FAUNA & FLORA INTERNATIONAL

Analysis of Historic Deforestation and Location Analysis of Projected Future Deforestation for the Wonegizi REDD+ Project, Lofa County, Liberia

"In the past century FFI has consistently saved species from extinction and protected habitats from destruction. Their solutions have always been practical, efficient and sustainable in local circumstances."

Sir David Attenborough,
FFI Vice-president

Request for Tender for:

ANALYSIS OF HISTORIC DEFORESTATION AND LOCATION ANALYSIS OF PROJECTED FUTURE DEFORESTATION FOR THE WONEGIZI REDD+ PROJECT, LOFA COUNTY, LIBERIA

Document release date: 28 October 2019
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Please return documentation and proposals in Word or PDF format by email to: james.smith@fauna-flora.org and chris.smith@fauna-flora.org

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Section 1. Background and conditions of the project

1.1 About the project

The purpose of this Request for Proposals (RfP) is to provide services to Fauna & Flora International (FFI) in support of its objectives to implement a REDD+ project in the Wonegizi Proposed Protected Area, Liberia (see Figure 1), with funding received from the Norwegian Agency for Development Cooperation (Norad).

This RfP seeks the provision of consultancy services in earth observation and spatial analysis to conduct four tasks critical to the development of an avoided deforestation REDD+ project under VCS Methodology VM0007:

1. Development of Land Cover Classifications (LCC) using high-resolution remote sensing imagery for the Wonegizi landscape for four time periods in the historical reference period
2. Defining the project Reference Region for Deforestation (RRD), Reference Region for projecting Location of deforestation (RRL) and Leakage Belt (LK), in reference to the existing and pre-defined Project Area (PA)
3. Estimation of gross deforestation rates for the RRD and LK over the historical reference period, and production of deforestation maps
4. A 'Location Analysis' to quantify and project the location of future unplanned deforestation across the project's RRL. This analysis will provide critical data for the establishment of the baseline GHG emissions scenario for the Wonegizi REDD+ Project.

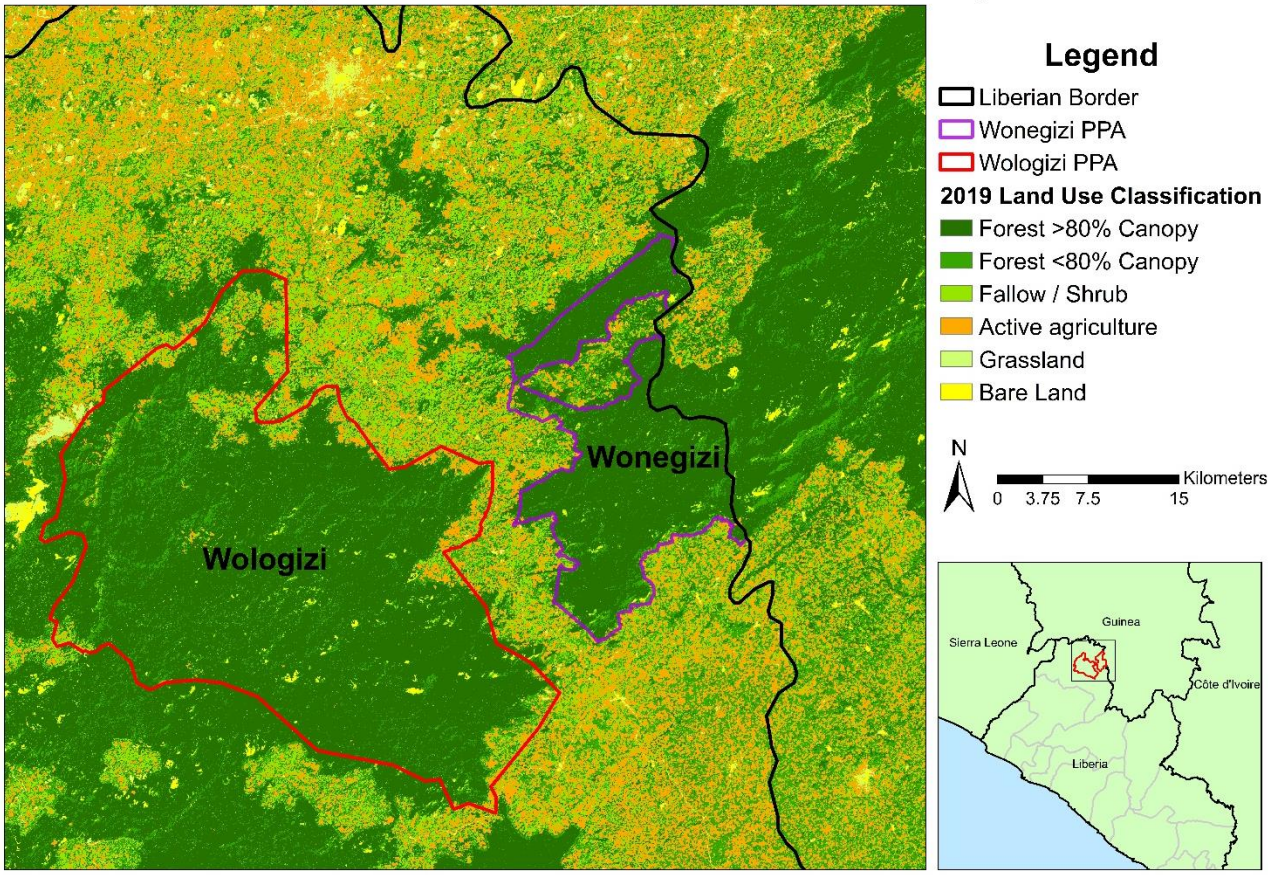
FFI therefore requires the services of a consultant(s) with expertise in processing remote sensing imagery, developing Land Cover Classifications, performing land cover change analyses to estimate historical deforestation rates, and in estimating and modelling future deforestation in tropical forest landscapes where slash-and-burn is rife.

