 2018
Forest-dependent communities	Information sharing (sensitize to topic), Consultation (validation results)	Information sharing, depending on their vision	Information sharing, depending on their vision
Government – decision making	Information sharing (sensitizing to topic)	Information sharing (sensitizing to topic), consultation (strategy development), decision-making	Information sharing, decision-making (support)
Government – facilitation	Information sharing (sensitizing to topic)	Consultation (strategy development), decision-making	Consultation (information processing)

Government – sector specific	Information sharing, consultation (strategy development, information processing, validation results)	Consultation (strategy development, information processing, validation results)	Consultation (information processing, validation results)
Government – other	Information sharing	Information sharing, decision-making (support)	Decision-making (support)
Civil society organizations	Information sharing	Information sharing, Validation results, decision-making (+support)	Information sharing, validation results, decision-making (support)
Private sector companies	X (non-structural/incidental information sharing) *based on request/demand driven*	Consultation (validation results) *Case/area/company specific*	Consultation (validation results) *Case/area/company specific*
Academia	Information sharing, consultation (strategy development) *Develop methodology, research*	Information sharing, consultation (information processing, validation results) *Pilot research*	Information sharing, consultation (information processing, validation results) *Process methodology*
International partners	Consultation (strategy development)	Consultation (validation results)	Decision-making (support)
General public	Information sharing	Information sharing	Information sharing, consultation (validation results), decision-making (support) *Case/area specific*

National Forest Inventory

In the development of the NFI, the engagement vision differs slightly compared to the SLMS. The SLMS is also further in the development, which requires a different approach. The focus weighs less on the group of government institutions to develop and set-up the NFI. Where SBB formed a core group with the sector specific government institutions for the SLMS in line with their responsibilities, in the development of the NFI the SBB has the main responsibility and the academia, private sector and civil society are and will be more involved in the earlier stages as part of the core group. In the first phase their involvement will be in the development of the protocols.

The civil society organizations will provide technical support, as well as provide a platform for including the civil society.

Stakeholder category	AWP 2016	Up to 2018	From 2018
Forest-dependent communities	Information sharing (sensitize to topic), Consultation (validation results)	Information sharing, depending on their vision	Information sharing, depending on their vision
Government – decision making	Information sharing (sensitizing to topic)	Information sharing (sensitizing to topic), consultation (strategy development), decision-making	Information sharing, decision-making (support)
Government – facilitation	Information sharing (sensitizing to topic)	Information sharing, Consultation (strategy development)	Information sharing, Consultation (information processing)
Government – sector specific	Information sharing, consultation (strategy development, information processing, validation results)	Consultation (strategy development, information processing, validation results)	Consultation (information processing, validation results)
Civil society organizations	Information sharing, consultation (strategy development)	Information sharing, Validation results, decision-making (+support)	Information sharing, validation results, decision-making (support)

Private sector companies	Information sharing, consultation (strategy development)	Consultation (strategy development, validation results) *Case/area/company specific*	Consultation (validation results) *Case/area/company specific*
Academia	Information sharing, consultation (strategy development) *Develop protocol, research*	Information sharing, consultation (strategy development, information processing) *Develop protocol, research*	Information sharing, consultation (information processing, validation results) *Implement protocol*
International partners	Consultation (strategy development)	Consultation (strategy development)	Decision-making (support)
General public	Information sharing	Information sharing	Information sharing, consultation (validation results), decision-making (support) *Case/area specific*

5. CONCLUSIONS

This document summarized the status and plans of the NFMS. It is a living document that will change and be updated over time, since what it is describing is not static. The NFMS is currently under development, and as with all systems, it needs to be adaptive to its changing circumstances in order to take off and thrive. If the NFMS is supported with political will and means of implementation, it can be very important for the future of Suriname.

