Terms of Reference

For

Procurement of Consultancy Firm for the Field Data Collection for the Development of Allometric Equations (Volume and Biomass) of Major nine Tree Species of Nepal

(Bagmati Province)

Ref: NP-REDD-462935-CS-CQS

(Budget Head 2.5.2.83)

Government of Nepal
Ministry of Forests and Environment
Forest Research and Training Centre
Babarmhal, Kathmandu

1. Background

Robust and reliable information of volume, biomass and forest carbon for the improvement of national forest monitoring system is one of the focused areas of the globe. In addition to the National Forest Inventory System, tree level allometric equations is one of the major areas to be strengthened in order to make it compatible with the needs of the REDD+ process, and establishing a reliable and effective monitoring, reporting and verification (MRV) system. One of the critical actions suggested for the second phase of the REDD+ readiness project, which includes MRV, is the development of precise and country-representative allometric equations for major tree species. However, this action has not been completed yet.

Allometric equations are statistical models used for estimating the volume and biomass of plant individuals (trees, poles, saplings, etc.), using the relationships against their different variables such as diameter, height, volume, and so on. Although input variables may vary between allometric equations, tree diameter at breast height (DBH), wood density and height are the most used input variables. Even though direct measurements of volume and biomass give higher accuracy; they are less practicable in the field due to resource limitations and the need for destructive procedures. Alternatively, allometric volume/biomass/carbon/nutrient stock equations as a function of easily measurable tree-level variables (such as diameter at breast height (dbh), total tree height, crown dimension) and stand-level variables that describe stand site quality (e.g., site index, site productivity index, etc.), stand density (e.g., stand basal area and number of stems per unit area etc.) and stand development stages are developed.

Estimating biomass is an essential aspect of carbon study, where the effects of deforestation, forest degradation, and carbon sequestration significantly affect the global carbon balance. Quantifying carbon stocks differences for various forest types is also necessary for the quantifying emission/removal factors, which are the key requirements for carbon credit market. As a result, many ecosystem services offered by forests can be evaluated using allometric equations, including the estimation of forest carbon stocks.

The use of an allometric equation has a significant contribution on carbon accounting. However, general allometric equations may not provide precise estimation due to the variability of the tree architecture and wood density of various species, affecting the amount of tree biomass and carbon stocks substantially. Thus, it is preferable to employ species-specific equations for determining the biomass of a forest.

Currently, there are no updated, accurate allometric equations for the various tree species that might be used for forest reference level (FRL) and MRV improvement for the REDD+ process in Nepal. Allometric models created by Sharma and Pukkala (1990) were used to estimate the carbon stock during the Forest Resource Assessment (FRA) in Nepal (2010-2014). Those models were developed using the wood volume tables generated from the non-destructively measured sampled data collected in the 1960s, and wood density was taken from different countries for different purposes. The 1990 allometric models are the ones used for the current version of the FRL. Updated allometric equations would support (i) the fulfilment of specific methodological framework requirements of specific standards (ii) the need to have more accurate measurements that will impact, among other elements, a lower uncertainty buffer (increasing the number of emission reduction (ERs) that can be transacted) (iii) the need to have accurate tool for scientific forest management. In order to upgrade the data tiers for

REDD+ processes, other related initiatives and forest management, there is an urgent need to develop species-specific volume and biomass allometric equations for major tree species using the robust scientific approach.

Over the past decade, REDD Implementation Centre (REDD-IC), under the REDD+ Readiness project, has made various attempts to create allometric equations (Volume and Biomass) for the significant tree species identified in the national forest resource assessment 2015 of Nepal. However, their initiatives were not completed for various administrative and technical reasons. Recognizing its importance, "Forests for Prosperity" has also identified the preparation of Allometric Equations as one of the significant activities for carbon accounting which ultimately help to develop appropriate and precise policies and plans for sustainable management of forests. As a result, the Forest Research and Training Center (FRTC) planned to develop allometric equations for each of the major sixteen tree species in Nepal. Among the identified 16 major forest volume/biomass contributing species, up to now FRTC has collected data of seven tree species from the field and planned to gather data of remaining nine tree species, namely, *Quercus* spp, *Acer* spp, *Rhododendron* spp*, Picea smithiana, Pinus wallichiana, Tsuga Dumosa, Betula Utilis, Lyonia ovalifolia and Abies* spp. However, the data of whole number of trees cannot be collected in a single year. Therefore, the assignment for the consultancy firm is intended to collect data from Bagmati province.