Ideally the consultant will have demonstrable previous experience in applying such analytical methods to REDD+ projects validated and verified in accordance with the requirements of the Verified Carbon Standard (VCS), specifically using VCS Methodology VM0007 or similar methodologies.

Background to the Wonegizi REDD+ project

The project area, Wonegizi, is a Proposed Protected Area (PPA) located in the north of Liberia in the county Lofa, bordering with Guinea. Within the PPA, an area of forest of approximately 26,700 ha forms the VCS 'Project Area'. The project aims to reduce greenhouse gas (GHG) emissions from deforestation driven by slash-and-burn agriculture, primarily through formal gazettement, management and protection of Wonegizi, alongside the engagement of local communities in agricultural-based sustainable livelihoods activities.

Map 1. Wonegizi REDD+ Landscape, Lofa County, Liberia



Initial project development activities are being funded by a Norwegian Agency for Development Cooperation Grant: QZA-16/0176 Driving REDD+ consensus through national policy implementation 2016-2020, with the view to generate a long-term and sustainable funding stream for ongoing REDD+ activities via carbon offsets sales and revenue.

The Wonegizi REDD+ project is being developed in accordance with requirements of the Climate Community and Biodiversity Alliance (CCB) and Verified Carbon Standard (VCS) and the VCS REDD+ methodology framework (VM0007).

About Fauna & Flora International

Established in 1903, Fauna & Flora International (FFI) is the world's oldest conservation organisation. FFI's mission is to conserve threatened species and ecosystems worldwide, choosing solutions that are sustainable, based on sound science, and which take into account human needs. With success in the field generating increased demand for FFI's services, the organisation has recently undergone a period of rapid growth. The current portfolio comprises of 140 projects in over 40 countries world-wide.

1.2 Contract requirements

The contract will be a negotiated fixed price contract, with milestone-based payment(s). The consultancy has been structured into four main stages, each comprising a stand-alone task; milestone payments will be made on completion of individual stages and receipt of deliverables (post stage review meeting with FFI). Stage 4 may not be necessary and therefore the RfP is structured as a series of stand-alone stages.

1.3 Scope of supply

The contract will include the provision of services to conduct historical land use land cover change analyses, estimation of gross deforestation rates, definition of REDD+ project spatial boundaries, and a 'Location Analysis' to project future deforestation in the Wonegizi landscape, plus other associated tasks and outputs, as described in section 2 below. This may include the provision of goods in the form of

satellite imagery.

1.4 Project location

The consultancy required may be performed from anywhere worldwide, and the contract does not require the consultant(s) to travel. The consultant(s) are required to hold regular meetings with FFI throughout the duration of the contract, which may be done so via teleconference facilities such as Skype.

The consultants may also need to make themselves available for discussions (remotely) with a VCS auditor at a later stage and should include provision for this in the tender submitted.

1.5 Tender process and timetable

The tendering process will be as follows:

1.	Request for tender documents issued	*28 October 2019*
2.	Tenders returned to FFI – the tenderer will supply a compliant tender including a fixed price or quote including a breakdown of components (depending on method chosen) for the entire scope of supply	*EXTENDED T0 MIDNIGHT 15 NOVEMBER 2019*
3.	Shortlisted tenderers notified – three preferred tenderers will be selected on the basis of the tender assessment criteria noted in section 1.6 below	*20 November 2019 or before*
4.	Tenderer interviews as required	*25-26 November 2019*
5.	Notification of successful tenderer	*29 November 2019*
6.	Contracting process / negotiation (depending on method chosen)	*29 November 2019*

FFI reserves the right to change its decision of successful tenderer if the negotiation / finalisation of contract is prolonged.

FFI reserves the right to discontinue the tender process at any time prior to contract signing.

1.6 Tender assessment criteria

For a tender to be assessed, the tenderer must:

- *Have appropriate qualifications, skills and experience in the analysis and interpretation of remote sensing and GIS data; and*
- *Have prior experience in performing land cover classifications in tropical forest landscapes, and land cover change analyses monitoring and measuring changes in forest area over time (preferably in contexts where shifting agriculture is the dominant driver of deforestation)*
- *Have experience in modelling future deforestation or land use change incorporating a range of independent variables, or of conducting Location Analyses as per VCS module VMD0007*
- *Clearly show how their spatial model of land change / deforestation meets the VCS requirements for a location analysis stipulated in VCS VMD0007 module, section 3.1.1.;*
- *The availability to complete all proposed deliverables by or before January 30th 2020.*

Compliant tenders will be assessed on the basis of the information provided by the tenderer, placing emphasis on the following criteria:

- *Knowledge and experience in processing and analysing remote sensing data in accordance with project-level VCS REDD+ requirements (or alternatively of jurisdictional REDD+ programmes);*
- *Prior experience and expertise in performing 'Location Analyses' to quantify the threat of unplanned deforestation particularly in contexts where dominant deforestation drivers include slash and burn (shifting cultivation) agricultural systems to requirements stipulated by the VCS Standard (VMD0007 module, section 3.1.1.);*
- *Reference projects and case studies where appropriate*
- *Degree of consideration given to utilising existing and freely available datasets, where considered appropriate;*
- *Suitability of the analysis approach(es) proposed for transferring skills and enabling capacity building amongst the Wonegizi REDD+ project's partners and stakeholders in Liberia; and*
- *Cost*
- *Proposed delivery date*

1.7 Tender conditions

The tenderer agrees to comply with the following tender conditions:

1 The tenderer must notify in writing if any of the submitted tender information changes or if the tenderer becomes aware that information provided to FFI is inaccurate, incomplete or misleading.

