



## **Assessment of Forest Biomass and Carbon stocks for REDD preparations in ACP Member countries**

### **Training for Construction of Aboveground Biomass Allometric Models**

#### **Workshop Report**

**Lae, Papua New Guinea, December 6<sup>th</sup> -9<sup>th</sup> 2011**



## **Introduction and Background**

The Centre for International Forest Research (CIFOR) has partnered with Papua New Guinea Forest Research Institute (PNGFRI) to deliver a project that builds technical and scientific research capacity and networking in the Pacific countries, Fiji, Papua New Guinea (PNG), Solomon Islands and Vanuatu. The project “**Assessment of forest biomass and carbon stocks for REDD preparations in ACP member countries**” was proposed by the African Caribbean Pacific (ACP) member countries and was accepted by the European Union (EU) as a priority where there is need in target developing countries. It is identified as the cross continental project (CCP) which is supposed to be undertaken concurrently in all regions. The project is funded under the ACP EU Forestry Research Network (FORENET) through an agreement between the African Caribbean Pacific (ACP) and the European Union (EU) for the support of selected developing countries.

Building on previous ACP EU FORENET workshops and meetings held in PNG, Fiji and Vanuatu 2008 and the regional workshop held in Lae, PNG (30-31 March 2009) and Honiara, Solomon Islands (1- 2 June 2011), this training on construction of above ground allometric models (6-9 December 2011) was focused on building technical capacity for scientist, managers and foresters to understand the need for biomass measurement and enable them to develop models from biomass measurements.

The December 2011 workshop in Lae, PNG was attended by 25 participants and expert presenters. Participants were from Pacific countries that receive support through the ACP EU FORENET under the Cross Continental Project (CCP).

The goal of the CCP is “strengthening forestry research network in the field of forest and climate change”.

### **Specific objectives;**

1. Build up institutional capacity in carrying out forest biomass and soil carbon assessment
2. Develop, implement and maintain a common procedure, to readily assess the regional forestry resource in terms of above ground biomass and carbon stocks
3. Build data base to develop regional allometric equations for more reliable estimation of regional and national carbon stocks in above ground biomass
4. To quantify at the same time the soil carbon stock and litter carbon from inventories for management and policy decisions.
5. Expand networking on forest research activity in ACP countries.

The workshop program included updates on the ACP EU FORENET and the CCP, expert presentations and discussions on what allometric models are and how they are constructed and used.

The three-day workshop ended on a high note, with recommendations for the participants from Fiji, Solomon Islands and Vanuatu to quickly confirm their countries coordinators so that plans and implementation schedule to be finalized for transfer of funds for the work to commence immediately.

## **Proceedings of the Workshop**

### **Opening Remarks and Introduction**

The Deputy Director of PNGFRI, Dr Martin Golman, opened the workshop. He gave a brief background on the nature of ACP EU FORENET project and stressed the importance for maintaining collaborations because small countries in the Pacific are long way from developing a lot of capacities in the scope of this project.

The Team Leader for CCP, Patrick Nimiago thanked and welcomed the participants. He provided an overview of the project and the broad expectations of this project, which is also expected to end in December 2012. He stressed the importance of keeping the same people on the project so that there is continuity and consistency in the approach towards implementing this collaborative project to meeting its goals. The specific aim of this workshop was on field testing the ACP EU FORENET “Manual of Standard Procedures for the measurement of Above Ground Biomass and Allometric equation development”

The ACP EU FORENET Focal Point Person, Forova Oaviva expresses his satisfactions with the progress made so far in the Pacific despite many difficulties and challenges faced firstly in getting the funds for CCP then slowness in procurement of essential equipment

### **Day 1- Presentations Biomass and Construction of Biomass Allometric Models**

This presentation was done by Dr Hitofumi Abe on what biomass is and why it is important to measure and report in relation to forest management practices and climate change under the United Nation Climate Change Conventions, the requirement for reporting of national green house gases (GHG). Key objectives emphasized in the beginning of the training are that participants are expected to understand;

1. What forest biomass is and why we need to know it.
2. Get the basic ideas of work involved for construction of biomass allometric models.
3. Know how to access funding and technical assistance.

