Terms of Reference

MONITORING THE IMPACT OF GOLD MINING ON THE FOREST COVER AND FRESHWATER AT THE GUIANA SHIELD REGIONAL SCALE

REDD+ for the Guiana Shield

Regional technical collaboration project

in cooperation with WWF GUIANAS

Context

REDD+ for the Guiana Shield[1] is a regional technical collaboration project that involves forestry services of French Guiana, Guyana, Suriname and the state of Amapá in Brazil in experience sharing and skills enhancement for REDD+ implementation, forest inventory and carbon stock assessment, forest cover monitoring, understanding of drivers of deforestation, modeling of future deforestation, land-use planning and related topics. The project is implemented by Office National des Forêts (ONF) and ONF International (ONFI) and is funded by FFEM, INTERREG and Région Guyane.

WWF Guianas acts as observer in the *REDD+ for the Guiana Shield* Steering Committee, motivated by their experience in working from a regional perspective in the Guiana Shield on topics such as forests, climate change and drivers of environmental change. An example of this is a regional study that was funded by WWF Guianas and performed by ONF Guyane in 2008/2009 on monitoring gold mining impact in the Guiana Shield forests and watersheds. The results are published in a report from 2010 entitled "*Impact de l'activité aurifère sur le plateau des Guyanes*".

In June 2014, WWF Guianas launched a request for proposal for a new study of gold mining activities in the region, to update the understanding of new developments since the last monitoring efforts. This research topic is relevant also for the objectives of *REDD+ for the Guiana Shield.* Discussions were initiated to explore opportunities for collaboration, including in the 3rd Steering Committee (SC) meeting of *REDD+ for the Guiana Shield* held in Cayenne in early June 2014. SC members encouraged the project team to keep discussing with WWF Guianas, seeking synergies in terms of possible integration of the mining study within the *REDD+ for the Guiana Shield* project. Any suggested way forward would be drafted in the form of Terms of Reference (ToR) and be shared via e-mail with the Steering Committee members, seeking approval to start implementation before the next SC meeting.

The ToR elaborated here are designed to answer the request by WWF Guianas but also to go beyond the initial idea and to maximize the usefulness of the study related to objectives of *REDD+ for the Guiana Shield*. Compared to what WWF had suggested, the digitization process is expanded in these ToR to include not only mining activities but also other types of deforestation variables, mainly roads and settlements. Important is that this will feed a regional database to be established by the project, which will be used later on for deforestation modeling and other purposes. Furthermore, the working approach and methodology has been adapted in order to allow more active involvement of the forestry services of Suriname, Guyana and the state of Amapá in Brazil throughout the entire process, in addition to ONF Guyane in French Guiana who produced the precedent study. More details on what this participatory approach will entail are provided below.

Access to satellite imagery is required for conducting this kind of work. In 2008/2009 ONF Guyane built the study based on SPOT imagery that was available to them. For the new study, ONF Guyane and ONF International have been discussing with Airbus Defense and Space (ADS) and Région Guyane in the framework of the *REDD+ for the Guiana Shield* project, seeking to grant access also for the forestry services in Suriname, Guyana and Amapá to SPOT image archives and user licenses. These negotiations have resulted in a proposed agreement that is now subject to Steering Committee approval. One of the conditions from ADS and Région Guyane is that the SPOT imagery will be used for implementation of this joint mining study. The opportunity is therefore included

[1] www.reddguianashield.com

within these ToR, although the imagery would remain available to the forestry services to use also for other purposes.

Objectives of work

The main and prior objective of the work described in these ToR is to quantify and map the land area and extent of waterways impacted by gold mining across Guyana, Suriname, French Guiana and the State of Amapá in Brazil for a recent year (2013). This will be done following a unique participatory methodology for the entire region, conducted in a way that allows sound comparison with earlier study results.

Another objective is that the process of conducting this study will help to feed a regional database planned to be established by the *REDD+ for the Guiana Shield* project (see separate ToR). Taking advantage of the fact that a large quantity of images need to be collected and manipulated for the main purpose of this study, it is envisioned that the process will also allow digitizing other factors impacting deforestation and forest degradation in the Guiana Shield region, especially road networks and settlements. This data will be entered into the regional database and might become useful for several purposes later in the project.