2 The tenderer must not hold itself out as an agent of FFI or make any representations that would lead people to believe that FFI guarantees the products and/or services offered by the tenderer.

3 If any claim is brought by any third party against FFI and the claim is caused by any act or activities of the tenderer (or its subcontractors) under or in connection with the service/goods delivery or any other act, omission, misrepresentation or negligence on the part of the tenderer (or its subcontractors), then the tenderer must indemnify FFI from and against all costs, expenses (including, but not limited to, legal and other professional fees and expenses) losses, damages and other liabilities (of whatever nature, contractual or otherwise) suffered or incurred by FFI.

4 The tenderer must gain FFI's prior written agreement to any publicity in connection with this contract. All details of the tender and any supporting documentation provided must otherwise be treated as strictly confidential.

5 Offers will be rejected if any illegal or corrupt practices have taken place in connection with the award.

6 FFI reserves the right to select the successful tenderer as Consultant in its sole discretion and without giving reasons to the selected or unsuccessful tenderers.

7 Contracts shall not be awarded to tenderers which, during the procurement procedure are guilty of misrepresentation in supplying information required by FFI as a condition of participation in the tender procedure, or fail to supply this information.

1.8 Tender eligibility

Tenderers are not eligible to submit tenders and will be excluded from the tender process if:

1. they are bankrupt or being wound up, are having their affairs administered by the courts, have entered into an arrangement with creditors, have suspended business activities, are subject of proceedings concerning those matters, or are in any analogous situation arising from a similar procedure provided for in national legislation or regulations;
2. they or persons having powers of representation, decision-making or control over them have been convicted of an offence concerning their professional conduct by a final judgment;
3. they have been guilty of grave professional misconduct; proven by any means which FFI can justify;

4. they share information about their tender with any other tenderers (or prospective tenderers) without the consent of FFI;
5. they have not fulfilled obligations relating to the payment of social security contributions or taxes in accordance with the legal provisions of the country in which they are established, or with those of the United Kingdom;
6. they or persons having powers of representation, decision-making or control over them have been convicted for fraud, corruption, involvement in a criminal organisation or money laundering by a final judgment;
7. they make use of child labour or forced labour and/or practice discrimination, and/or do not respect the right to freedom of association and the right to organise and engage in collective bargaining pursuant to the core conventions of the International Labour Organisation (ILO).

1.9 Conflict of interest

Tenderers must not be subject to any conflict of interest. Conflict of interest refers to any situation where the impartial and objective exercise of the functions of the Tenderer or anyone acting on behalf of the Tenderer is, or may be, compromised for reasons involving family, personal life, political or national affinity, economic interest or any other connection or shared interest with another person.

Declaration

By signing below the tenderer agrees to be bound by the Tender (including maintaining confidentiality and non-disclosure of any information provided to the Tenderer by FFI) and confirms that the information set out in its submitted tender documentation document is true and accurate in all respects:

.....

for and on behalf of [*insert tenderer name*]

Name: .....

Position: .....

Date: .....

Section 2. Request for Tenders

2.1 Context and Tender Information Requirements

Tasks Required

This consultancy is comprised of four tasks necessary to the development of VCS avoided deforestation REDD+ projects under VCS Methodology VM0007:

1. Development of Land Cover Classifications using high-resolution remote sensing imagery for the Wonegizi landscape for four time periods in the historical reference period.
2. Defining the Project Area (PA), and then the Reference Region for Deforestation (RRD), Reference Region for projecting Location of deforestation (RRL) and Leakage Belt (LK), in reference to the (PA).
3. Land Use Land Cover Change Analyses. From these analyses gross deforestation rates for the RRD and LK will be estimated over the historical reference period, and deforestation maps produced.
4. A 'Location Analysis' to quantify and project the location of future unplanned deforestation across the project's RRL. This analysis will provide critical data for the establishment of the baseline GHG emissions scenario for the Wonegizi REDD+ Project.

Due to the large size of the consultancy each of the tasks listed above is to be considered a 'Stage' within the consultancy. The stages must be completed in numerical order (as each stages are dependent upon the completion of the preceding stage). All work must be in compliance with the relevant sections of the VCS Module VMD0007 "Estimation of baseline carbon stock changes and greenhouse gas emissions from unplanned deforestation, version 3.1 (BL-UP). The relevant sections of BL-UP will be referenced in the details description of tasks below to facilitate the development of proposals.

FFI stipulates as a condition within the consultancy that the consultant must present the work completed and results of each stage to FFI for review and ensure consistency with the technical requirements of VCS Module VMD0007, and to integrate FFI's comments and feedback, before the consultant begins work on the next stage.

In their proposal, the consultant is requested to present their indicative fees for the entire consultancy, with a break down for each individual stage (including costs for the procurement of any additional remote sensing imagery if deemed necessary).

