

Report on REDD+ Readiness Technical Workshop, Bhutan

16-18 March 2011



Living Himalayas Network Initiatives

WWF Nepal

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1. Background

Reducing Emissions from Deforestation and Forest Degradation (REDD+) is a mechanism that establishes incentives for developing countries to protect and better manage their forest resources by creating a financial value for the carbon stored in forests. It is linked with market mechanism that allows industrialized countries to offset their emissions by purchasing carbon credits from developing countries, which reduce emissions from deforestation and forest degradation by avoiding such activities. Therefore, it is a win-win strategy whereby host countries can be compensated for their land use, while industrialized countries are expected to pay less than half of the prices of other types of carbon credits. REDD+ includes the role of biodiversity conservation, sustainable management of forests and enhancement of forest carbon stocks.

Basically, there are 3 mechanisms under REDD+. First the host country should have REDD strategy in place that includes incentive system for forest dependent communities whose participation is crucial for the plan's success. Secondly, the host country should establish a reference deforestation rate, based on an examination of historical deforestation trends, and using a credible and verifiable methodology. And, thirdly a monitoring mechanism capable of providing data on deforestation and forest degradation on an annual basis should be developed. This monitoring mechanism is the key to independent verification of emission reductions from deforestation and degradation. Hence, the amount of emission reductions is determined by comparing the achieved deforestation and forest degradation rates against a baseline scenario and payments are made usually once the emission reductions have been verified independently.

Developing countries like Nepal and Bhutan could take advantage from forest carbon marketing under REDD+ mechanism as majority of the country's area are intact with forest cover. But, despite the potentiality of carbon financing that contribute to global carbon abatement under REDD+ mechanism, inadequate technical difficulties and scientific basis has limited forest carbon estimation in developing countries and thereof the claim for the payment of carbon compensation in international market. The key technical and ecological challenges include ensuring the permanence and additionality of carbon stocks, preventing leakage, and setting an appropriate reference scenario or baseline for assessing reductions in deforestation and forest degradation. Therefore, sound knowledge and technical capacity of human resources should be developed to overcome the above challenges and accrue financial, social and environmental benefits. With this aim WWF Living Himalayas Initiative and Forest Resources Development Division (FRDD) under Department of Forest and Park Services jointly organized a workshop from 16th to 18th March 2011 on forest carbon assessment and LiDAR application for REDD+ readiness in Bhutan.

2. Objectives

The specific objectives of the workshop were –

- a) To strengthen the technical capacity of officials in the Forest Resources Development Division on forest carbon inventory and LiDAR application
- b) To explore integration of Arbonaut's LiDAR application into the National Forest Inventory of Bhutan for undertaking forest resources assessment and carbon inventory.

3. Capacity building of Bhutan Government officials on Forest carbon inventory

More than 35 participants (see Annex I) from Department of Forests and Parks Services (Forest Resources Management Division; Watershed Management Division; Forest Research and Development Centre; National Parks and Wildlife Sanctuaries; Nature conservation Division) including stakeholders from SAARC Forestry Center, The Ugyen Wangchuck Institute of Conservation and Environment and WWF Bhutan attended the 3 days' workshop. The resource persons from WWF Nepal and Arbonaut, Finland facilitated the technical sessions and field works on the ground.

Day I. Technical session on international standards and methods of forest carbon inventory

After a formal welcome note from Ms. Kezang Yangden, Forest Officer (FRDD) and introduction by participants, Mr. Kinley Tshering, Chief Forest officer shortly briefed on the objectives of the REDD+ Readiness Technical Workshop. Before starting the technical session, expectations were collected from the participants. Most of the participants showed their willingness to learn about reliable forest carbon assessment methods and applicability of Arbo-LiDAR in Bhutanese context. Considering the expectations from the participants, firstly, a background was set up on -Emergence of REDD, International standards and Methods for carbon accounting. With this the participants became acquainted on-

- a) 3 tier models of 2006 IPCC guidelines for national greenhouse gas inventories,
- b) Voluntary carbon standards (leakage, additionality and permanency) and
- c) Climate, community and biodiversity project design standards (which described community and biodiversity benefits).

