



## Forest Carbon Partnership Facility

### Assessment of innovative technologies and their “readiness” for remote sensing-based estimation of forest carbon stocks and dynamics

– Terms of Reference for Consulting Firm –

28 May 2020

#### 1. BACKGROUND

1. The World Bank’s Forest and Landscapes Team within the Climate Funds Unit (SCCFM) manages carbon funds and facilities, worth over \$1.3 billion, including the Carbon Fund of the Forest Carbon Partnership Facility (FCPF CF) and the Initiative for Sustainable Forest Landscapes of the BioCarbon Fund (BioCF ISFL). These funds provide result-based finance against Emission Reduction Units generated by a total of 23 ER Programs located in 21 countries. Emission reductions are estimated by a Measurement, Reporting and Verification (MRV) system which estimates GHG emissions based on a combination of remote sensing and field observations.
2. MRV systems are complex and even in those cases when they are operational and sustainable, the time for conducting the monitoring and reporting spans between 3 – 16 months, depending on the country, and for verification an additional 6 – 12 months are required. However, new technologies are causing a shift in paradigm; cloud computing technologies coupled with new satellite sensors and new machine learning algorithms are enabling the production of highly accurate land cover maps and the estimation of biomass stocks. The use of such new technologies and methods could reduce the MRV cycle substantially, i.e. 3-6 months or less, unlocking access to carbon finance and the ability of countries to report on a timely manner. These types of innovations could eliminate the need for integration of separately estimated activity data (AD) and emission factors (EF) thus also reducing uncertainty coming from these two types of estimates.
3. Although some experience exists in the use of these novel technologies and methods to produce static biomass or carbon maps (one year), there is little experience in the estimation of carbon stock change through dynamic biomass or carbon maps (multiyear) and currently the view of the forestry R&D is that these technologies are far from ready. Although it is possible to generate carbon maps and carbon change maps, the great limitation identified by the forestry R&D community is the lack of understanding of the uncertainty of the estimates derived from these maps. For instance, the uncertainty of a model-based estimator is difficult to estimate as

it requires a covariance matrix of predictions of all pixels across the region of interest<sup>1</sup>; the covariance matrix is not possible to be generated for certain estimators (such as non-parametric) and processing a covariance matrix would require a tremendous computing power. Moreover, even if the uncertainty of a biomass map is obtained, it is not clear how the uncertainty of two biomass maps would be propagated and the uncertainty of biomass change would be estimated. Lastly, there is an additional level of complexity due to the need to estimate biomass change historical trends in order to establish baselines which relies on different sources of data of different quality. The forestry R&D community is working on solutions for this but solutions are in very early stages of development, which could be due in part to the lack of familiarity of this community to work with model-based estimators and geostatistics. Hence, such technology solutions could exist in other sectors and could be utilized to estimate changes in carbon stocks and dynamics with remote sensed data.

4. Thus the World Bank has identified the need for gaining a clear understanding of the state of the art on remote sensing-based technologies to estimate carbon stock changes, emission reductions and related uncertainties, and other novel technologies that could be leveraged, as well as to identify the barriers to implement these novel technologies to estimate carbon stock changes and related uncertainties and identify the strategies to enable eliminating these barriers.
5. The World Bank would like to have a comprehensive understanding of the “readiness” of novel technologies that could disrupt the way forest monitoring is currently conducted as the need to reduce the current amount of time needed for MRV is prominent, and if there is a clear path for rolling-out this disrupting technology, the World Bank will use its convening power to support the implementation of this path.

## 2. SCOPE OF WORK

6. The consulting firm will prepare an analytical assessment report of innovative technologies<sup>2</sup> for remote sensing-based estimation of forest carbon stocks and dynamics. The report will need to define what “readiness” means, will evaluate whether these technologies meet the “readiness” criteria, and if not, identify a comprehensive list of barriers which prevent their readiness and points to strategies to overcome those barriers. In the case, when the identified technologies meet the “readiness” criteria, the consultancy firm will define a roadmap for implementing the novel approaches outlining technical and policy recommendations. The consultancy firm will also advise and assist the World Bank in all aspects of organizing a workshop of experts in a virtual format.