Annex 1: Overview of meetings held with stakeholders

Stakeholders	Date
Meetings with Governmental institutions	
Ministry of Natural Resources (NH)	Jan 28, Feb 24
Ministry of Physical Planning, Land and Forestry (RGB)	Jan 22, Nov 8
Meeting with DRR-members	Jan 13
Ministry of Foreign Affairs (BUZA)	May 18
Ministry of Trade & Industry (HI)	Jun 1
Ministry of Regional Development (RO)	Jun 9
Ministry of Public Works (OW)	Sep 20
MI-GLIS	Sep 28, Oct 14
Meetings with research institutions and academia	
CELOS	Feb 3, Mar 15, Aug 15, Oct 14
Coordinator of MSc. of SMNR	Jan 15
NZCS	May 25
National Herbarium	Jun 24, Aug 23, Sep 28
University of Utrecht	Aug 16
University of Florida	Aug 19
University of Hamburg	Jul 27
Meetings with NGOs	
Tropenbos International	Jan 13, Jun 24
Amazon Conservation Team	Mar 11, Apr 14
WWF	Apr 5, May 17, Aug 16
Conservation International Suriname	
Meetings with private sector	

Greenheart Suriname	Feb 24, Oct 21, ..
Dennebos Suriname	Apr 14, ...
CM Engineering	Apr 4
Meetings with local communities (on NFMS)	
Krutu Galibi	May 26-27
Krutu Kwamalasamutu	Sep 17-19
Work sessions	
Work session to present the AWP 2016 to ministries and NGOs	Jan 8
Seminar on Land Monitoring system	Mar 4
Seminar on Forest Inventory	Mar 10
LULC map- session with stakeholders	Apr 8, 15, 22, Nov 15, 23
Launch workshop LULC-map	Aug 3
Workshop on National Forest inventory	Aug 31-Sept 1
Work session with RAC in Berg & Dal	Jul 22-23

Annex 2: Terms of Reference for the establishment of the geoportal

Context

Suriname is currently in its REDD+ Readiness phase, which means that the institutional frameworks are being strengthened, human capacity is built and the REDD+ National Strategy is being developed. 2016 will be a crucial year within this Readiness phase, with the submission of the first FRL/FREL for Suriname to the UNFCCC by December as one of the main milestones. One important component of the REDD+ Readiness process, is the development of a National Forest Monitoring System (NFMS).

To establish an NFMS, there is need for data collection related to forest cover changes and forest carbon stocks. While the forest in Suriname is difficult to access, many resources have been allocated in past and recent years to the collection of data about this valuable natural ecosystem. During stakeholder meetings and workshops, the need for bringing together all national forest-related data in the broadest sense, and to make them accessible for users, has been brought up at several occasions. Within the development of the NFMS, the availability and accessibility of solid and up-to-date forest related information is considered crucial for effective participatory approaches and collaborative decision making.

While the National Institute for Environment and Development in Suriname (NIMOS) is in charge of the overall coordination of the national REDD+ program in Suriname, the Foundation for Forest Management and Production Control (SBB) is responsible for the FRL/FREL and the design of the NFMS. To strengthen the national collaboration, and to guarantee an efficient and adequate establishment of the NFMS, SBB is planning to lead the process of centralizing all forest related data, in a close collaboration with all relevant stakeholders.

Within this process, an open source database will be created, allowing stakeholders to add in their data. The data will be accessible for the broad public through a NFMS-geoportal, allowing for some restricted access internally to some more sensitive data. The database will have a multi-user approach with management of the related roles.

Overview of existing database systems

To guarantee its efficiency and usefulness, the geoportal and its related database will be built in a way that the existing systems used at SBB or relevant systems used by other partner organizations are strengthened or embedded where possible. Ideally an all-inclusive centralized national forest information database will be the source for the geoportal.