2. Objectives of the Assignment

The main objective of the program is to prepare the allometric equations of nine major tree species of Nepal, namely: *Quercus* spp, *Acer* spp, *Rhododendron* spp*, Picea smithiana, Pinus wallichiana, Tsuga Dumosa, Betula Utilis, Lyonia ovalifolia and Abies* spp.*,* The purpose of this assignment is limited to felling, measurements, recording, and collection of data and samples of the above-mentioned tree species within Bagmati Province. The details of variables and measurement/sampling protocols are documented in a field manual. Specific objectives of the assignment include:

- Collecting tree and stand-level variables/attributes;
- Collecting data on the stem, branches, and foliage attributes;
- Collecting and transport samples/specimens to the laboratory for developing volume and biomass models.

3. Scope of the Work

For work convenience, time management and efficient outputs, the project has divided this assignment into two clusters - Gandaki and Bagmati. This TOR is related to for the Bagmati Province. The following tasks need to be carried out for the successful completion of this assignment.

3.1 Desk Review

Before beginning this task, it is crucial to review and comprehend the volume and biomass equations already existing for the different tree species. To understand the methods, procedures, and designs employed thus far, a desk review of the FRA process in Nepal, FRA reports, FRL, MRV documents related to REDD+ readiness, and other national and

international allometric equations related to published or unpublished reports, documents, and guidelines are necessary. Such guidelines and manuals are also required to ensure the accuracy of data collection and comprehend the standard data collection process.

3.2 Consultation with the Technical Committee and Other Stakeholders

The consultancy firm shall work in regular consultations and discussions with the Technical Committee formed by the MOFE/FRTC to get appropriate guidance for the successful completion of the task assigned. The committee will also supervise and oversee this assignment for quality assurance and quality control. The Technical committee will comprise of;

1. Coordinator -DDG or senior undersecretary from FRTC
2. Member - Representative from REDD-IC
3. Member - Representative from the Department of Forests and Soil Conservation (DoFSC)
4. Member - Representative from the Department of National Parks and Wildlife Conservation (DNPWC).
5. Member Secretary – Officer from Biometry section, FRTC.

Related experts from FRTC, REDD-IC, the Ministry of Forests and Environment (MOFE), the Department of Forests and Soil Conservation, and Provincial Ministry of Forests and Environment & Division Forest Offices (DFOs) should be consulted regularly. It is also necessary to consult with the relevant forest authorities, local government, local communities, and forest users.

3.3 Sampling Design and Selection of Trees

Sampling design for tree selection, harvest and measurement is essential to create accurate and representative allometric equations. In order to construct a sampling frame, it was assumed that there are adequate quantity and size of trees around the FRA permanent sample plots. Before starting this program, the REDD IC, FRTC and other concerned stakeholders had already listed the number of possible sample trees and FRTC will identify the sample trees for harvesting and measurement. However, if the selected trees are found decayed or broken or are not suitable for sample collection due to any other causes at the time of harvesting, the FRTC will arrange other alternative tree of same group of size and species.

Around 100 (subject to revision until RFP is issued) trees of different sizes and of nine species should be felled, sectioned, debarked, measured, and recorded as prescribed in the Manual prepared for such assignments. In addition to the felling and measurement around 3 (subject to revision until RFP) trees would be studied by uprooting the whole trees. The consulting firm should work closely with the Technical Committee and FRTC.

3.4 Preparation of fieldwork

Fieldwork is the core part of this assignment. Therefore, fieldwork preparation is essential for successfully completing the task efficiently, effectively, and precisely. The consulting firm is responsible for making necessary arrangements for fieldwork, travel, and logistics. Besides, field crews will be instructed on tools and equipment as well as the measurements and safety measures during the pre-field training. Furthermore, the consulting firm should prepare the field plan in coordination with the Technical Committee then approved by FRTC. The

consulting firm should follow the data form prepared by FRTC for collecting the field information of the fieldwork.

3.4.1 Trainings

The consultancy firm should organize and manage the field crew's pre-field training for 4 days with at least two field days, including field practical. Field crews should be mobilized only after they are adequately trained for the job. The firm should be responsible for all aspects of training.