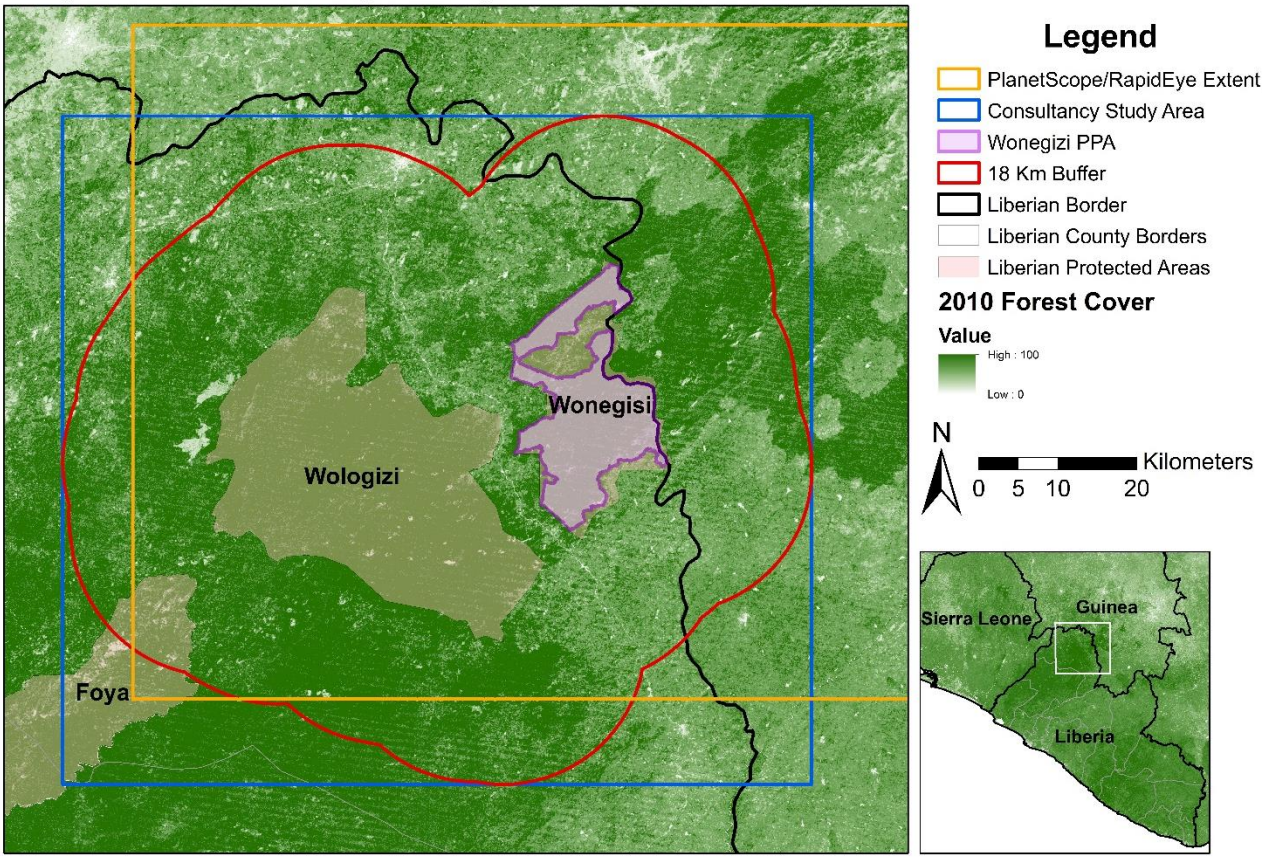
Stage 1. Land Cover Classifications

VMD0007 relevant sections:
Step 2 Estimation of annual areas of unplanned deforestation
Step 2.1 Analysis of historical deforestation
Step 2.1.1 Collection of appropriate data sources
Step 2.1.2 Mapping of historical deforestation
Step 2.1.3 Calculation of the historical deforestation
Step 2.1.4 Map accuracy assessment

1.1 Satellite imagery procurement and/or processing

The study area for the consultancy is defined as all land in Liberia (as per the GADM.org version 3.6 Level 0 national borders) within a rectangular minimum bounding envelope surrounding the Wonegizi and Wologizi PPAs, both buffered to a distance of 18 km (Map 2). Based on a preliminary analysis of land cover in the landscape this area is believed to be sufficient to encompass all of the project boundaries (as listed in Stage 2). FFI will provide the extent of the 'study area' to the consultants in ArcGIS shapefile format.

Map 2. Consultancy Study Area located on 2010 Forest Cover



The consultant will procure and/or source satellite imagery meeting the requirements stipulated in VMD007 section 2.1.1. The dates for satellite imagery listed below are specific to the project, given its retrospective start date of 01/01/2019:

a. Minimum 30m resolution satellite imagery for the following time-points and study area coverage requirements;
    i. Circa 01 January 2019.
    ii. Two time-points from within the period of circa January 2012/2013 and January 2015/2016 (but at least 3 years apart).
    iii. Circa 01 January 2009.

All satellite imagery sourced must meet the follow requirements;

    iv. Spatial coverage of each of the image time series must cover the relevant study area.
    v. Cloud cover in the selected images should be as close to 0% as possible and must be not more than 10%. Use of multiple-date images for the same 12 month period (January to December) is allowed to reduce cloud cover.

Note, where **already interpreted data of adequate spatial and temporal resolution and accuracy** are available, and they meet the requirements defined in VCS Module VMD007 (2.1.1) these can be used instead of collecting new original data.