This table provides an overview of the currently operational systems, and the future planned activities within SBB related to data collection, management and dissemination:

Type of data	Data collection	Data management	Data dissemination	Next steps
Timber production data	Hardcopy-all digitized in SBB HQ	MySQL database LogPro-MIS	Some integrated reports Mostly reports created in Microsoft	Mobile data collection using tablets, Online submission of information by private sector and dissemination by SBB Integration with geographic data
Geographic data related to timber production	GPS Digitized maps International layers	ESRI personal geodatabase	On request maps	Online platform allowing SBB staff to access the field data through mobile or online solutions (so they can make their own reports) Online platform for selected stakeholders to improve overall forest management
Forest cover maps and satellite images	Online Through image processing protocols	PostGreSQL accessed through TerraAmazon	Through on request maps	Online geoportal for everyone
Preharvest forest inventory (checks)	Mobile data collection with ODK	PostGreSQL	Automatically generated reports in Java connecting the PostGreSQL and the LogPro databases	Further developing the implementation of ODK
Forest inventory data (PSPs etc)	Hardcopy	MsAccess databases InfoStat (idb2)	Through reports	Make information available online for broad or selected public

				Include data in PostGreSQL/ PostGIS database Develop mobile data collection tool (using ODK)

Besides SBB, other institutions in Suriname acknowledge the need for sharing information, especially information related to more basic data sets. Additionally, no national spatial data infrastructure has been implemented yet. This results in multiple versions of incomplete basic spatial data sets.

Nevertheless, a number of stakeholders are actively taking the initiative to improve this. While this list will be further developed in collaboration with other institutions and stakeholders, a number of interesting related activities can already be identified:

· MI-GLIS is using Enterprise ArcGIS and sharing geographic information online
· MI-GLIS and N.V. GISSAT launched an online ArcGIS platform “Suriname Online”.
· ACT-Suriname is also developing and implementing ODK-solutions for data collection by the Indigenous Park Guards in the field using tablets
· CI-Suriname and ACT-Suriname are collaborating with Global Forest Watch
· The Ministry of Natural Resources is currently exploring the possibility to implement Tremarctos
· SBB, MI-GLIS, CBB and the Ministry of Public Works are currently working together on the development of a National Street Layer
· Other relevant activities will be listed when starting this activity.

Beside these more recent activities, lots of information was collected about the forest, soils, land cover etc. This information is currently archived in extensive hardcopy archives, and to make sure they are conserved for the future, and can be used as a starting point for the NFMS, there is an urgent need for these to be digitized. Within the ACTO-project *Monitoring the Forest Cover in the Amazon Region* a large scanner was obtained, and this scanner will be used to digitize the existing archive. The resulting image files could become part of the NFMS-database, allowing for all relevant stakeholders to be able to access them.

Proposed principles for data management within the NFMS

The following principles are proposed for data management within the National Forest Monitoring System (NFMS) in Suriname:

· Existing national and international databases should be centralized and harmonized where possible.

· Open-source software: To reduce the risks on a long term availability of funding, the NFMS database will be developed based on Open Source solutions. Currently a PostGreSQL/PostGIS, with Open Layers and Geoserver solution is envisioned.

· Physical storage Security: To assure the general security of this national database, it might be recommendable to store it in an appropriate location (cool, fireproof, theft-proof). Options should be reviewed. Also a secure backup procedure needs to be developed. The option to store the database in the cloud will be seriously reviewed, including an assessment of the internet connectivity.

· Cyber Security: The data needs to be protected from any local or foreign aggressor, person with malicious intent, or malicious software seeking to destroy, manipulate, alter, or remove any data from any given data set. These threats can be minimized by constructing a legally binding and robust end user license agreement (EULA), and setting up secure cyber security protocols. These matters need to be consulted by both the judiciary and cyber crime experts.

· Data standardization: SBB will work, with guidance of MI-GLIS and in collaboration with other institutions, on the development of data (formats), topology, projection and metadata standards to allow for an easy exchange of information.

· Documentations: Protocols used to develop the NFMS data will be documented and published.