---

<sup>1</sup> Mc Roberts et al. (2018). <https://www.fs.usda.gov/treearch/pubs/58891>

<sup>2</sup> “Technologies” must be understood in the broad sense, not only including sensors and equipment, but processing technology, estimators, data analytics, etc.

### 3. TASKS AND METHODOLOGY

7. The consulting firm work will comprise of the following tasks:

**1. Assess the “readiness” of innovative technologies and data management systems for estimating forest carbon stocks and dynamics via a state-of-the-art review of the relevant scientific and technological advances to date. The goal of the task is to assess the “readiness” and will need to focus on:**

- 1.1. Identify any existing case studies where remotely sensed approaches have been used to quantify forest carbon stocks and dynamics.
- 1.2. Identify other innovative remote sensing technologies available that could provide robust estimates of forest carbon stocks and dynamics, beyond those already employed.
- 1.3. Identify any technologies used and present in other sectors (i.e. currently not used in forestry or earth observation applied to forestry) that could be leveraged to enable estimation of forest carbon stocks and dynamics.
- 1.4. Highlight any existing gaps, methodological issues, and limits as well as any emerging technologies and data management tools that will contribute to overcome the identified problems, including the identification of any policy and institutional barriers to rolling-out these emerging technologies.
- 1.5. Provide recommendations for the best ways to apply the selected approaches and a roadmap for implementing remote sensing-based estimation of carbon stocks dynamics and data management at appropriate scales.

The work will consist of a literature review, interviews with experts from different sectors, creation of “readiness” criteria, data analysis, and summary recommendations. These will be summarized in an analytical report.

**2. Propose and organize in collaboration with the WB FCPF team a virtual meeting of experts to discuss the finding of the assessment report and generate conclusions among the experts in the fields of science and technology and policy regarding the needs, on the limitations and readiness of current state of the art techniques for biomass/carbon estimation for estimating carbon stocks and emission reductions.**

The work will consist of developing a proposal with detailed outline for a virtual international meeting of experts to discuss the findings of the analytical assessment. The proposal needs to include, but not limited to the following: identify the best virtual platform to allow for interactive discussions; propose the best format for the meeting including the number of days and sessions; recommended potential experts for the meeting from various fields of research and justification for the proposed participants; identify specific topics, around which to structure the discussions for the meeting of experts to achieve the goal of

determining the adequacy of the latest available remote sensing-based approaches for robust and rapid applications for forest carbon stocks and dynamics.

**3. Write a summary report from the virtual meeting of experts to include the presentations and positions of all participants in full details and a summary of the most important points and include recommendations shared by the participants.**

The work will consist of taking detailed notes during the virtual meeting and writing up the summary report.

**4. Put together a position paper to serve as catalyst for finding best ways to apply the selected approaches and a roadmap for implementing remote sensing-based estimation of carbon stocks dynamics and data management at appropriate scales.**

The work will consist of writing a position paper as a synergy between the analytical assessment report and the summary report of the knowledge gained and recommendations shared from the one-day virtual meeting of experts. The position paper is to be a guidance document with the summary of findings and proposed roadmap for 1) disruptive technologies frontier for more efficient ways to apply forest monitoring via remote sensing technologies and 2) for policy makers on the necessary institutional frameworks, mandates, and incentives to ensure the operationalization of the recommended remote sensing and data management approaches.

The Consulting firm may be requested to prepare and contribute communication materials on the study and its findings. This includes a one-page summary, brochures and short video with the summary of findings.