VMD0007 section 2.1.1 requires the use of high resolution imagery (≤ 5m resolution) to coincide with the most recent time point for which the low resolution imagery is collated (circa January 2019), and overlapping with the geographic coverage of the study area. Through other projects active in the landscape FFI has access to high resolution imagery (PlanetScope and RapidEye (Visual), zoom level

15, resolution 4.77m; see map 2 for extent in orange), and will make the available to the consultant (on the proviso its use is limited to this project commissioned by FFI). In the event that the consultant considers that the high resolution imagery available does not meet the requirements of VMD0007, and that the sourcing of additional high resolution imagery is necessary, the consultant should provide a cost estimate (as part of the tender) for the procurement of high resolution imagery suitable for the task.

1.2 Land Use Land Cover Classification

Apply good practice remote sensing analysis procedures to map forest and land cover consistently across the time series of images, including the following considerations;

- Forest cover must be mapped in accordance with the Liberian (unvalidated[1]) definition of a forest[2];
    - A minimum area of one hectare
    - Minimum canopy cover of 30%
    - Minimum tree height at maturity of 5 metres
- As much as possible, Forest strata should be mapped in accordance with the Liberia definition of forest strata;
    - Dense forest: > 80% canopy cover
    - Forest: 30 – 80% canopy cover
- Non-forest land use cover should be mapped in accordance with the following categories as using best-practice definitions[3];
    - Mangrove and swamp
    - Settlements
    - Roads
    - Water bodies
    - Grassland
    - Shrub / Fallow land
    - Bare soil
    - Ecosystem complex (rock and sand)
    - Other land as applicable.

1.3 Accuracy Assessment

Using high-resolution imagery made available by FFI to the consultant (as per section 1.1 above), and ground-truthing data collected by FFI during 2019, conduct an accuracy assessment(s) and ensure that all land use land cover maps are classified to a minimum accuracy of no less than 90% for both “forest” and “non-forest” land cover classes (as per section 1.2 above).

i. Use ground-truthing data collected from the field by FFI in Q3 2019 to perform an accuracy assessment following remote sensing best practices and guidance within the VCS module VMD0007
ii. Supplement the ground-truthed data with on-screen validation data, using a GIS program to randomly distribute the required number of reference locations across the study area, ensuring representation across all study area parcels (in proportion to their size), and stratified geographic features, as considered applicable.
iii. Analyse the reference locations to produce a confusion matrix, user accuracy, producer accuracy and overall accuracy of the map(s).
iv. If accuracy is less than 90%, source additional training data and refine the classification, and repeat tasks i-iii above until this level of accuracy is achieved.

Note: data derived from high-resolution imagery for the reference locations and subsequent accuracy

[1] “World Bank. 2018. Liberia Country Forest Note. © World Bank.

[2] Goslee et al. 2016. Development of Liberia’s REDD+ Reference Level. Final Report for Republic of Liberia Forest Development Authority. Winrock International.

[3] Goslee et al. 2016. *Development of Liberia’s REDD+ Reference Level. Final Report for Republic of Liberia Forest Development Authority*. Winrock International.

assessment must remain independent of, and not be used for, any reference locations used for the imagery classification analysis.

Stage 2. Define Project Spatial Boundaries

VMD0007 relevant sections:
Part 1. Definition of Boundaries
1.1.1 Reference Region
1.1.1.1 Reference region for projecting deforestation rate
1.1.1.2 Reference region for projecting location of deforestation
1.1.2 Project Area
1.1.3 Leakage Belt

This stage will use the land cover classifications developed in Stage 1 to define the various REDD+ project spatial boundaries:

a) Project Area (PA)
b) Reference Region for projecting rate of Deforestation (RRD)
c) Leakage Belt (LK)
d) Reference Region for projecting Location of Deforestation (RRL)

The RRD, LK and RRL will be defined in reference to the characteristics of the Project Area (PA) (Maps 1 and 2). FFI defines the PA as all forest (that has been forest for at least 10 years) located within the 'harmonized boundary' of the Wonegizi Proposed Protected Area (PPA) as at 01/01/2019 (see map 2). The 'harmonized boundary' of the Wonegizi PPA has been defined through a participatory mapping exercise, facilitated by FFI, involving the communities closest to the Wonegizi PPA and the Forest Development Authority (FDA) of the Government of Liberia. This boundary will be made available to consultant in ArcGIS shapefile format.

The total extent of the harmonized boundary of the Wonegizi PPA is 27,594 ha. A draft 2019 land cover classification suggests the area of forest within this boundary – constituting the 'Project Area' – is approximately 26,700 ha.

The definition of the RRD, LK and RRL requires that factors such as the agents of deforestation, landscape and habitat, human infrastructure, social settings and prevailing policies and regulations are similar between the different spatial boundaries. The consultant will need to demonstrate how these factors have been qualitatively or quantitatively incorporated into the definition of each spatial boundary, and provide a written justification in support of the boundary defined (particularly in instances where a relaxation of the similarity criteria are necessary to define a suitable boundary for the project). If in the process of defining project spatial boundaries it becomes apparent that the 'study area' defined is insufficient in size, the consultant will increase the study area size to one sufficient to meet the VCS requirements.

Due to its proximity to the Wonegizi PPA, similarity in forest habitat and topology, local socio-economic conditions and land-use practices, and policies and regulations, FFI has identified the Wologizi Proposed Protected Area as the best candidate site for the RRD. Should the consultant identify a separate forest area within the wider landscape or Liberia as being a better fitting RRD – or conversely reasons why the Wologizi PPA is unsuitable – this must be communicated and discussed with FFI.