Secondly, topics related to forest carbon inventory, the necessary equipments, project boundary delineation, forest stratification, sampling design and field measurement methods (for trees, shrubs, litter and soil) were broadly discussed along with some technical terms and social dynamics of REDD+.

Day II. Field work at Enroute Dochula

The participants were divided into 3 groups prior to working on the sample plots identified at Enroute Dochula near Thimphu. At the beginning, participants were acquainted on calibrating and using the equipments (especially GPS, DME, crown densitometer etc.) in the field. Then they located individual sample plots and tagged all the trees inside 500 sq m circular plot for measurements. Above ground biomass (Trees-500 sq m, shrubs-25 sq m and litter-1 sq m) measurements and soil sample were taken from the nested circular plots for further calculation and data analysis. Crown densitometer and fish eye lens were used to estimate the forest crown density. Additionally, the groups were also trained to use Arbonaut's mobile android data collection application. By using this application one can enter details on the sample plots, reference plots, take pictures of the sites and so on. These attributes can be modified as per the database requirement of any specific project. After collating all information, they are saved and sent to the main server for data analysis. Currently, this software application is limited to HTC mobile, Samsung Galaxy mobile and those mobile which support the android application.

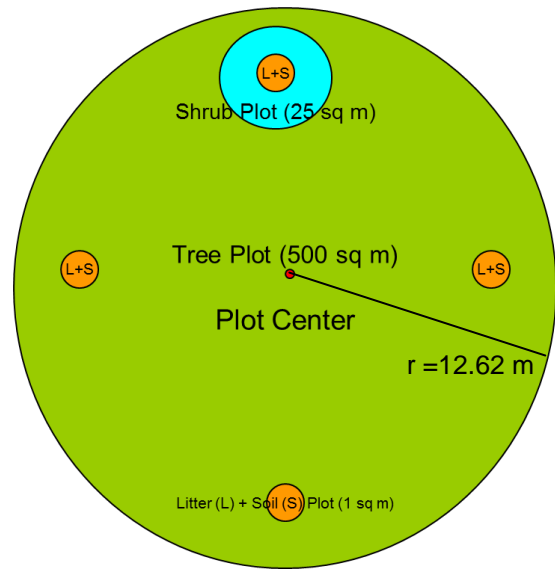


Fig 1. Nested circular plots

Day III. Data analysis and brief on carbon market- 1st half

The three groups worked individually on the data that they collated from the field for above and below ground carbon estimation. Since biomass equation for Bhutan was not available at the moment to calculate forest carbon, so biomass equation used by WWF Nepal in TAL area was used to demonstrate data analysis methods. Similarly a proxy figure was taken for dry weight of shrubs, litter and a soil sample respectively as lab analysis was not done for the samples collected. Nevertheless, the participants got acquainted on the process and methods of data collection and analysis for forest carbon assessment. In addition, carbon market options were also discussed to offset carbon footprint nationally and globally. As REDD+ has not yet been institutionalized under IPCC, so carbon credits from standing forests are currently sold in a voluntary carbon market after certified by an accredited third party.

Day III. Technical session on Arbo-LiDAR- 2nd half

During the technical session the participants were briefed on Arbo-LiDAR methods, its benefits in forest inventory and carbon assessment. The method has been proven in Finland, Sweden, Norway, Laos, New Zealand, Australia, Brazil, Peru and currently being used for national forest resource assessment in Nepal. The Arbo-LiDAR method uses LiDAR Assisted Multi-source Programme for REDD+ monitoring,

reporting and verification. LiDAR (Light Detecting and Ranging) is an active remote sensing developed for terrain mapping and provides precise 3D shape information of the terrain and vegetation.