3.5 Felling and Measurement of Trees

Felling and measurement are the core part of the assignment given sites. Field protocol/manual, prepared by FRTC, must be followed during felling, measurement, and data recording. The following activities to be performed under this task include, but are not limited to:

I. Navigate to the tree, layout the plot and measure all the tree diameter (greater than 5 cm) within plots, and measurement of stand and site-specific parameters, including trees to be felled,
II. Felling of the sample trees in accordance with tree felling rules and safety measures,
III. Measuring the diameter (both over bark and under bark) at different intervals of the stem up to 10 cm top diameter,
IV. Delimbing, sectioning, and taking measurements of tree stem and large branches (>10cm diameter),
V. Measuring *in-situ* weights of smaller stems, smaller branches, and all foliage immediately after separating them from the tree,
VI. Collecting representative specimens/sub-samples of each component of all felled trees, *i.e.,* taking out of an adequate number of discs from stems, large branches, and composite samples of foliage and smaller branches for laboratory analysis,
VII. Recording weight and volume of discs of stem, root and branches following the standard methods,
VIII. Transport collected materials (stem discs, branch discs, and foliage) to the FRTC Biometry lab in pristine condition.

3.5 Management of Felled Trees and their Parts

Stems and branches of felled trees should be sectioned, piled, and stacked. Timber and fuel wood should be stacked separately. The felled materials (tree stems, branches, etc.) and their records should be handed over to the concerned authorities (DFO and/or Community Forest User Groups). Moreover, field crews should clean the sites before leaving the camp. The pit created by the uprooting of the tree should be filled to prevent any potential issues caused by the pit.

The samples/discs should be properly labeled, safely transported, handed over to the FRTC staff, and placed in the designated space.

3.6. Data Entry and Submission

The consultancy firm shall provide a hard copy and digital copies of every piece of data/information gathered during the field. The data collected during the fieldwork should be verified and confirmed. The data must be entered into a spreadsheet or any suitable format.

Software should be in a correct format as agreed upon with the FRTC, and its accuracy should be thoroughly checked and confirmed. FRTC and technical committee will validate the submitted data.

4. Work schedule and Reporting

4.1 Inception Report with Detail Action Plan and Timeframe

An inception report with detailed methodology and an action plan with a timeframe should be submitted within one week of signing the contract or as per the agreement in the contract. The consultancy firm shall prepare a stepwise work schedule present at the Inception Workshop. After incorporating all the feedback, suggestions, and inputs from the FRTC, the Technical Committee, and the workshop participants, the inception report must be finalized and submitted to the FRTC for approval. The consultancy firm shall submit three hard copies and a digital copy of the inception report to the FRTC.

4.2 Progress Report

The consultancy firm shall submit a monthly progress report (both field and office work) during the assignment period as per the reporting format/template provided by the FRTC. The template should, not limited to include the following information;

i. Statistics of data, sample/specimen collected;
ii. Photographs (movie clips if any) from the field;
iii. Manpower (both skilled and unskilled) used during the period;
iv. Issues in the field and feedback from the field activities.
v. Narrative of the progress.

4.3 Draft Report and Final Report

The consultancy firm shall submit two hard copies and a digital copy of the draft report to FRTC for comments and suggestions after completing the assignment. The comments and suggestions provided by the FRTC should be incorporated into the final report. Three hard copies and a soft copy of the final report should be submitted to FRTC. In addition, all relevant photographs, videos, raw data, digital data and samples/specimens must be submitted to FRTC.

5. Deliverables

The consultancy firm shall submit the following deliverables to the FRTC:

1. Inception report: within two weeks after the contract;
2. Training report: Field crews will be trained after approval of the inception report, and the training report will be submitted within one week of completion of the training;
3. Monthly Progress reports: First week of following month till the completion of the task
4. The draft report: will be submitted after completion of the fieldwork and data entry (within 4 months of the contract).
5. Handover of tally sheet and sample specimens/discs of stem, branches, foliage and bark to FRTC.
6. Final report: June 2025.

Deliverable will be tied up with a payment mechanism elaborated in RFP.

6. Team composition and qualification of the firms

6.1 Qualification of the Firms

The consultancy firm should be legally registered to the concerned authority and registered in the VAT system as provisioned in the prevailing Act. The firm/company should have tax clearance until the last fiscal year. The firm should have a minimum of 5 years of general work experience and have conducted at least one of the following activities: (a) allometric equation, (b) growth modeling, or (c) forest inventory (i.e., covering a large area, at least at the provincial level). Firms having experience in allometric equations will have preference. When applying as a joint venture (JV), each company must individually meet the requirement of having a minimum of five years of general working experience with a valid JV agreement or with an intention to form a JV agreement and its purpose. At the shortlisting stage, the firms will be assessed for (a) Experience of firms (general and specific), (b) Qualification and (b) organizational capability (technical and managerial capability).