Stage 3. Land use land cover change analysis and estimation of gross deforestation rates

VMD0007 relevant sections:
Step 2 Estimation of annual areas of unplanned deforestation
Step 2.1 Analysis of historical deforestation
Step 2.1.2 Mapping of historical deforestation
Step 2.1.3 Calculation of the historical deforestation
Step 2.2 Estimation of the annual areas of unplanned baseline deforestation in the RRD
Step 2.3 Estimation of annual areas of unplanned baseline deforestation in the project area

3.1 Land Use Land Cover Change Analysis

The consultant will use the individual land use land cover classifications developed in Stage 1 to develop land use land cover change maps; one for each of the transitions between the historical time points used, and one for the entire historical time period. Land use land cover change maps should document all raw land transitions between individual land cover classes.

3.2 Estimates of Gross Deforestation by Project Spatial Boundaries

The consultant is required to provide estimates of gross deforestation for each of the project spatial boundaries (both for between each time period and for the entire historical time period):

a) Reference Region for projecting rate of Deforestation (RRD)
b) Leakage Belt (LK)
c) Wonegizi Proposed Protected Area (PPA)
d) Reference Region for projecting Location of Deforestation (RRL)

3.3 Estimation of projected unplanned baseline deforestation

The consultant will perform a regression (Alpha level of 0.05) on the RRD deforestation data (area deforested ~ year) estimated above as per step 2.2 in VMD0007. The annual area of deforestation in the RRD will then be calculated from the fitted values of the regression (if significant) or mean annual historical deforestation over the historical reference period (if regression is insignificant). Subsequently the consultant will calculate the projected unplanned baseline deforestation in the RRL as per step 2.2 in VMD0007. These data will be used in Stage 4.

Stage 4. Location Analysis to locate and quantify the threat of unplanned deforestation

VMD0007 relevant sections:
Part 3. Location and quantification of threat of unplanned deforestation
Step 3.0 Determination of whether location analysis is required
Step 3.1 Preparation of data sets for spatial analysis
Step 3.2 Preparation of risk maps for deforestation
Step 3.3 Selection of the most accurate deforestation risk map
Step 3.4 Mapping of the locations of future deforestation

4.1 Overview of Location Analysis

The consultant will use a transparent and peer-reviewed land change model to project where future deforestation is most likely to happen in the Project's Reference Region for Location (RRL). The land change model/software will use multiple different combinations of GIS and remote sensing data sets as explanatory variables to create spatial models of deforestation. The accuracy of each model in modelling historic deforestation will be assessed against actual, observed deforestation within the RRL during a historic reference period using a "Figure of Merit" approach. The model with the highest correspondence to past deforestation in the RRL will be selected to predict the future location of deforestation (on a pixel-by-pixel basis) within the RRL, creating a Prediction Map for the project duration, which will subsequently be used to determine the baseline GHG emissions scenario for the project on an annual basis.

4.2 Determination of whether location analysis is required

Deforestation in an around the Wonegizi Proposed Protected Area follows a 'transition configuration' of deforestation. A preliminary analysis by FFI observed that < 25% of the Project Area boundary is within 50 m of anthropogenically driven deforestation between 2008 and 2018, and consequently that a 'Location Analysis' must be conducted.

Using the outputs of the land cover change analyses from Stage 3 the consultant will perform additional checks to assess whether < 25% of the Project Area boundary is within 50 m of anthropogenically

driven deforestation in the 10 years prior to project start date. If yes, the consultant will conduct a Location Analysis as per VMD0007. ***If no, Stage 4 will not be necessary and the consultancy will end at this point.***

4.3 Spatial data sets to be used in creating risk maps for deforestation

The location analysis requires that spatial datasets from four different land classes (Landscape, Accessibility, Anthropogenic and Land Tenure Factors) are used as explanatory variables in model predicting future deforestation. Many of these datasets are open access and hence freely available for global or national data portals, and therefore no costs is foreseen for the collection of data for completion of this analysis (FFI will provide the consultant with links to multiple open access spatial data sets to be used as explanatory variables in the land change model at consultancy inception). These will be formatted for the Location Analysis as per VCS requirements (i.e. as Distance Maps where required) by the consultant.

4.4 Spatial data sets to be used for model calibration and validation

The consultant will use the land cover classifications and historical deforestation maps developed in Stages 1 and 3, and the projected unplanned baseline deforestation in the RRL calculated in Stage 3, in Steps 3.3 and 3.4 of the location analysis as per VCS VMD0007v3.2.

4.5 Preparation of deforestation risk maps (VCS Step 3.2)

The consultant will use the land change model to create deforestation *Risk Maps* showing, for each of the potential models (i.e. combination of explanatory factors from the four factor classes) the locations where deforestation is most likely to happen in the Project RRL. The *Risk Maps* will identify "for each pixel location *I*, the risk, or "suitability", for deforestation as a numerical scale (e.g. from 0 = minimum risk to some upper limit representing the maximum)" (VCS VMD007).

The VCS methodology requires that at least one factor from each of the four classes of landscape, accessibility, anthropogenic and actual land tenure and management will be included in the final deforestation model selected. The consultant will therefore be expected to run the land change model using different numbers and combinations of factor maps, producing a Risk Map showing the most likely location of deforestation for each model.

Importantly the model "must provide feedback on the relative contribution of explanatory variables and assess model fit through comparisons with empirical data. Further, in applying the model/software, project proponents must provide clear documentation and justification for all model inputs and assumptions." (VCS VMD0007 section 3.1.1.)

