Carbon Benefits Project:
Modelling, Measurement and Monitoring

Gemma Shepherd, UNEP

Assessing Total System Carbon:
A review workshop for the GEF of the tools developed by
The Carbon Benefits Project
12-16 September 2012
Introduction

• Land use and land use change contribute 30% of greenhouse gas emissions

• Sustainable land management projects have potential to:
  • reduce GHG emissions
  • sequester carbon

• GEF need a standardized way of assessing carbon benefits & smallholders could benefit through carbon credits
The Carbon Benefits Project: Modelling, Measurement and Monitoring

Aims to develop scientifically rigorous, cost-effective tools to establish carbon benefits of sustainable land management interventions in terms of protected or enhanced carbon stocks and reduced greenhouse-gas emissions.

(1) estimate and model carbon stocks and flows and GHG emissions under present and alternative management, and

(2) measure and monitor carbon changes under specified land use and management
The Carbon Benefits Project: Modelling, Measurement and Monitoring

• A suite of tools, with instructions on how to use them, available from a single website.
  http://www.unep.org/ClimateChange/carbon-benefits/cbp_pim/

• Applicable to all projects involving interventions in natural resources management, such as forestry, agroforestry, agriculture and pasture management, in all climate zones, soils types and land uses.
Carbon Benefits Project: Modelling, Measurement and Monitoring

Approximately 30% of greenhouse gas (GHG) emissions come from land use and land use change. Sustainable land management (SLM) projects have the potential to not only reduce GHG emissions, by reducing emissions from biomass burning, biomass decomposition and the decomposition of soil organic matter, but also to sequester carbon (C) through practices that increase biomass production and promote the build up of soil organic matter and therefore provide global environmental benefits.

**Problem**
The GEF finances a wide range of SLM activities in developing countries from reforestation and agroforestry projects to projects that protect wetlands or foster sustainable farming methods. The carbon benefits of these and other non GEF SLM projects are likely to be considerable. However, at the moment it is difficult to compare the C benefits of different land management interventions as a range of different methods are used to measure them. Equally, it is difficult for SLM activities in developing countries to gain the financial rewards they deserve from emerging carbon markets.

**Opportunity**
GEF and other SLM projects need to know if SLM interventions affect C stocks or GHG emissions. A protocol is needed which guides the user through all stages of delivering an SLM intervention in terms of proving C benefits, from forecasting at the planning stage, monitoring and verification at the implementation stage, to long term projection of future impacts. The CBP is developing such a protocol.

**Product**
The product of the effort will be a modular, web-based system that allows the user to collate, store, analyze, report and project carbon and total GHG benefits in a standard and comprehensive manner.

**Potential Application**
A standardized C benefits protocol will allow the comparison of different SLM projects by the GEF and other donors. It would also bring developing countries closer to being able to gain reward for land management activities that sequester carbon.

**Project Benefits**
These include:
- Measurement of terrestrial carbon in heterogeneous landscapes with many land cover types that include smallholders in developing countries.
- A cost effective and accurate system documenting the mitigation of atmospheric carbon levels as a global environmental public good and thus providing a way to compare and document project performance in climate change mitigation (a global environmental public good).
- The system will facilitate projects that create climate adaptation, mitigation and conservation benefits by reinforcing their ability to demonstrate carbon benefits, thus making projects that include a carbon component more attractive.
- The system will assist land use carbon project developers in selecting methods that combine livelihood benefits with climate change mitigation benefits.
Please Login

E-mail

Password

Forgot your password?

Remember me?

Login >>
Create New Project

1. Please Enter Basic Project Information

- Project Name
- Project ID Code
- **Project Status**
  - Proposal
- Project Start Date
  - MM/DD/YY
- Project Duration
  - Years
- Project Country (Countries)
  - Afghanistan
  - Akso Chin
  - Albania
  - Algeria
- Project Region
- Communities/Countries/Provinces Involved

2. Is this a GEF co-funded project?
  - Yes
  - No

buttons:
- Cancel
- Create
## View Current Projects and Reports

<table>
<thead>
<tr>
<th>Project Name</th>
<th>GEF Project Code</th>
<th>Status</th>
<th>Start Date</th>
<th>Edit</th>
<th>Reports</th>
<th>Go to…</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test1</td>
<td>999</td>
<td>Proposal</td>
<td>1/1/2012</td>
<td>Edit</td>
<td>View</td>
<td>Toolkit Advisor</td>
</tr>
</tbody>
</table>

**To view a report, click on View in the Reports column above.**

[Carbon Benefits Project: Modelling, Measurement and Monitoring](#)
## Select Modelling or Measurement Tools