Mr. Drukpa, Director of FRDD Government of Bhutan stressed that the REDD+ readiness workshop was a timely intervention when Bhutan is planning for its National Forest Inventory. He further added that Bhutan should come up with a good baseline for forest carbon and should coordinate with other stakeholders to best adopt applicable scientific methods and techniques for forest carbon assessment. With this, there is more likelihood that the government of Bhutan will carry out forest carbon assessment at national level through integrating it into the national forest inventory program.

4. Applicability of Arbo-LiDAR for REDD+ monitoring, reporting and verification

The Arbo-LiDAR uses airborne laser scanning to measure- a) Distance, time elapsed between pulse emission and registration of back scattered laser pulses, b) Orientation (yaw, pitch, roll) and c) Position. Normally 0.5 to 2 return pulses/m² is sufficient for forest inventory. It is applicable for mapping vegetation density, vegetation height and biomass and carbon density. The earlier two variables do not require ground reference, but for mapping biomass and carbon density, it requires ground reference. A block of 5X10 km² is divided into 6 clusters and each cluster is divided into 8 plots for ground truthing. The size of plots may vary from 250 m² to 1250 m² and distance between plots measure 150 m X 300 m. Later, biomass of each plot is computed with allometric models, root-shoot ratios or biomass expansion factors. Some other deliverables by Arbo-LiDAR were- mean diameter, mean height, basal area, stem count/ha., stem volume/ha., canopy cover, above and below ground biomass etc. The cost of using this application for forest inventory varies according to coverage of the surface area, viz.

a) 20 million ha. (2-stage sampling) costs US\$ 0.07-0.15/ha;

b) 2 million ha. (2-stage sampling) costs US\$ 0.4-0.6/ha; and

c) 200 000 ha. (Wall to wall) costs US\$ 3.5-4.5/ha.

5. Experiences of WWF Nepal on REDD+ readiness

WWF Nepal initiated first forest carbon project in the Terai Arc Landscape (TAL) to establish forest carbon stock at a sub-national level. With prior approval from the Department of Forests (DoF) and Department of National Parks and Wildlife Conservation (DNPWC), the inventory was conducted in community forests, national forests and inside the national parks. The project was accomplished in 4 phases; in the 1st phase, 3 districts (Banke, Bardia and Dang) were covered; in 2nd phase, 2 districts

(Kailali and Kanchanpur) were covered; in 3rd phase, 3 districts (Kapilvastu, Rupandehi and Nawalparasi) were covered and lastly other 4 districts (Chitwan, Parsa, Bara and Rautahat) were covered for forest carbon inventory. A methodology was developed for forest carbon stock using ground truthing inventory, tested and results obtained to establish a forest carbon stock baseline for the year 2009. A total of 121 permanent sample plots were laid out across TAL for ground truthing and developing baseline of forest carbon stock. The forests were classified into 4 strata depending on the crown cover of the forest, viz. Strata I=1-10% canopy cover; Strata II=11-40% canopy cover; Strata III=41-70% canopy cover and Strata IV=71-100% canopy cover. The weighted average carbon stock from these strata across TAL was 237.74 tC/ha. The total carbon sequestered across TAL varied according to the forest management regime. The carbon stock was found highest in the forests inside protected areas (274.58 tC/ha.) followed by forests managed by local communities (240 tC/ha.) and government managed forests (206.15 tC/ha.). Concurrently, the annual deforestation rate (including all forest strata) from 1990 to 2009 was found to be 0.19 %; and with this reference it was projected that 0.13 % deforestation rate could be avoided until 2050 with sustainable forest management practices under REDD+ mechanism (i.e. 54854 ha. total avoided deforestations until 2050). Thus, reduced emission across TAL from avoided deforestation was calculated 12,373,316 CO₂e in tons.

Recently, WWF Nepal is preparing for the 3rd tier forest carbon inventory across TAL using Arbo-LiDAR application within the framework of National Forest Resource Assessment (FRA) Project in coordination with Ministry of Forest and Soil conservation and Department of Forest Research and Survey.