**4. DELIVERABLES AND TIMELINE**

8. The deliverables and the expected timeline are provided in the table below.

	<b>DELIVERABLES</b>	<b>DATE</b>
1.	<b>Analytical report</b> assessing the “readiness” of innovative technologies and data management systems for estimating forest carbon stocks and dynamics	October 2020
2.	<b>Virtual meeting of experts</b>	November 2020
3.	<b>Summary report from the meeting of experts</b> of the knowledge gained and recommendations shared by the experts attending	November 2020

4.	<b>Position paper</b> serving as catalyst for identifying the best ways to apply the selected approaches and a roadmap for implementing remote sensing-based estimation of carbon stocks dynamics and data management at appropriate scales	December 2020
----	---	---------------

9. The Consulting firm needs to also submit one inception/kick-off report to present proposed structure and approach as well as progress summary reports halfway from the assignment.
10. The final draft deliverables need to be submitted to the World Bank team for comments at least four weeks before final submission dates listed in the timeline table.
11. All deliverables need to be in English language and will be submitted to the World Bank electronically.

## 5. ACCEPTANCE CRITERIA FOR THE DELIVERABLES

12. The acceptance criteria for the deliverables are set to be met against the specified work under each task and the set timeline, as a minimum criteria.

## 6. EVALUATION & SELECTION CRITERIA

- “Strength of proposed technical methodology for conducting the assignment” (50%). Strength of the methodology is demonstrated by explaining how the firm will engage with experts in other sectors in search of novel technologies and solutions, how such solutions will be utilized to achieve the objective of this project and by laying out a first idea of possible "readiness" indicators/criteria.
- “Proven qualifications and competences of the key team members for conducting the assignment” (30%). More information on competency and qualification requirements may be found below.
- “Understanding of the scope of the assignment and the FCPF and ISFL program” (20%). This will be demonstrated by the firm by showing their understanding of result based payment mechanisms such as the FCPF/ISFL, specially on carbon accounting (RL establishment and ER estimation), and how these novel technologies could disrupt this area.

Note: These evaluation criteria might be revised before to request for proposal stage.

## 13. QUALIFICATIONS

- The consulting firm should have demonstrated understanding in identifying innovative technologies and proven record in developing indicators for performance of such disruptive technologies.

- The consulting firm will need to identify experts, who will be working synergistically on this consultancy, with expertise in remote sensing technology, machine learning, artificial intelligence, cloud computing technology, statistical modeling, and data analysis. It is important that the firm understands not only remote sensing applied in the context of REDD+ and the LULUCF sector, including the estimation of carbon stocks and changes, but also understands what technologies are being used elsewhere that could be brought to this sector, i.e. the unknown unknowns. The firm shall present in its technical proposal its understanding of the problem and how the team members are able to support in the identification of disruptive solutions.

14. Key Qualifications for the experts

- Senior team leader to manage the various experts
- Ability to interact with scientists from various sectors and a wide range of stakeholders (including private sector) and to facilitate discovery
- Experience with projects focused on identifying (through scientific and market research) and qualifying (through indicators) innovating technologies to advance science beyond the status quo
- Experience developing indicators and criteria
- Experience working in more than one of the identified sectors
- Strong analytical and quantitative skills, alongside strong synthesis skills
- Experience working on UNFCCC framework related to REDD+ and LULUCF sector, result-based finance in the context of REDD+ and similar (i.e. MRV, RL), forest carbon estimation (i.e. model-based inference), cloud computing, modelling, and data analysis (e.g. big data, machine learning, deep learning, geostatistics, statistics).
- Excellent written and oral communication skills
- Strong interpersonal and communication skills

## 7. WORLD BANK PRIMARY CONTACTS

- **Project lead:** Andres Espejo, [aespejo@worldbank.org](mailto:aespejo@worldbank.org)
- **Coordinator:** Ellie Peneva-Reed, [epenevareed@worldbank.org](mailto:epenevareed@worldbank.org)

## 8. INTELLECTUAL PROPERTY

17. The World Bank shall, solely and exclusively, own all rights in and to any work created in connection with this project.

## 9. OTHER REQUIREMENTS

- **Communications:** All communications to the general public regarding this work, must be authorized by the World Bank.

- **Right of Review of Documents:** The World Bank retains the right to review any and all documents, prior to them being shared externally.
- **Staffing and Change of Staffing:** The firm must inform the World Bank of any exchange of researchers for this work. In case of failure to inform about such exchange, the World Bank retains the right to cancel or modify the original contract.