· Data Sharing Policy: To stimulate effective use of the data, and to protect ownership of the data, it is important to contribute to a sound data sharing policy. Nevertheless, it is important to distinguish between data to be shared with the broader public and Personally Identifiable Information (PII) such as information providing insight in the strategic management of a private company. Data sharing policies will define how and where data will be stored, including access procedures, embargo periods (if any), and technical mechanisms for dissemination and exchange formats. In case some parts of the data set cannot be shared, the reasons for this should be mentioned (e.g. ethical, rules of personal data, intellectual property, and commercial, privacy-related, security-related). It is dependent on national legislation, strategies and policies which data sets to make publicly accessible, and for which data sets to define a more restricted access.

Output of these Terms of Reference

The desired output of this collaboration is a national satellite forest monitoring system web portal in Suriname hosting the relevant forest related (including REDD+) datasets, based on free and open source software, operationalized and managed by SBB that will ensure continued update and maintenance.

The system will include:

· A dissemination portal where time dependent data can be visualized and basic statistics and reports can be obtained, this dissemination portal will also be accessible through mobile devices to improve the data accessibility in the field;

· An administrative portal where the administrators prepare and publish the data that is available in the dissemination portal. This preparation includes data preprocessing to improve visualization performance, precomputing statistics and other results related to the data loaded in the system for better performance and scaling.

The system will make use of well-known open source projects, such as GeoServer and OpenLayers, as well as of OGC standards in order to guarantee the technological independence of the users that deploy the system and seamless interoperability with other systems. It will be possible to make a clones of the database on national servers, allowing the geoportal to be accessible even when limited internet is available.

Approach

A step-wise approach with five stages will be used for implementation of these Terms of Reference. LTO is Dr. Inge Jonckheere at FAO HQ, while LTU is the FAO Forestry Department.

Stage 1

Geographical data, that might be available from the local institutions, national bodies, external partners like WRI, or globally (Global Forest Watch), is gathered by FAO HQ RS and webportal group in collaboration with the national GIS and remote sensing counterparts. This will build upon the systems and datasets shared in the section "*Overview of existing database systems"* of this ToR.

A demo version of the web portal will be built with the data gathered, for presentation purposes and as a base for discussions and developments.

Stage 2

The portal is presented to local institutions and technical partners. A mission of a FAO IT expert is foreseen for the purpose. The demo portal is meant as a basis for discussions to decide what data to show and what missing features to implement: statistics, missing data, custom non-geographical data to be published, etc.

During this first training workshop, the following activities will be carried out:
- Running and installing the Training Machine
- Training Machine Architecture
- Training about basic system administrator's tasks
- Explanation about the raster data optimization (overview and retiles)
- Overview of main GeoServer concepts: stores, layers, styles
- General overview of zonal stats system

Stage 3

The portal is improved through a technical collaboration between the team of developers and the local GIS, remote sensing, and IT experts, in collaboration with decision makers from local institutions. This step can be done remotely between SBB and FAO, through email exchanges and live discussions on Skype. At the end of this stage, all necessary elements will be ready to carry out the training of experts at national level for the definite portal.

Stage 4

Capacity building: the local IT, GIS and remote sensing experts are trained on the usage, update, and maintenance of the portal. At least one mission of an expert from FAO HQ should be foreseen. Depending on the local capacity and availability of local experts, additional missions could be needed.

During the second workshop, the following activities will be carried out:
- Support local system administrator for the installation and tuning of the system
- Advanced training about development of new features of the portal to local software engineer
- Advanced training about statistic utility and geospatial data management to local GIS specialists

Stage 5

The portal is published and launched officially in-country. Set-up of the local server is foreseen as well.