The first presentation by Dr Abe provided a brief background on biomass as an important biological component of universe that has the capability to increase or decrease in size and its implication in the global carbon balance and climate change. The impacts of climate change and role of forest in mitigations under UNFCCC (United Nations Framework Convention on Climate Change) endorsed concepts of A/R CDM and

REDD+. All these mechanisms require a robust monitoring reporting and verifications systems based on good science for compliance to set standards and baselines.

The second presentation by Dr Abe was focused on what biomass allometric models are and procedures involved in data collection, constructions of models and the interpretations and applications of such models in each site. Specific references were made to previous work in PNG undertaken by Dr Abe for construction of allometric model for one *Eucalyptus deglupta* plantation and a natural forest. Examples were shown to participants for them to understand what is involved in site selection, tree and species selection, destructive sampling methods and the constructed models with estimated biomass, which were the end results of the work undertaken by Dr Abe in his studies.

The practical approaches in estimating forest biomass without constructing allometric models by adopting already available generic models from similar forest or geographic regions was also mentioned and discussed. This include discussion on models by (Chave *et al.* 2005), and (Brown 1997), for tropical forests. Using these generic models to estimate forest carbon is probably acceptable under IPCC (Intergovernmental Panel on Climate Change) at Tier 2, which requires emission factors and activity data from country specific data that are derived from improved inventory or better data sources. However a previous study shows possible risk of large errors (up to 40%) using generic models to estimate forest biomass and carbon. The countries, which has already conducted national forest inventory or is going to conduct it, should consider constructing country's own biomass allometric models to improve accuracy and reliability of forest carbon estimation.

The third presentation by Dr Abe on how to construct biomass allometric models was based on the ACP-FORENET manual of standard procedures for the measurement of above ground biomass and allometric equation development. This presentation gave participants an insight into sampling strategy, sampling, design, selection of trees by species and diameter size classes, and the whole tree measurements from standing trees to all the samples. Dr Abe also showed where he thought the ACP manual could be slightly changed to suit conditions of each forest type. He made specific reference to tree selection by diameter classes, sectional measurements of diameter with bark thickness, and the set mid point's measurements and selection of samples for determining the wood density.

The fourth presentation by Patrick Nimiago on field work was again based on the ACP EU FORENET manual. He went through the procedures for tree selection, the measurements to be taken during sampling for fresh weights, proper labelling and recording of measurements.

The importance of ensuring that all necessary equipment is prepared and field sheets are ready was emphasised, this is because most participants would assume the supervisor role in such work. The participants were then divided into three groups in preparation for working in biomass measurements. However due to lack of time after we were unable to work in separate groups.

There was also a presentation made on the Oomsis research site by Mr Forova Oavika. This site has been one of the main research sites for PNGFRI over the years and still has intact forest. The site is now leased from landowners for this work and work already done included boundary survey and establishment of sample inventory plots. Information on species abundance, volume and basal area by species were used as the basis for first selection of main species, *Protium* sp, *Anisoptera thurifera*, *Canarium* sp, *Cryptocarya* sp, *Litsea* sp, *Horsefieldia* sp, *Pometia* sp, *Terminalia* sp.

## **Day 2 Demonstrations and practical training in field (Oomsis)**

The objective of the field work was for all to learn how measurements are done.

The participants were divided into three groups and required to observe and take part on the first tree together then to work in separate teams. However the selected tree, *Pometia pinnata* with buttress, measuring 44.2 in diameter and 35.0 height with large branches was just enough for one days work. Since this was the first time for most participants to have a feel of this type of work they were soon exhausted.