6.2 Team Composition, Responsibilities, and Qualification of the Team Members

The assignment will be executed by a team of experts led by a Team Leader assisted by a one field manager and 5 field crews. However, more field crews might be necessary depending on the time of contract and climatic condition to complete the task on time. Each field crew should include one Crew Leader, one Senior Forest Technician, one Forest Technician, one power chain saw handler with one helper, and field laborers (skilled and unskilled) as required. Furthermore, Local Resource Persons and the representative of the concerned forest authorities and/or forest users are also required to facilitate the fieldwork. Among them, the qualification and experience of only Team Leader, Crew Leader and Senior Forest Technician and Forest Technician will be evaluated. However, other experts such as Forest Technician and Field manager must be offered with at least minimum qualification and experience mentioned in this TOR.

6.2.1 Team Leader (One person)-2.3 person Months (Intermittent input over the period of 3 months)

Roles and responsibilities: The Team Leader will lead the team in close coordination with and under the guidance of the technical and management committee and FRTC. The team leader will:

- Study and analyze FRA documents, FRA system, and other inventory and allometric equations-related literature;
- Develop action plans with a timeline of each activity after discussion with other team members;
- Coordinate team and make sure that all the crew members are trained and capable of performing their respective jobs for the assignment;
- Prepare the Inception Report for presentation in the inception workshop;
- Incorporate comments and suggestions and finalize methodology for fieldwork in consultation with the FRTC and Technical committee;

- Coordinate consultation meetings and discussions with the Technical Committee, FRTC, REDD-IC, and other relevant forest authorities at the provincial and district/field level;
- Make sure that all the field works (felling and measurement of selected trees) are completed following the protocol developed by FRTC and data are recorded and appropriately kept;
- Prepare and submit reports in accordance with the deliverables mentioned in section 5.

Required qualification and experience:

The team leader should have the following qualifications and experience for this assignment:

- MHinimum qualification of Master's degree in any of the following subjects: Forestry/ Natural Resource Management or equivalent
- at least 10 years of working experience after minimum qualification in a related field;

The consultant should have specific experience in conducting at least two activities or having two years of experience in allometric equations, forest inventory, or biometry work. Preference will be given to experts with experience in allometric equations.

- Experience in leading a project/team/program etc., is preferable.

6.2.2 Crew Leaders (5 persons)- Each 2.5 person Months (Intermittent input over the period of 3 months)

Roles and responsibilities: The crew leaders are responsible for leading the field crews and coordinating concerned forest authorities and other stakeholders at the field level. S/he is mainly responsible for the field work, including stand and plot measurement, felling of sample trees, sectioning, and measurements. Furthermore, the crew leader is responsible for collecting sub-samples/specimens, labeling them, and transporting them to the Kathmandu laboratory. S/he is also responsible for recording data, quality control, data validation, and data entry.

Required qualifications:

- Have minimum qualification of Bachelor's degree in forestry and three years of work experience in related fields (or higher Degree in forestry/related fields and one year's experience);

Specific experience in allometric equations, tree measurements (related to this task), national forest inventory, or biometry work will be considered. Preference will be given to candidates with experience in allometric equations.

6.2.3 Senior Forest Technician (5 persons)- Each 2.5 person Months (Intermittent input over the period of 3 months)

The forest technicians are responsible for assisting the crew leader. They are mainly responsible for measuring plot-level and tree-level data: preparation of sample disc, proper leveling, and packaging, and directing to forest technician for other measurements of the tree sections.

Required qualification:

- Have minimum qualification of I. Sc. forestry/Diploma in Forestry degree and 3 years of work experience in related assignments (or higher Degree in forestry and one year of experience);
- Preference will be given to the person having specific experience in tree measurement, forest inventory, and biometry works;

6.2.4 Forest Technician (5 persons)- Each 2.5 person Months (Intermittent input over the period of 3 months)

The forest technicians are responsible for assisting the crew leader and senior forest technician. They are mainly responsible for measuring tree-level data, assisting the senior forest technician and volume measurement of samples as guided by the field protocol.

Required qualification:

- Have minimum qualification of I. Sc. in forestry or Diploma in forestry or above;
- Preference will be given to the person having specific experience in tree measurement, forest inventory, and biometry works.

6.2.5 Field Manager (1 person)-2.5 Person Months (Intermittent input over the period of 4 months)

The field manager is responsible for assisting the team leader. They are mainly responsible for the logistic and field equipment management, organizing training, crews' mobilization to the field, coordination to the Divisional Forest office (DFO), Warden (Protected Areas), Forest User Group and other concern stakeholders. The field manager is also responsible for managing the conflict if any adverse condition arises in the field.