<table>
<thead>
<tr>
<th><strong>Simple Assessment</strong></th>
<th><strong>Direct Measurement</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>of the impact of a project on carbon stock and greenhouse gas emissions. Requires information on land use changes and/or livestock production in the project area. Suitable for a quick assessment at any stage including proposals. Uses standard information on greenhouse gas emission rates.</td>
<td>provides a general protocol and specific methodologies for field, laboratory and remote sensing measurements of carbon stocks and greenhouse gases. Requires extensive field measurements and remote sensing analysis to measure carbon stocks in soil and biomass and monitor their changes over time in the project area. Displays project spatial information in an online information system to manage measurement data in carbon and greenhouse gas projects. Project indicators display a results framework of social, biodiversity and environmental indicators of carbon and greenhouse gas benefits in the project area. The data derived from measurements can be used directly for reporting changes in the carbon and greenhouse gas balance or the measurement data may be used as inputs for CBP modelling assessments.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Detailed Assessment</strong></th>
<th><strong>Project Planning Tools</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>of the impact projects have on carbon stocks and greenhouse gas emissions. Requires information on land use changes and/or livestock production in the project area plus can utilize local and project specific field measurements and other local datasets. Suitable for detailed reporting in projects with a reasonable focus on climate change mitigation.</td>
<td>provide supporting information for project managers during the development phase of landscape carbon and other sustainable land management projects. The information provided is useful for making decisions on which trees to plant based on a large database of agroforestry trees, to estimate the economic benefits that can be expected from participating in the carbon markets by planting trees and support in setting up project boundaries using available maps.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Dynamic Modelling</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>utilizes the Century Model to assess soil and biomass carbon stock changes. For users with a scientific background who wish to model carbon stock changes in projects with a carbon focus.</td>
<td></td>
</tr>
</tbody>
</table>
Modelling System Pages

Welcome

Welcome to the Carbon Benefits Project (CBP) Modelling Pages, hosted by Colorado State University.

This Component of the CBP System provides three tools for estimating the impact of a land management project on carbon stock changes and greenhouse gas emissions:
- The Simple Assessment,
- The Detailed Assessment,
- The Dynamic Modelling option

It also provides a Cost-Benefit Analysis (CBA) and a social analysis - the Drivers-Pressures-States-Impacts-Responses (DPSIR) Framework.

After using the tools, users can generate a report giving the carbon / greenhouse gas balance of their land management project.

Help can be accessed from the button in the upper right corner of each page.

To begin, click on the Project Description menu at the top of this page and then select an option in "Step 1" to begin describing your project.

We recommend using the web browsers Firefox, Chrome, or Safari with these tools.
Measurement & Monitoring

The direct measurement guidelines within the Carbon Benefits Project provide general guidelines for field, laboratory, and remote sensing measurements of carbon dioxide and other greenhouse gases in GEF land based projects. These measurement efforts require extensive field sampling inventories and remote sensing analysis to measure carbon stocks in soil and woody biomass and then monitor their changes over time in the project area. Project measurement data can be displayed in an online Monitoring, Reporting, and Verification geographic information system to manage carbon measurement data in GEF land based projects. Project indicators based upon multiple date remote sensing analysis of the project area display a results framework of carbon benefits within the lifetime of the project. The data derived from measurements can be used directly for reporting GHG emissions or the measurement data may be used as inputs for CBP modelling assessments.
Measurement Guidelines for Carbon in Woody Biomass

The first five modules on this page provide general guidance for field, laboratory, and remote sensing measurements of above ground woody biomass in Global Environment Facility projects. These guidelines require minimal field sampling and extensive remote sensing analysis to measure carbon stocks in woody biomass in both forest and non-forest land cover and then monitor their changes over time within the project area. Landscape carbon indicators that are based upon multiple date remote sensing analysis of the project area display a results framework of carbon benefits within the lifetime of the project. The data derived from measurements of above ground woody biomass are used for reporting greenhouse gas emissions or the measurement data may be used as inputs for CBP modelling assessments.

<table>
<thead>
<tr>
<th>Ex Ante Carbon Calculations</th>
<th>Guidelines to calculate ex ante carbon sequestration in tree planting projects and avoided emissions in forest conservation projects using global default values or national data when available.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agroforestry &amp; Trees Outside Forests</td>
<td>Guidelines to measure the carbon stocks in the woody biomass of trees in non-forest land cover (agroforestry in crop land, trees outside the forest in grassland) using minimal field measurements and extensive satellite remote sensing.</td>
</tr>
<tr>
<td>Afforestation &amp; Reforestation</td>
<td>Guidelines to measure the carbon stocks in afforestation or reforestation projects using extensive field measurements and minimal satellite remote sensing.</td>
</tr>
<tr>
<td>REDD</td>
<td>Guidelines to measure carbon stocks in woody biomass in forest land cover for reduced emissions from deforestation and degradation projects using minimal field measurements and extensive satellite remote sensing.</td>
</tr>
<tr>
<td>Project Assessment Indicators</td>
<td>Guidelines to develop landscape carbon indicators that are based upon multiple date remote sensing analysis of the project area that can display a results framework of carbon benefits within the lifetime of the project.</td>
</tr>
</tbody>
</table>