### **Description of the field work undertaken**

1. Tree species was recorded with confirmed diameter reading above the buttress. Point of measurement was 1.3m.
2. Chainsaw operator cut down the tree.
3. Distance tape was stretched along the tree bole and diameter was measured at mid point of every odd number (1,3,5 ....31). Bark thickness was also measured along using bark thickness gauge.
4. Branches were separated from the stem and leaves were removed from branches. Flowers were also removed from branches.
5. Flat base electronic balances were placed on firm ground and leveled prior measurements. Lagre sacle was for the big samples
6. Branches were divided into separate sizes and then fresh weights were taken as per the manual.
7. Two samples each for the flowers, leaves, twigs, and all branches were weighed and taken for dry weights (oven drying).
8. The stem was divided into 6 meter sections and then a section measuring 30 cm was cut off from the bottom end then fresh weight taken immediately. Total of 5 sections for the whole tree.
9. Three diameters (top, middle and bottom) were measured with bark then without bark. Four measurements were taken for the lengths (at right angles). A sub sample of about 5 cm thick was cut severed from each of the 5 sections then weighted and taken for dry weight.
10. Total fresh weights of barks were taken and then two samples were weighed and taken for oven drying.
11. The tree stump including the buttress was cut off at ground level, total parts with and without bark was measured.

12. All samples were properly labeled and moved to laboratory for oven drying.

The field work was undertaken with assistance from 10 people engaged from the local landowners from Oomsis. They helped in removing leaves and separation of all branches by parts.

### **Day 3 Data analysis – hands on training**

The first short session included a recap of what was undertaken the previous day out in the field. All the recorded field data were cross checked and confirmed with what was done in the field.

The main event in the day was for some practice or hands on training on construction of allometric models. It was hoped that the project would have already had some data from some initial work prior this workshop for the participants to use but that was not possible. Because of that Dr Abe again provided the data from his work from the plantation and natural forest in PNG. He showed how all the data collected was then combined for each tree on Ms excel. Relationship between diameter and biomass using the scatter and the logarithm function was displayed with the strength of allometric equation indicated by the  $R^2$ . Though this exercise was meant to be done individually, not all participants had a laptop computer so it was done in groups. It was a very simple exercise which everybody cope with easily.

After some work on tree measurements have been taken then it is hoped that each country will have some real data for their selected forest type as good representative of their country and for combination to come up with something for the region as well.

In the last session, oven dryer in the herbarium was prepared and samples were placed at set temperature of 60 ° C. The samples will be monitored and weighed each day until constant weigh is attained. This should take about two week depending on the species and size of wood samples. Dry weights for the first tree done together will be provided to participants later after drying is completed.

Electronic copies of all the presentation were prepared and copies to provide to participants. And that ended the formal training program.

### **Day 4 Where to go from here**

This session was dedicated to open discussions on how this project will be implemented. The key issues put forward by P. Nimiago included;

1. Collaborators – the project need to confirm quickly names of individuals and collaborating institutions for each country within the region. This will enable proper coordination and administration of the project with each country and the region. This was a real concern because apart from PNG, other countries have not yet really

decided on who is participating and this could affect the implementation in each country.

In this discussion Fiji, Solomon Islands and Vanuatu put forward another list but will be subjected to confirmation in their respective countries?

<b>Country</b>	<b>Coordinator</b>	<b>Collaborator</b>
<b>Fiji</b>	<i>Rafaele Raboiliku</i>	<i>Sefa</i>
<b>Solomon Islands</b>	<i>Fred Pitisopa</i>	<i>Terence Titiulu</i>
<b>Vanuatu</b>	<i>Ioan Viji</i>	<i>Toufau Kalsakau</i>

2. Budget - the budget need to be formulated consistent with approved activities for the project. This should include travels, transport, allowances, and personal, essential equipment purchase, and field and laboratory operational costs.

- ✓ All agreed that draft budget and work/activity plan be done and submitted by end of January 2012- **30/01/12**
- ✓ Draft will be revised and finalized and proposed date to start real work is beginning March 2012 -**01/13/12**.
- ✓ Patrick Nimiago to format the budget and reporting templates.

3. Coordination of CCP- P. Nimiago explained the need to have a counterpart within collaborating institutions in the region to implement the project in their country and provide report to PNG for compilation to submit to CIFOR and ACP EU on quarterly basis and if and when required. However the group felt that, proposed time for reporting back to PNGFRI should be flexible because it depends on each country's activities and a major report must be submitted to FRI by the end of September 2012 before final presentation expected by November 2012.

Forova mentioned that if 80% of the funds allocated for carrying out the activity is used and work is incomplete than each countries must quickly request for funds together with their acquittals/expenditure reports and the progressive reports to FRI and FRI will compile the final report together and submit it to CIFOR for further funding.