4.6 Selection of the most accurate deforestation risk map (VCS Step 3.3)

The accuracy of individual models in modelling historic deforestation will be assessed against observed deforestation within the RRL during a historic reference period (model calibration and validation). For each deforestation *Risk Map* created in 4.5 (VCS step 3.2) above a *Prediction Map* will be created for the RRL for the confirmation (historic reference) period. A "Figure of Merit" approach will be used to select the best fit model with highest correspondence between predicted deforestation and observed deforestation (on a pixel-by-pixel basis). The observed data will be available from IV above.

The model with the highest correspondence to past deforestation in the landscape will be selected to predict the future location of deforestation (on a pixel-by-pixel basis) by creating a Prediction Map over the project duration, which will subsequently be used to determine the baseline GHG emissions scenario for the project on an annual basis.

4.7 Mapping the locations of future deforestation (VCS Step 3.4)

The consultant will use the Deforestation *Risk Map* of selected best fit model to map out locations of

likely deforestation in the RRL for the project duration. For the first project year, the pixels with the highest deforestation risk score will be selected, up to the area of projected unplanned baseline deforestation in the RRL as estimated in Stage 3. For each successive year the remaining pixels with the highest risk score will be selected, up to an area of equal size to the mean annual deforested area during the reference period. *Maps of Annual Baseline Deforestation*, presenting this yearly projected deforestation data, will be created for both the first 10 years (Baseline period) and the entire project duration (30 years). This data will also be tabulated. Secondly, the annual data will be aggregated for the entire project for both the first 10 years (Baseline period) and the entire project duration (30 years) to map the *Deforestation for the Baseline Period* and the *Deforestation for the Project Duration*.
Each of these maps will be created for:

a. The Reference Region for Location of deforestation (RRL)
b. The Project Area (PA)
c. The Leakage Belt (LK)

Reporting and Deliverables

The consultant will provide the following outputs and deliverables in the specified format;

Stage 1: Land Cover Classifications

i. Satellite imagery:

All satellite imagery acquired and/or processed, in both raster and vector formats (ESRI Grid, GeoTiff and Shapefile).

ii. Land use land cover maps:
One for each of the historical time series for the study area in both ArcGIS 10 compatible shapefile and raster format (ESRI Grid and GeoTiff).

iii. Accuracy assessment data and results:

Reference locations[4] and individual results of reference location assessment in ArcGIS compatible format (shapefile), and accuracy assessment data and results in Microsoft excel compatible format.

iv. Report:

A report in word document format, describing:

a. Satellite imagery procurement and general processing methods;
b. Land use land cover classification methods;
c. Accuracy assessment methods and results (including confusion matrix, user accuracy, producer accuracy and overall accuracy of the map(s)); and
d. Description of land cover in the study area.
e. An Annex to the main report documenting in detail the work flow taken to classify the imagery, including decision trees (where applicable) and a step-by-step guide and the analytical tools used within the relevant software.

Stage 2: Define Project Spatial Boundaries

i. Spatial boundaries:

The spatial boundaries of the:

a. The Project Area (i.e. the forest area within the 'harmonized' Wonegizi PPA);
b. Reference Region for projecting rate of Deforestation (RRD);
c. Reference Region for projecting Location of Deforestation (RRL); and
d. The Leakage Belt (LK);

in ArcGIS 10 compatible vector format (Shapefiles; .shp).

ii. Report:

A short written report in Microsoft Word format (and PDF) describing:

a. The methodology / processes followed to select the various spatial boundaries;
b. Justification on how each boundary meets the selection criteria outlined in VCS VMD0007;
c. Tables showing land cover by class for each spatial boundary; and
d. A map showing the relative locations of the spatial boundaries.

Stage 3: Land use land cover change analysis and estimation of gross deforestation rates

[4] Training data must be stored in an accessible format where a supervised classification is used

i. Results:

Results of the land use land cover change analysis including estimates of gross deforestation for:

a. The Reference Region for projecting rate of Deforestation (RRD)
b. The Leakage Belt (LK)
c. The Wonegizi Proposed Protect Area (PPA)
d. The Reference Region for the Location of deforestation (RRL)

Results of the land use land cover change analysis, including all raw land transitions between individual land cover classes, should be provided in excel format. This document should also present the calculations to estimate gross deforestation for each spatial boundary.

ii. Deforestation maps:

One for the transition between each historical time point and one for the entire historical reference period, in ArcGIS 10 compatible format (Shapefile), and raster format (ESRI Grid and GeoTiff). Deforestation maps should be made for both the RRD and the RRL.

iii. Report:

A short report describing / including:

a. The methodology used to conduct the land us land cover change analysis (including technical details of tools or functions used within GIS / RS software)
b. individual deforestation maps as per ii
c. Observed rates of gross deforestation for the spatial boundaries over the historical reference period (i.e. written description of i above)
d. Results of the regression analysis to model annual area of deforestation in the RRD (presented in written and graphical format)
e. The projected unplanned baseline deforestation in the RRL
f. A description of the main land use / land cover transitions during the historical reference periods, highlighting the main observed drivers of land use change in the REDD+ project spatial boundaries (defined in stage 2)
g. An Annex to the main report documenting in a step-by-step manner the processes and tools used to calculate land cover transitions on a pixel by pixel basis between time periods.