The participative approach for data development has the following objectives:

- Reinforcing the capacities of forestry services in Suriname, Guyana, Amapá and French Guiana, especially on high resolution data such as SPOT 5 and SPOT 6;
- Initiating and maintaining the habit to collaborate and increasing dialogue in the region;
- Capitalizing on existing data and methodologies used by forestry services (including data produced in the framework of the ACTO project *Monitoring of forest cover in the Amazon region*);
- Facilitating comparison of data produced at national and regional scale, to assure relevance of results and quality data produced by the forestry services for this study.

Organization of work

The study itself will be supervised by the *REDD+ for the Guiana Shield* project manager (Marie CALMEL) and project officer (Mathieu RAHM). They will be in charge of following up the good achievement of tasks and deliverables, will facilitate the exchanges with forestry services and will be the main interlocutor to partners.

Full and active participation of each forestry service (ONF-Guyane in French Guiana, SBB in Suriname, SEMA in Amapá and GFC in Guyana) will be crucial throughout the process of developing the study. The forestry services commit to each identify one staff member who will be in charge of the study from their side. This person will be part of the regional core team and must be available to participate in trainings and accept responsibility to process the data for their respective territory. Forestry services will be asked to each sign an agreement accepting this responsibility and accepting to share data and publish the findings.

The core team of two experts from each forestry service will be technically led by the head of the GIS department (Gaëlle VERGER) and a GIS expert (Anthony Lauger) of ONF-Guyane who will be in charge of:

- Facilitating exchanges on and finalizing the regional methodology;
- Training the national team on this methodology;
- Compiling data and reporting.

Some additional expertise and staff will be provided in order to:

- Validate data that will be produced (Anoumou KEMAVO, Cédric LARDEUX and Anne-Cécile CAPEL from ONFI GIS and remote sensing department, Paris)
- Facilitate logistics, especially for training missions (Rachida LE JEANNIC, administrative assistant to the *REDD+ for the Guiana Shield* project).

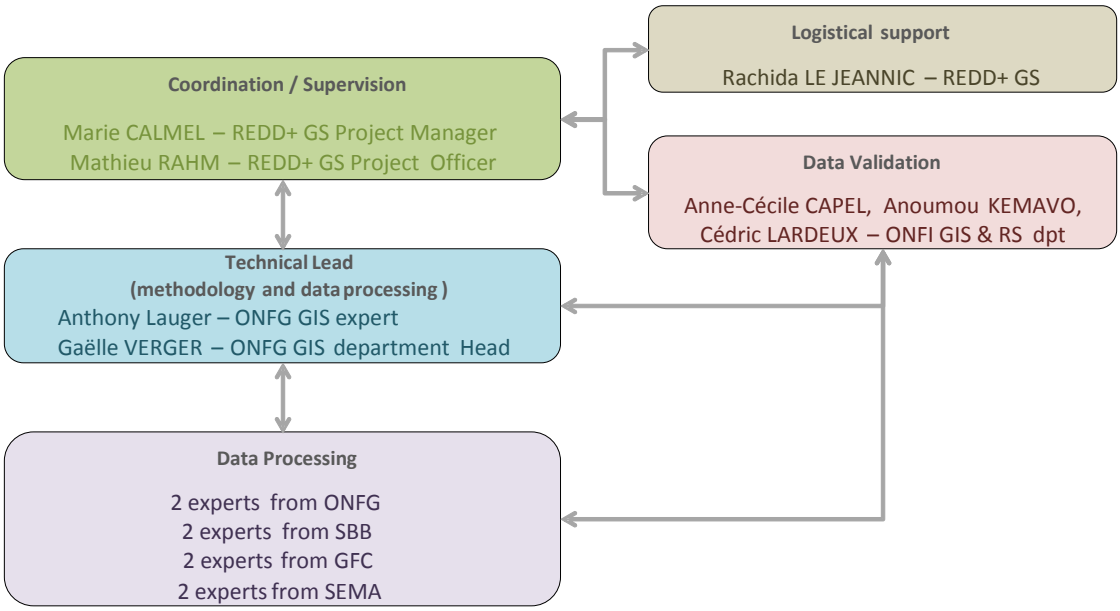

Figure 1. Team organization

Methodology and tasks

The work will be implemented through the following steps: 1) Work preparation, 2) Training on data preparation and discussion on the methodology, 3) Data processing by the team, 4) Data validation, 5) Data compilation, report and analysis. Each step is detailed below.