4. Trainings

- ✓ Forova Oavika will revise and finalize the methodology for the biomass allometric equation.
- ✓ Preparations are underway for soil and carbon assessment training proposed to be conducted at FRI by Forova Oavika, Patrick Nimiago and Lydia Edoni in June 2012.

## 5. Equipment and Personnel

Sets of scales (electronic balances) for biomass measurements have been ordered from Australia and now in PNGFRI. These scales will be further shipped to each collaborating institutions from Fiji, Solomon Islands and Vanuatu for the work to start when ready. It was intended that participants from those countries will want to take with when they returned after the training. However they were still undecided thus their scales were left behind. The constraints faced by the partner countries as highlighted by Vanuatu and Solomon Islands is yet to be addressed; availability of staff capacity and financial arrangement for the transfer of funds.

## Evaluations on the training

In understanding whether the objectives of the training were met participant were requested to provide feedback based on questions related to the objectives of the training. There were 14 participants (excluding P. Nimiago and Dr Abe) who responded to the set of questions. These responses were summarized and presented below.

### 1. How do you rate your understanding of forest biomass?

Almost all stated that they had good understanding while one had a very good understanding of the subject.

### 2. How do you see the need to assess forest biomass?

All rated high importance, 86 % thought very import to assess forest biomass.

### 3. Are oral presentations on descriptions of methods on tree sampling clear?

The oral presentation appeared to not meeting their expectations, 29% stated that they found it difficult to follow though 71 % did stste they followed through easily. This reflected the differences in their experiences background knowledge on this type of work.

### 4. Are the examples on tree sampling and construction of allometric equations clear?

There was only one person who thought the examples were very clear while 64% thought the examples were clear while 9% indicated that the examples were not clear.

### 5. Is this training enough to get you started on data collection and construction of allometric equation?

It was clear that this training alone is insufficient as 64 % indicated that this training is not enough, and more assistance is needed.

**6. Are you familiar with the funding sources or technical assistance for this or similar work?**

There was one who is fully aware of financial assistance, 53% seemed aware while 39% claimed to be not aware of such funding and technical assistance under the project.

**7. Is the training relevant?**

On the question of relevance, all rated the training as relevant, 69% rated it to be very relevant.

**8. What is your overall expectation of the training provided?**

There were three people whose overall expectations of the training were not met, while 78 % were satisfied with two people claiming to be very satisfied.

**9. Other comments and suggestions (Optional)**

- Some were not happy with their accommodations.
- Two people thought the training was poorly organized; PNGFRI participants were not informed in advance.
- Tree sampling was not done in orderly manner or step wise.
- Lack of time for group training was blamed on poor planning. More time is needed in field work and hands on training.
- Field data sheets need to be revised and improved
- Follow training is desirable for better planning of such work and to field and laboratory work include data analyses

Those were honest responses and comments from the participants. Unfortunately the project could not find better alternative accommodations at the rates within our budget and we thought as part of training we have to be accustomed to staying in cheap places in some remote places to undertake such field research work. Lack of full time personnel on the CCP project meant not everything could be done excellently meeting all expectation from the participants. As this is the first training on forest biomass work covering three countries and many participants we agree that we did not properly organize some component of the training. It was obvious when we could not keep together and complete the selected tree, and then time ran out for group sessions. Since time and time are deciding factors, such group trainings might not be repeated under this project. However this is only the beginning of such collaborative work and Dr Abe did express his desire to assist anytime. All that is needed is for countries to first schedule the work, state their purpose and send official invite to him, he is flexible and would attend to their requests.

## **Discussion**

The nature of the project is such that all participating country new to this type of research work must be first acquainted with the methodology. The overall objective was to develop allometric equations for applications in biomass estimation. The work requires very careful and diligent measurement of trees from the field to laboratory and mathematical analyses. It is basically a capacity building project where participants learn by doing. We wanted representatives to be confident first, and then go on with sampling in each country. Time has been spent on consulting publications and in getting further expert scientific advice on correctness of methodology and the type of instruments to employ. The most reliable scales and ovens were not immediately available in all participating countries thus a lot of time and effort were committed towards searching for scales and oven.