Proposed outputs and calendar

The stepwise approach described above will be implemented over a 4 months' period:

Outputs and deliverables	Due by	Payment tranches
1. Letter of Agreement signed with UN-REDD RS group FAO HQ	August 5st, 2016	
2. Detailed work plan proposed by UN-REDD and reviewed and approved by SBB	August 31st, 2016	10 %
3. Building of demo version of portal and presentation of this portal to local counterparts- in country mission. Report of the mission with overview of all recommendations received approved by SBB.	September 15th, 2016	25%
4. Improved portal based on comments received	October 31st, 2016	
5. National experts trained in the system administration of the geoportal during in-country visit.	November 15th,2016	25%
6. Decision on the hosting of the system: option (a) UN-REDD continues to host server or (b) migration of the server to a country solution.	November 30th 2016	Not Applicable
7. Official launch of the geoportal in country during a workshop, accompanied by an extensive documentation of the system.	November 30th,2016	40%

Proposed technical considerations

The backend of the proposed SLMS system is developed in Java, so it can be run on top of different operating systems. Nevertheless, Ubuntu 12.04 LTS Linux distributions is recommended.

There are three possible scenarios for the installation:

- Installation of the two subsystems (staging and dissemination) in the same machine: normally for trainings.
- Installation of staging and dissemination in two different machines: typically in production environments, but not always required.
- Installation of the simplified architecture without a staging area, thus without the possibility to review the data before publishing it, but less demanding in terms of maintenance and hardware resources.
- First, the principle requirement is that the systems run on intel based processors. In addition, the possibility, application, and feasibility of GPU computing to effectively increase vector computations and raster drawing should be taken into account.

Considering the target group of at least 20 users per day and leading up to 100 users at peak hours, the following requirements are proposed to run the geoserver. However, the server housing these specifications should be expandable and upgradable the other option that will be reviewed, as mentioned earlier, is the possibility to use a cloud storage solution. The overall purpose of the server is to be future proof.

a) Staging area

The staging area will run at least the following applications:

· Preprocessing utilities, requiring ~2 GB RAM.
· GeoServer, requiring ~1 GB RAM.
· Administrator and dissemination portals, with default memory requirements (128 MB).
· PostgreSQL, ~512MB RAM

In addition, memory will be needed by the Operating System and other running services. A minimum of 8 GB of RAM is recommended.
Ingestion and preprocessing of layers are specially demanding in terms of computational power.
Disk requirements depend mainly on the amount of data being ingested and managed.

b) Dissemination area

The dissemination area will run at least the following applications:

· GeoServer, requiring 2 GB RAM.
· Portal, with default memory requirements (128 MB).
· PostgreSQL, ~512MB RAM

In addition, memory will be needed by the Operating System and other running services. A minimum of 6 GB of RAM is recommended.

Disk requirements depend mainly on the amount of raster data being published in GeoServer, and on the size of the tile cache. Furthermore, it is recommended that to ensure longevity of the disk functionality, that the options for choosing the optimal storage device should be reviewed in depth. The optimal storage device should consider load capacity, disk usage and read and write speeds. Furthermore, installing the hard drives in RAID configuration will double the costs but improve I/O and provide assurance in case of potential fatal disk failure.

c) Software requirements

The system needs some base applications: Oracle JDK 7, Tomcat 7, Apache 2, PostGIS 2.0 on PostgreSQL 9.1 and GDAL Toolkit. All these will be installed during the second mission to the country.

d) UN-REDD virtual server hosting

As a temporary solution, until the local institutions have chosen their hosting service, the UN-REDD virtual server can be used. It's based on the EXSi virtualization infrastructure and allows to easily deploy virtual machines that have been for example prepared on a desktop computer. Local system administrators will be given full access to the virtual machine at the operating system level, while FAO REDD will be in charge of managing the virtual machine and the ESXi hypervisor.

e) Backup

A backup and restore procedure should be established. Backup schedule depends on the frequency of data updates. The whole configuration of the portal is stored on the /var/ directory, so it's sufficient to back up its content. The system can be then fully restored by performing a full installation and restoring the /var/portal, var/diss_geoserver, etc. directories. A backup strategy can be discussed among the FAO REDD IT and local experts.