1. Work preparation

Preparation is needed in terms of identifying the core team, selecting and pre-processing data, as well as establishing the methodology to be applied. As part of the preparation phase, contracts will need to be signed between each forestry service and ONFI.

Core team constitution:

- In order to facilitate the core team constitution, ONF-Guyane will prepare a job description detailing all needed background, expertise and level of knowledge on remote sensing, as well as the tasks and workload that will be asked from the team

members to perform the study. This job description will be shared with the forestry services in order to help them identify the staff that could join the core team, i.e. participate to two training sessions in French Guiana (in total one month) and process the data for its territory (around 20 man-days per country is expected depending on the size of the territory).

Data selection, collection and pre-processing:

- For the purpose of this study, it will be necessary to make use of high resolution satellite imagery. The priority will be given to SPOT imagery (SPOT 4, 5 and 6) that will be available to all forestry services through an agreement to be signed with ADS and Région Guyane. This would enable good comparability with the 2010 ONF-WWF study for which SPOT imagery was also used. In case of low data quality and/or availability, additional satellite data from other sensors might be required in order to cover the full region. It is expected that about 300 SPOT 4/5 scenes will be required to get a full coverage.
- Among all available images, it will be necessary to select and download the ones that will be used for the study. While priority will be given to the most recent scenes, a range of 2 years will be accepted for the 2012/2013 time point, i.e. data could be collected from January 2011 to the most recent available imagery. A file will be prepared with a per country classification in order to facilitate the process.
- Satellite images will also have to be pre-processed (ortho-rectified, geo-referenced, color treated, etc).
- Ancillary data might also be necessary such as SRTM, existing roads network and settlement shapefiles, and/or maps that have already been produced in the countries and that are used by them (including information on how those data have been produced).

Methodology design:

- ONF-Guyane will facilitate discussions with other forestry services in order to reach an agreement on a regional methodology to be implemented for the purpose of this study. A methodology proposal will be presented to and discussed with the core team during their first visit in Cayenne.

The methodology needs to be established based on:

- The 2010 WWF-ONF study on mining activities in the Guiana Shield, in order to ensure perfect comparability with the results provided in this study for the years 2000 and 2007 (+/- 1 year);
- Existing land use cover maps, drivers assessments and deforestation maps (including ACTO ones) made in the different countries, as well as feedback gained from those initiatives;
- Existing roads and settlements data sets if any;
- Available satellite images that will be used;
- Data processing using open source software as far as possible, especially Q-GIS.

The methodology proposal will detail several processes to be published in a user manual:

- Selection criteria and processes of images;
- Data pre-processing and processing to digitize:
- Areas impacted by mining activities in 2012/2013 (surface data – deforestation);

- Length of rivers not impacted, impacted or potentially impacted by mining activities in 2012/2013 (linear data);
- Roads network in 2012/2013 (linear data);
- Settlements extent in 2012/2013 (surface data).

2. Training on data preparation and discussion on the methodology

The core team will be gathered together for a first 5-days training session dedicated to:

- Data selection, downloading and pre-processing;
- Presentation and short training on the Q-GIS functionalities useful for the production
- Presentation of the previous gold mining monitoring study and general discussions about gold mining monitoring and detection through photo-interpretation
- Presentation and discussions on the methodology.

The core team can consist of up to two persons for each country. It is expected that all members of the core team will be able to share its own country experience in monitoring mining impacts, as well as the data that have been produced and could be used in this study in terms of land-use cover and changes analysis, drivers' assessment, etc.

At the end of this training, ONF-Guyane will be able to update the methodology which will be shared with partners for comments, including to the forestry services involved in the *REDD+ for the Guiana Shield* Steering Committee for non-objection.

The training will be provided in English.

3. Data processing by the team

A second training session (10 working days = 2 weeks) will be organized in French Guiana for the same core team in order to:

- Train the team members in digitizing all items and processing the data following the agreed methodology;
- Start the processing;
- Perform a cross-validation among the team by sharing processed data.

During the first week, the participants will pursue their training on the methodology that was provided in November 2014. During the second week, each member of the core team will focus on his/her own territory under the supervision of the trainers and share the first results with others in order to check the quality and sensitiveness of results to interpreters. Those results will be discussed and the methodology updated if needed.

After the 10 days session in Cayenne, each member of the core team will be in charge of processing the data for their own territory. It is expected that this process will take about 20 man-days depending on the total surface of each territory, distributed over 10 weeks. Equipment for core team members will have to be provided by the forestry service and organization that the expert is belonging to. Some flash disks will be prepared for all pair of team members involved in order to provide and collect the data.