In this training participants were provided with an update on project activities, developments in the CCP, application of allometric models and ACP EU methodology for measurement of above ground biomass and allometric equations development. The training included lectures and practical training on tree selection, tree measurements and sampling of fresh and dry weights and allometric calculations.

The CCP will require measurement, data entry and construction of allometric model based on 150 trees from selected representative forest type and to be done in each participating countries. This was the initial training on research methodology for forest biomass assessment for the development of allometric equations and is the start off for the CCP research work within the pacific region. The participants from the four countries have now been introduced to the type of work, what preparations are necessary and most importantly hands on training on the common methodology. It is hope that what is learned will be then enables them to plan first then assistance will also be provided to undertake research in their own countries. It is going to be a big challenge but the project is committed to supporting some work and capacity enhancement in each member country. This project is setting the stage for each country to build on. Not much time is available for this project, which must produce some results by November 2012.

The importance of carefully selecting a representative forest type in each country was discussed. There are difference in each country, the structure and function of forests, species composition and forest values, forest and land ownership and land uses. These are pertinent issues that should be considered and included in the planning of the project in each country.

The manual for CCP is now available for use. Funding is also available however it will require compliance with approved procedures for accessing and reporting on the use of funds. Results and report on work undertaken will have to be provided timely for verification. It is import that all activities must be documented and reported, this is the responsibility of coordinating teams of each country. Strengthened collaboration amongst institutions in the participating countries is our common interest and goal under this project.

## **Acknowledgement**

Participants left the workshop much better informed about how biomass allometric models are constructed, the value of biomass data for providing information on forest carbon stocks, methods for measuring forest biomass and the issues and challenges in implementing the CCP. We acknowledge the support from SPC and JICA for the involvement of Dr Hitofumi Abe, the JICA regional forestry technical advisor based in Fiji. We also thank Ms Janet Sabub for her excellent support in organizing workshop and for her contribution to the project.

## The Workshop Program

Date	Time	Training contents
6 Dec (Tue)	09:00 09:15 09:30 09:50 10:10 10:40  12:00 13:00 13:40 14:20 14:50 15:30 16:00	Welcome ( <i>Dr Martin Golman, Deputy Director, PNGFRI</i> ) Training orientation ( <i>Patrick Nimiago</i> ) ACP-FORENET project ( <i>Forova Oavika</i> ) ACP-FORENET Cross Continent Project ( <i>Patrick Nimiago</i> ) Morning tea Introduction of Biomass Allometric Models ( <i>Dr Hitofumi Abe</i> ) <ul style="list-style-type: none"> <li>Objectives of the training</li> <li>Why we need to know forest biomass</li> </ul> Lunch How to construct biomass allometric models ( <i>Dr Hitofumi Abe</i> ) Introduction of the field exercises ( <i>Dr Hitofumi Abe</i> ) Afternoon tea Introduction of Oomsis Forest ( <i>Forova Oavika</i> ) Fieldwork orientation ( <i>Patrick Nimiago</i> ) End
7 Dec (Wed)	All day	Fieldwork at Oomsis – <i>hands on training</i>
8 Dec (Thu)	09:00  10:30 11:00 12:00 13:00	Lab sample processing <ul style="list-style-type: none"> <li>Drying &amp; grinding samples</li> </ul> Morning tea Statistical analysis ( <i>Dr Hitofumi Abe</i> ) Lunch Data analysis – <i>hands on training</i>
9 Dec (Fri)	09:00 09:30 09:50  10:10 10:40 12:00 13:00 14:00 15:00	Lab sample processing – <i>hands on training</i> Where to go from here ( <i>Patrick Nimiago</i> ) How to access ACP-FORENET funding and technical assistance ( <i>Forova Oavika</i> )  Morning tea Action plan preparation by participants Lunch Training wrap-up ( <i>Patrick Nimiago</i> ) Introduction of PNG forestry and <i>Araucaria</i> plantations in Bulolo (Wake Yelu) Closing / Farewell gathering
10 Dec (Sat)	All day	Field visit to Bulolo

## Participants

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