Supplemental Tools

<table>
<thead>
<tr>
<th>Standard Operating Procedures</th>
<th>This tool provides Standard Operating Procedures for Field Measurements, Data Collection, and Reporting to support the Forest Carbon Measurement Guidelines.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allometric Equations</td>
<td>Guidelines to develop project specific allometric equations to measure woody biomass.</td>
</tr>
<tr>
<td>Wood Density</td>
<td>Guidelines to measure wood density and carbon content in woody biomass using NIR Spectroscopy.</td>
</tr>
</tbody>
</table>
Measurement Guidelines for Soil Organic Carbon and Non-CO2 GHGs

The documents on this page provide specific guidelines for field, laboratory and remote sensing measurements of soil organic carbon and other non-CO2 greenhouse gases. These guidelines require extensive field measurements to measure soil organic carbon stocks and emissions of methane and nitrous oxide within the project area. The data derived from measurements can be used directly for reporting GHG emissions or the measurement data may be used as inputs for CBP modelling assessments.

Guidelines to Measure Soil Organic Carbon

A methodology to measure soil organic carbon stocks in agriculture, forestry and other land uses incorporating field measurements, laboratory analysis, remote sensing, data management, and reporting forms. Click HERE to download an Excel file with sample calculations.

Guidelines to Measure Non-CO2 Greenhouse Gases

A methodology to measure soil emissions of methane and nitrous oxide in agriculture, forestry and other land uses incorporating field measurements and laboratory analysis.
## Project Planning Tools

Project Planning Tools provide supporting information for project managers during the development phase of biocarbon and other sustainable land management projects. The information provided is useful for making decisions on which trees to plant based on a large database of agroforestry trees, to estimate the economic benefits that can be expected from participating in the carbon markets by planting trees and support in setting up project boundaries using available maps.

<table>
<thead>
<tr>
<th>Tool</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agroforestry Database</td>
<td>Detailed information for 670 agroforestry trees.</td>
</tr>
<tr>
<td>Useful Tree Species for Africa</td>
<td>A species selection tool based on “The Vegetation Map of Africa” website.</td>
</tr>
<tr>
<td>Multi Criteria Tree Species</td>
<td>Click here to download the spreadsheet tool to prioritize tree species for planting. Click here for guidelines to use the MCTS tool.</td>
</tr>
<tr>
<td>Species Selection Tool</td>
<td>A tool to help define project boundaries.</td>
</tr>
<tr>
<td>Project Boundary Tool</td>
<td>A tool to help stratify land cover classes within the project boundaries.</td>
</tr>
<tr>
<td>Stratification Tool</td>
<td>A tool to help stratify land cover classes within the project boundaries.</td>
</tr>
<tr>
<td>Data Management Tool</td>
<td>Click here for guidelines to set up a structured data management system. Click here to download sample databases.</td>
</tr>
<tr>
<td>Community Participation Manual</td>
<td>A manual to engage local communities in carbon measurement and monitoring.</td>
</tr>
<tr>
<td>Training the Trainers Manual</td>
<td>A manual to train extension workers who are training local communities for landscape carbon measurement.</td>
</tr>
<tr>
<td>CBP and other Carbon Standards</td>
<td>A manual to compare the CBP with other existing carbon standards.</td>
</tr>
</tbody>
</table>
Select Modelling or Measurement Tools

**Simple Assessment** of the impact of a project on carbon stock and greenhouse gas emissions. Requires information on land use changes and/or livestock production in the project area. Suitable for a quick assessment at any stage including proposals. Uses standard information on greenhouse gas emission rates.

**Detailed Assessment** of the impact projects have on carbon stocks and greenhouse gas emissions. Requires information on land use changes and/or livestock production in the project area plus can utilize local and project specific field measurements and other local datasets. Suitable for detailed reporting in projects with a reasonable focus on climate change mitigation.

**Dynamic Modelling** utilizes the Century Model to assess soil and biomass carbon stock changes. For users with a scientific background who wish to model carbon stock changes in projects with a carbon focus.

**Direct Measurement** provides a general protocol and specific methodologies for field, laboratory and remote sensing measurements of carbon stocks and greenhouse gases. Requires extensive field measurements and remote sensing analysis to measure carbon stocks in soil and biomass and monitor their changes over time in the project area. Displays project spatial information in an online information system to manage measurement data in carbon and greenhouse gas projects. Project indicators display a results framework of social, biodiversity and environmental indicators of carbon and greenhouse gas benefits in the project area. The data derived from measurements can be used directly for reporting changes in the carbon and greenhouse gas balance or the measurement data may be used as inputs for CBP modelling assessments.

**Project Planning Tools** provide supporting information for project managers during the development phase of landscape carbon and other sustainable land management projects. The information provided is useful for making decisions on which trees to plant based on a large database of agroforestry trees, to estimate the economic benefits that can be expected from participating in the carbon markets by planting trees and support in setting up project boundaries using available maps.