After three weeks of processing of the core team in their respective country, the forestry services will deliver intermediate results by the end of February 2015. These results will be analyzed by the experts who supervised the training. Based on the results and the possible support needs claimed by the core team, two experts could make a visit to the forestry centers in each country/state to

support them in data processing. One of the experts will be from ONFG and the other from ONFI. A first mission would enable to visit Suriname and/or Guyana, a second one Amapá. After the missions, those two experts will be available throughout the full process to support members of the core team from Cayenne and on demand. They will ensure that processing is going smoothly and follows the expected deadlines. The delivery of the final product is expected the 24th of April, 2015 at the latest. At the end of the process, the products will be collected and compiled into a regional data set (see deliverables).

If a country needs support to carry out these activities, they can request the support of ONF Guyane. When ONF Guyane notices artefacts while compiling the regional dataset, additional information and/ or further data processing can be discussed with the relevant country.

4. Data validation

A validation protocol will be developed in order to check and control quality of the regional data that will have been produced by the core team. This validation protocol will be based on scientific reliability, good practices, as well as on data availability. Different types of data will be collected:

- Existing ground-truthing points or field measurements that can be used for that purpose (NB: no field campaign will be undertaken for the specific purpose of this study);
- Very high resolution data and especially SPOT 6 images;
- Existing validated data if any have been produced for the year 2012/2013.

Implementation of the data validation protocol will allow the estimate of data accuracy.

5. Data compilation, report and analysis

At the end of the processing period, processed data will be submitted by the core team to ONF-Guyane and ONFI. ONF-Guyane will be responsible for compiling it and uploading it to a regional database. Once the products will be compiled, they will be validated and the accuracy will be assessed before the final delivery to WWF-Guianas.
A report will also be produced in order to:

- Detail the methodology and data used;
- Present and analyze results, including the evolution of impacted surfaces and impacted or potentially impacted rivers since the first 2010 report (2000 and 2007 time points, i.e. 2007-2012/2013 evolution will be analyzed). In addition, the report will compare and comment results given by different remote sensing methods and data resolution.
- Identify and analyze potential impact of roads and settlement proximity with mining activities.

This report will include:

- A regional map of areas deforested by gold mining activities in 2012/2013;
- A regional map of waterways impacted by gold mining activities in 2012/2013;
- Regional maps showing the trends between 2000, 2007 and 2012/2013;
- Tables presenting the figures of hectares deforested and linear of kilometers of waterways impacted for each date and per territory (Guyana, Suriname, French Guiana and Amapá State of Brazil);
- Graphs showing the trends between 2000 and 2012/2013 for the different territories;
- A regional map of roads in 2012/2013 and a corresponding table with the length of roads per territory;
- A regional map of settlements in 2012/2013 and corresponding table with the surface of settlement per territory.

The draft report will first be shared with partners (WWF-Guianas and forestry services) for comments to be submitted within 2 weeks. Comments will be integrated and a final version sent within a month after the first version.

Deliverables and data sharing

The following deliverables will be produced through the work described in these ToR:

- A manual with detailed description of the methodology
- A draft report (in English) in digital form (.doc and PDF)
- A final report (in English) taking into account comments on the draft, in hardcopy and digital form (.doc and PDF)
- All maps will be provided separately in high resolution JPEG and PDF format
- All GIS data used to create the maps will be provided in shapefile format, creating the following shapefiles data set:
    - Areas impacted by mining in 2012/2013
    - Areas that underwent conversion due to gold mining between 2007 and 2012/2013 (using the data from WWF-ONF (2010), *Impact de l'activité aurifère sur le Plateau des Guyanes*)
    - Waterways impacted and potentially impacted in 2012/2013 by mining activities;
    - Waterways that underwent a change of status (not impacted/potentially impacted/impacted) between 2007 and 2012/2013;
    - Roads network in 2012/2013;
    - Settlements extent in 2012/2013.

In terms of data sharing, all partners agree to make the final report publicly available, including all results of the study presented in an objective and uncensored manner. Transparency will be applied in terms of data production methodology and validation results.

Ownership of data will be shared between all forestry services and donors including WWF-Guianas, in terms of data processed in all the different countries for the purpose of this study. This data, maps and GIS shapefiles will feed a regional database governed by separate ToR and the *REDD+ for the Guiana Shield* data sharing policy.