6. Foreseen challenges on Forest Carbon Inventory in Bhutan

a) Lack of technical capability and human resources

REDD+ is an emerging topic for climate negotiations by developing countries. In countries like Bhutan where more than 60% of its total area is under forest cover, the country can benefit from global carbon market, but lack of technical capability and trained human resources on forest carbon estimation is one of the issues hindering the process. The Department of Forest and Park Services, Government of Bhutan therefore seeks to train their field based officials on forest carbon assessment to enhance their capacity and ground implement the REDD+ works simultaneously with the national forest inventory. At the mean time the current workshop has been a stepping stone for capacity building of the human resources in Bhutan.

b) Tree Biomass equation not available for Bhutan

Forest carbon depends on many variables like type of species, age of trees, slope and aspect, soil types, climate etc., hence different forest types sequester carbon at different rates and thereof allometric equation for biomass estimation also varies. In Bhutan, there is no biomass equation developed yet to be used for forest carbon assessment. Even the IPCC guideline report does not have any biomass

equation that imply to the forest types in the South Asia region. Therefore, the government of Bhutan along with focal persons from the School of Forestry is planning to develop allometric equations using destructive sampling method for 40-50 important species found in the country.

c) Fund limitation for forest carbon inventory in Bhutan

The development of a national level forest carbon baseline would require sound human resources, time and money. The fund allocated for national forest inventory would not be adequate for doing forest carbon assessments in Bhutan. Application of modern technologies like satellite imagery, LiDAR assisted multi source programme for REDD monitoring, reporting and verification cost high. However, integrating forest carbon assessment with national forest inventory might certainly reduce the total cost because most of the datasets (for e.g. tree height, diameter etc.) collected from forests for both national forest inventory and carbon inventory are similar and these can go hand to hand at a time to develop a baseline scenario. Hence, Department of Forest and Park Services seek financial and technical support from Bhutan government, academic institutions, major stakeholders and other potential donors for conducting national level forest and carbon inventory.

7. Opportunities from Forest Carbon in Bhutan

It is difficult to predict the REDD market due to technical complexities (permanence and leakage), high implementation costs (monitoring) and insecurity of land tenure for the forest dependent communities that may lead to inequality in benefit sharing. Nevertheless, it offers opportunities for countries like Bhutan where major chunk of lands are covered under forests. REDD+ offers a cost effective way to mitigate greenhouse gases, while simultaneously delivering sustainable financing scheme and strong co-benefits like- poverty alleviation and biodiversity conservation.

8. Major outputs of the workshop

- There is high commitment level from the government of Bhutan to develop biomass equation and methods for carbon estimation. The FRDD has planned to develop allometric equations of 40-50 important tree species using a destructive method.
- Government of Bhutan is planning to integrate forest carbon measurement within the National Forest Inventory program. Currently, as a preparatory work for National forest inventory, the FRDD is setting up 4 regional offices (*where??*) for data management.
- The participants of the workshop agreed on a number of action points (see Annex II).

ANNEX I List of Participants

S.N.	Name of the Participants	Designation/Agency	Email
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ANNEX II Action points agreed by the participants on future REDD+ readiness activities

Activity	Projected Time	Collaborators
1. FRDD and Jarno work on projected outcomes of LiDAR relevant to proposed components in NFI Bhutan	18 March – 21 March	FRDD and Jarno Arbonaut
2. FRDD present proposal to NFI Core Group and Ministry	March 2011	FRDD
3. Based on Approval/Recommendations –		
a. Arbonaut (possibly Taumo)/Other Experts visit and discussions with Bhutan	May 2011	FRDD, WWF, Arbonaut
b. DoFPS, MoA team sensitization on LiDAR	April-May	FRDD, WWF, Arbonaut
c. Participants from Bhutan visit Nepal to learn field applications of LiDAR	1st week May recommended Set no. of days/visit program	FRDD, WWF, Arbonaut
4. FRDD coordinates meeting among stakeholder agencies and international/regional partners to finalize methods, tools and funding commitment	By Aug/Sept 2011	FRDD, WWF, Arbonaut, USFS, Yale University
5. LiDAR Integration Proposal Finalization	Depends on decisions made by stakeholders meeting	
6. Plans for procurement, capacity building	Depends on decisions made by stakeholders meeting	
7. Start NFI Field Implementation	July 2012	FRDD