Stage 4: Location Analysis to locate and quantify the threat of unplanned deforestation

i. Factor maps

For all independent variables ('factors') considered in the location analysis.

ii. Deforestation Risk Maps:

For each land change model run a *Risk Map* for the Wonegizi REDD+ Project RRL. *Risk maps* will be delivered in raster format (ESRI Grid and GeoTiff).

iii. Prediction Maps:

For each of the land change models run a *Prediction Map* of deforestation in the confirmation period. *Prediction Maps* will be delivered in raster format (ESRI Grid and GeoTiff).

iv. **Model calibration and confirmation results:**

Data, and results of Figure of Merit (FOM) calculations for each Prediction Map, in Microsoft excel compatible format. Maps will also be generated showing the correspondence between the Prediction Maps and observed deforestation in the confirmation period (i.e. locations where both the Prediction Maps and actual data observed deforestation).

v. Selected best fit model Deforestation Risk map:

One for the transition between each historical time point, and one for the entire historical reference period, in ArcGIS 10 compatible format (Shapefile).

vi. Maps of Baseline Deforestation:

Maps of annual Baseline Deforestation, Deforestation for the Baseline Period and the Deforestation for the Project Duration for the VCS Project Area, Leakage Belt and entire RRL, for both the first 10 years (Baseline period) and the entire project duration (30 years) will be delivered in raster format (ESRI Grid and GeoTiff). Table of annual deforestation per project year and for the project duration will be delivered for the VCS Project Area, Leakage Belt and entire RRL in Microsoft excel format.

vii. Report:

A report in word document and PDF format, describing:

a. The deforestation risk factors used, and their data sources and metadata

b. A methodological description of the land change model used to predict deforestation, including key model and data inputs
c. A description or table documenting each of the land change models run and the explanatory variables used
d. Deforestation *Risk Maps* and *Prediction Maps* for each of the models run
e. The model calibration and confirmation process and Figure of Merit scores for the competing prediction risk maps
f. The final selected best fit deforestation model and justification for its selection
g. The Deforestation Risk Map of the selected best fit model
h. Maps of annual Baseline Deforestation, Deforestation for the Baseline Period and the Deforestation for the Project Duration
i. Tabulated deforestation data for the VCS Project Area, Leakage Belt and entire RRL on an annual and cumulative basis.
j. Estimate of baseline carbon emissions on an annual basis for the Wonegizi REDD+ project for the project duration for the best fit model if allowed by the software/methodology utilised

Additional Information

The technical requirements for the consultancy are found in VCS Module VMD0007. Should any information or instructions within the tender document differ or contradict the requirements of VCS Module VMD0007, the VCS requirements are to take precedent (with any such cases being communicated to James Smith, FFI's Technical Specialist – Forestry and Forest Carbon).

FFI stipulates as a condition within the consultancy that the consultant must present the work completed and results of each stage to FFI for review and ensure consistency with the technical requirements of VCS Module VMD0007, and to integrate FFI's comments and feedback, before the consultant begins work on the next stage.

All spatial data should adhere to INSPIRE metadata standards (https://inspire.ec.europa.eu/metadata/6541).

2.2 Local knowledge and impact

An understanding of the dynamics and drivers of land use and land cover change in Liberia, and in particular Lofa County, would be advantageous but is not required for the successful completion of this consultancy.

2.3 Guarantees

NA

2.4 Meeting

The tendered may be requested to present their proposal (via skype meeting) to FFI as part of the consultancy selection process. The successful tenderer will be required to attend regular (weekly) 1-hour meetings with FFI's Forest Carbon Specialist and/or Senior REDD+ Programme Manager throughout the duration of the consultancy. The consultant may also need to be available to discuss details of the outcomes with a VCS auditor at a later stage and should include provision for this in the tender submitted.

2.5 Company information

a. Address Details:

Company name:			
Address:			
Town:		**Postcode:**	
Registered Office (if different from above):			
Phone:		**Website:**	
Person to contact regarding this tender:			
Position:			
Direct line:		**Mobile:**	
E-mail:			

b. Company Details:

Legal status (e. g. Sole Trader, Partnership, Private Limited Company, Public Limited Company or other):			
Details of any outstanding claims or litigation against the Company:			
VAT registration number:		**Date established or registered:**	
Name of Parent Company or details of Group Structure Include details of other organisations when bid is on behalf of a group of organisations**:**			
Relevant accreditations held:			
Number of Staff:			

c. Technical scope

How long has your organisation been delivering this service/good?	
What is your specialist area and what are the other services you provide?	
Can you provide one or more case studies as a demonstration of your previous experience?	YES, documents enclosed ☐ NO ☐

2.6 Application procedure

Please send the following information and documentation by email to james.smith@fauna-flora.org and chris.smith@fauna-flora.org by **6 November 2019**:

1. A proposal document outlining the data sources, software and methods to be employed to meet the Tasks required and deliverables of the consultancy (Section 2,1), and a written quote **in USD**, broken down by consultancy stage as listed in the tender (Section 2.1). The tender will also include a quote for indicative prices for the purchase of satellite imagery if required by the methods employed. *NB If you are based outside the UK please note that you need to include 20% reverse-charge VAT payable by FFI in this calculation.*
2. A description of the consultant's prior relevant experience, including links to any relevant evidence, such as case studies and publicly available work
3. Confirmation of availability for the dates of the review set out under 'Schedule of Tasks and timeline' above
4. A scan of the signed declaration, Section 1 Page 8
5. A copy of the completed questionnaire in Section 2.5

PLEASE REMEMBER TO COMPLETE AND SIGN THE DECLARATION ON PAGE 8 AND INCLUDE THIS WITH YOUR RETURNED TENDER DOCUMENTATION.