Required qualification:

- Have minimum qualification of B.Sc. in forestry and three years of general experience in forest related field work or I. Sc. /Diploma in forestry and 10 years' experience in forest related field work;
- Preference will be given to the person having specific experience as field manager in relevant work.

6.2.4 Other Support Staff

Other support staff includes local resource persons (LRPs), tree cutters, skilled and unskilled laborers, porters, drivers, foresters for volume measurement etc. LRP should help the field crews at the local level by providing field level support and coordination, whereas the laborers are required for felling, sectioning, measurement, and weighing of tree components. Each field crew should have at least one power chain saw handler and one helper; the consulting firms should hire them. Power chain saw operators should have high skill for felling trees and minor maintenance of chain saw.

7. Inputs to the Firm

7.1 Information about selected Trees

The client will provide the location, size, and site information of selected trees for felling, measurement, recording, and sample collection to complete the assignment.

7.2 Documents and Consultations

The FRTC and REDD-IC will provide access to background documents to carry out the assignment. These include:

- Data collection field manual for biomass and volume equations;
- Publications on Volume and biomass equations of tree species in Nepal;
- Reports and methodologies about biomass modeling and related works;
- Reports of ongoing NFI system and periodic reports of FRA in Nepal;

FRTC will provide the necessary support for organizing the consultations at all levels.

7.3 Equipment and Tools

It is the responsibility of the firm to manage the required equipment/tools for the assignment. The consulting firm will have the required field equipment and tools for forest plot measurements, tree measurements, tree felling, sectioning, measuring sections, and taking weights of the sections. The FRTC will provide GPS, Vertex, and Diameter Tape to the selected consulting firm for this task if available, the consulting firm should submit a bank guarantee of an amount as decided by FRTC. All the equipment taken from the client must be returned in good condition after completing the assignment. In case of loss of equipment, typically, replacement should be done. Other required equipment will be managed by the consulting firm itself.

8. Supervision, Monitoring, and Quality Control

The FRTC and the Technical Committee constituted explicitly for this task will cooperate in overseeing, monitoring, and ensuring the quality of the data collected in the field by the firm. A separate budget will be allocated for this purpose (The firm will not be responsible for the cost associated with this). Supervision and monitoring of the work will be done simultaneously with the measurement activities conducted by the field crews. Since the method for this assignment is destructive, supervision and monitoring is more important.

Quality control and quality assurance are done in the overall process from the client's beginning to the end of the assignment. The quality assurance and control will be done mainly in tree and site selection, felling, sectioning, and measurement of the trees, and collection and measurement of sample specimens. The quality of the sample will be checked, especially by repeated measurement. At least 5% of the plot will be measured.

9. Safety and Precaution

The firm should ensure all the safety and security measures such as complete safety equipment and accessories for field crews, including First Aid, field gear, insurance, etc. The consulting firm should make all such arrangements for the field staff (including the lab).

10. Intellectual Property Rights

All the data collected in the field, daily field books, original sets of maps used, processed data, and the database developed during this assignment will be the property of the Government of

Nepal. The consulting firm must submit primary field data (hard and soft copy) sample specimens and final report to the FRTC. The data should not be used for any other purpose or to any third party without the prior written consent of FRTC.

11. Deliverables and tentative Payment Schedule

SN	Deliverables/Output	Timeline/Duration after signing the agreement	Instalment of Payment
1	Inception report	2 weeks	-
2	Training report: Field crews will be trained after the approval of the inception report, and the training report will be submitted	Within 1 month	20%
3	Monthly Progress reports: Monthly progress reports will be submitted during the first week of the following month	First week of following month	
4	Completion of 50% works (i.e., Handover of 50% tally sheet and sample specimen)		30%
5	Draft Report and Field Tally Sheet: The draft report along with tally sheet will be submitted after completion of fieldwork and data entry	within 4 months of the contract	-
6	Handover sample specimens/discs of stem, branches, foliage and bark etc. to FRTC		35%
7	Submission and Approval of final report	June 2025	15%

Note: Payment would be made after submission and acceptance of each reports/deliverable.

12. Selection Process and Criteria

The consultancy firm shall be selected based on the Consultant Selection method set forth in World Bank's Procurement Regulations for IPF Borrowers, Fifth edition September 2023. The method of selection will be Consultant Qualification Selection (CQS). The selected firms based on EOIs will be requested to submit the full proposal following the World Bank's Procurement Regulations.

13. Work Schedule

The assignment is expected to begin in March 2025 and should be completed by June 2025.