ANNEX III REDD+ Readiness Technical Workshop Schedule

REDD Capacity Building Training
(Technical Workshop for Forest Carbon Stock Assessment Methodologies)
Bhutan

Day I: 16th March 2011

VENUE: WWF Conference hall, Kawajangsa.

Time	Programme	Lead
11:00-11:15	Short brief about the aim of the REDD training	Kinley Tshering, CFO,FRDD
11:15-11:30	Introduction – ice breaking	All participants
11:30-12:00	Emergence of REDD	Mr.Ugan Manandhar, WWF Nepal
12:15-12:45	International standards and Methods	Mr.Ugan Manandhar, WWF Nepal
12:45-13:45	Lunch break	
13:45-15:45	Inventory Steps and Equipments Project Boundary Delineation Stratification Sampling Design Locating plots Establishing Permanent Plot Field Measurement Highlights to degradation	Mr.Ugan Manandhar, WWF Nepal and Ms. Erica Udas, WWF Nepal
15.45-16:00	Tea break	
	Arbonaut's mobile Android-data collection application (as a	Mr. Basanta

16:00-16:30	modern option for traditional field data logging)	Raj Gautam
16:40-17:00	Technical Terms	Mr.Ugan Manandhar, WWF Nepal
17:00-17.25	MRV System	Mr.Ugan Manandhar, WWF Nepal
17:25-17:45	Insight to Social Dynamics of REDD	Mr.Ugan Manandhar, WWF Nepal
17:45-18:00	Overview of National Forest Inventory and the plans for Forest Carbon measurement	Kezang Yangden, FO, FRDD

Day II: 17th March 2011 (Field Work)

Field Site: Enroute Dochula- four selected plots

Time	Program	Lead	Remarks
08:00	Leave to the field site and group division for field work at the site.	FRDD and resource persons	Pick up from respective hotel by bus
08:30-08:45	Group division and equipment distribution to each group		
8:45-9:00	Quick demonstration for field measurements before starting plot data collection	Mr.Ugan Manandhar, WWF Nepal and Mr. Basanta Gautam	
09:00-13:00	Work on sample plots (tentative 2 plots)	Each group	
13:00-14.00	Lunch -Dochula top		
14:00-17:00	Work on sample plots (tentative 2 plots)	Each group	

Day III: 18th March 2011

Venue: WWF conference Hall, Kawajangsa

Time	Programme	Lead
09:00-11:00	Data analysis and presentations (use MS-Excel)	Each group
11:00-11:15	Tea break	
11:15-11:30	Analysis and Carbon Market	Mr.Ugan Manandhar, WWF Nepal
11:30-12:00	WWF Nepal's experience on REDD	Mr.Ugan Manandhar, WWF Nepal
12:00-12:30	Demonstration of ArboWebForest (Open Source Platform for Forest Data Collection, Reviewing and Publishing)	Mr. Basanta Raj Gautam and Mr Jarno Hamalainen
12:30-13:00	Discussion/ Q & A session	Resource persons
13:00-14:00	Lunch break	
14:00-14:45	LIDAR-Assisted Multi-source Programme (LAMP) for REDD+ Monitoring, Reporting and Verification	Mr.Jarno Hamalainen
14:45-15:45	LAMP in scope of the National Forest Resource Assessment (FRA) in Nepal: Lessons learnt	Mr.Basanta Raj Gautam
15:45-16:15	Discussion and Q&A session	
16:15	Tea break	
18:30	Closing Dinner	