Duration of service and schedule

It is expected that the work will start in October 2014 and will last 9,5 months. All deliverables must be provided by July 15, 2015 the latest.

Forestry services core team members must be available for training sessions in French Guiana in the end of November (5 days) and in January-February (15 days) and to process data after the trainings (approximately 20 man-days per country spread over 10 weeks).

A more detailed calendar of implementation is provided below:

Activities	Responsability	October 2014				November 2014				December 2014				January 2015				February 2015				March 2015				April 2015				May 2015				June 2016				July 2017	
		W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15	W16	W17	W18	W19	W20	W21	W22	W23	W24	W25	W26	W27	W28	W29	W30	W31	W32	W33	W34	W35	W36	W37	W38
1. Work Preparation																																					
Team constitution: prepare a job description and facilitate selection in countries	*ONFG*																																				
Images' identification and purchase, organization of a complete file	*ONFG*																																				
Data preprocessing	*Core team*																																				
Preparatory work to update and detail the methodology based on existing data in the countries																																					
Literature review and exchanges with countries	*ONFG*																																				
Methodology preparation	*ONFG*																																				
2. Training on data preparation and discussion on the methodology																																					
Preparation of training and training	*ONFG*																																				
5 days mission of the team in French Guiana	*Core team*								X																												
Final description of the updated methodology to be submitted to partners validation	*ONFG*																																				
Expected validation by partners	*Partners*											X																									
3. Data Processing by the team																																					
Preparation of the training and training	*ONFG*																																				
10 days mission of the team in French Guiana	*Core team*																	X																			
Processing for French Guiana territory	*Core team*																																				
Processing for Suriname	*Core team*																																				
Processing for Guyana	*Core team*																																				
Processing for Amapa	*Core team*																																				
Delivery of intermediate processing results	*Core team*																				X																
Delivery of final processing results	*Core team*																										X										
Support mission to countries (1 mission in Suriname/Guyana and 1 mission in Amapa)	*ONFG/ONFI*																						X	X													
4. Data validation																																					
Identification of existing ground-truthing points	*ONFI*																																				
Development of a validation protocole	*ONFI*																																				
Implementation of the validation protocole and uncertainty estimates	*ONFI*																																				
5. Data compilation, report and analysis																																					
Compilation of data	*ONFG*																																				
Report writing	*ONFG/ONFI*																																				
Preparation of data files	*ONFG*																																				
Provision of draft report	*ONFG/ONFI*																																		X		
Expected comments	*Partners*																																			X	
Provision of final report	*ONFG/ONFI*																																				X
6. Coordination																																					
Coordination	*ONFI*																																				
Technical support	*ONFG*																																				

Budget

The total budget for this study is estimated to 103 250€, satellite imagery excluded. Out of this, approximately 73 000€ will be covered by the *REDD+ for the Guiana Shield* project while WWF Guianas has agreed to contribute up to 30 000€. Those amounts exclude the possible acquisition of satellite imagery and user licenses.

From *REDD+ for the Guiana Shield*, around 52 500€ of the funding will be taken from the budget line for "regional studies". This cover most of the expenses including work preparation, expertise and preparation of trainings, support missions to countries, compilation of data, reporting and analysis. The additional 20 500€ will be taken from the "training" budget line to cover international travel to the two training sessions as well as per diems and other fees related to participation.

The contribution from WWF Guianas will be spent on validation of the work and some technical support for methodology preparation and data processing. It will also enable forestry services in Guyana, Suriname and Amapá to receive an amount ranging from 3600-4400€ (depending on the size of their territory) as a compensation for the time that will be spent by their staff member on data processing. This kind of direct payment to forestry services would not be possible through the *REDD+ for the Guiana Shield* project due to restrictions by donors.

For imagery, it has been negotiated that an additional 75 000€ from the *REDD+ for the Guiana Shield* project, taken from the technology transfer budget line (out of the total available 180 000€) would open up the necessary databases, namely SPOT 4 and 5 imagery for the whole region from 2011 until now as well as some SPOT 6 imagery for each country (2.5 m resolution). This agreement would be signed between Airbus Defense and Space (ADS), Région Guyane and ONF-Guyane. User licenses would be provided to GFC, SBB and SEMA who will also be able to independently use the imagery for their own purposes as desired.