

The Carbon Benefits Project (CBP)

Tools to estimate the climate change mitigation co-benefits of land management projects

Eleanor Milne, Mark Easter and Keith Paustian

Plus many more!

**NASA Carbon Monitoring System: Policy
Speaker Series**

30 November 2016



The CBP Modelling Component



Colorado State University

NREL at CSU are Component A Lead and responsible for Component A methodology



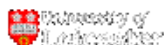
ISRIC—World Soils Information

Providing global soils information for carbon stock assessment



Overseas Development Group, UEA

Providing socio-economic expertise



The University of Leicester

The Department of Geography is providing advice on RS and supporting coordination



Centro de Energia Nuclear na Agricultura

Providing detailed data for parameterization and testing of CBP methods and models



The KAP SLM Project

This Kenyan project, involving KARI will help develop and implement a C benefits protocol



The Ningxia IEM Agricultural Dev. Project

This Chinese GEF project will help develop and implement a C benefits protocol



The Niger/Nigeria IEM Project

The NN IEM GEF Project will help develop and implement a C benefits protocol



The GEF Gansu Capacity Building Project

This Chinese GEF project will help develop and implement a C benefits protocol



Institut de Recherche pour le Développement

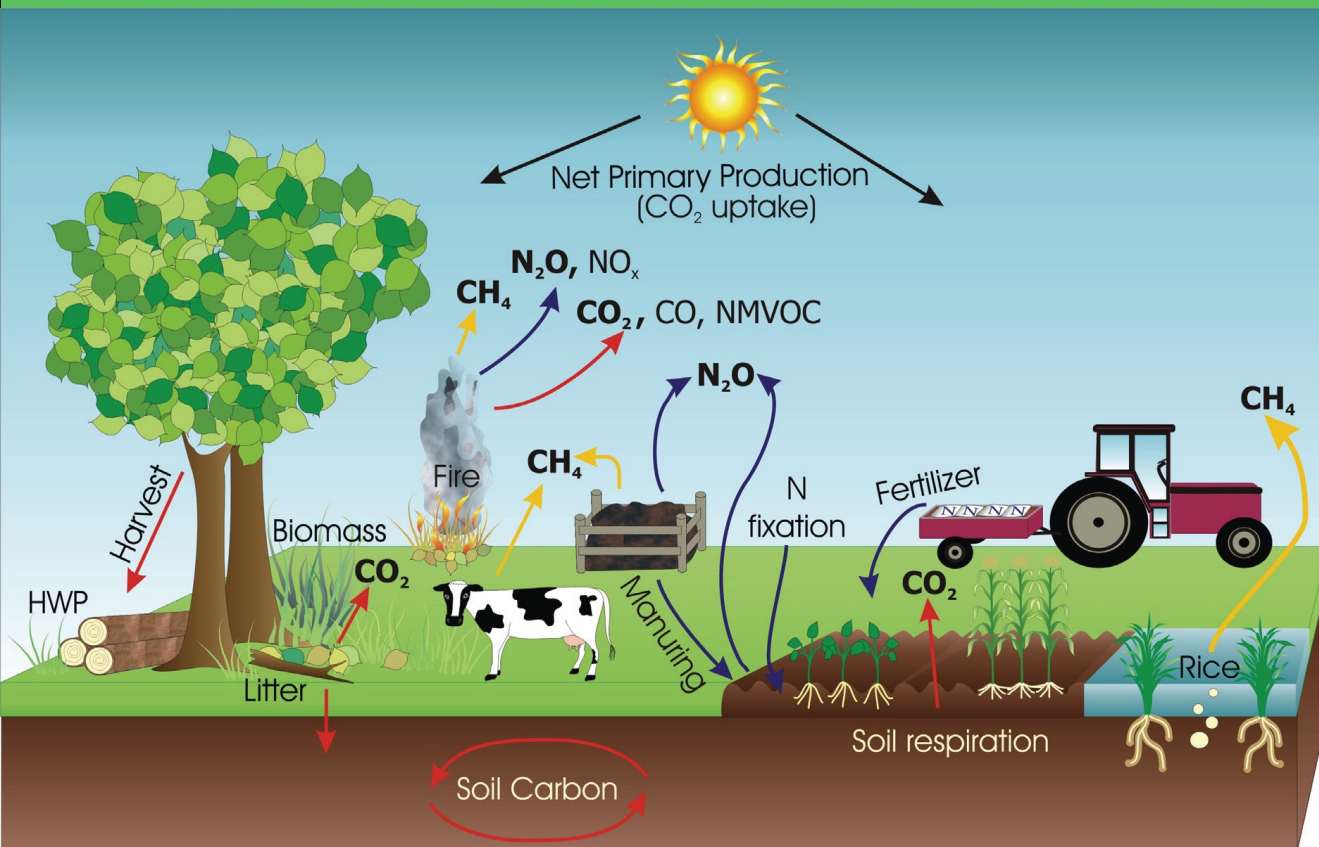
IRD are providing expertise on GHG assessment methods in SLM projects



International Livestock Research Institute

ILRI are working with the CBP on GHG emissions from livestock

Land Management



- Carbon stock changes (biomass and soils)
- GHG emissions (livestock, fertilisers, soils, biomass burning...)

From 2006 IPCC Guidelines

'Carbon Benefits'

Sustainable Land Management

Sustainable land management projects such as those supported by the GEF have potential to:

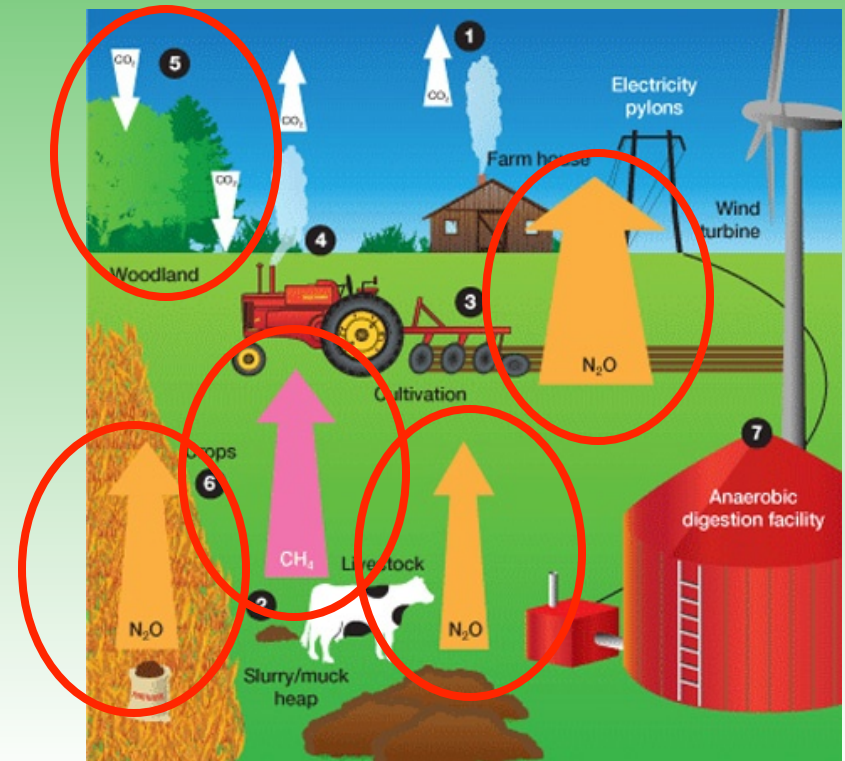


- reduce GHG emissions
- sequester C from the atmosphere

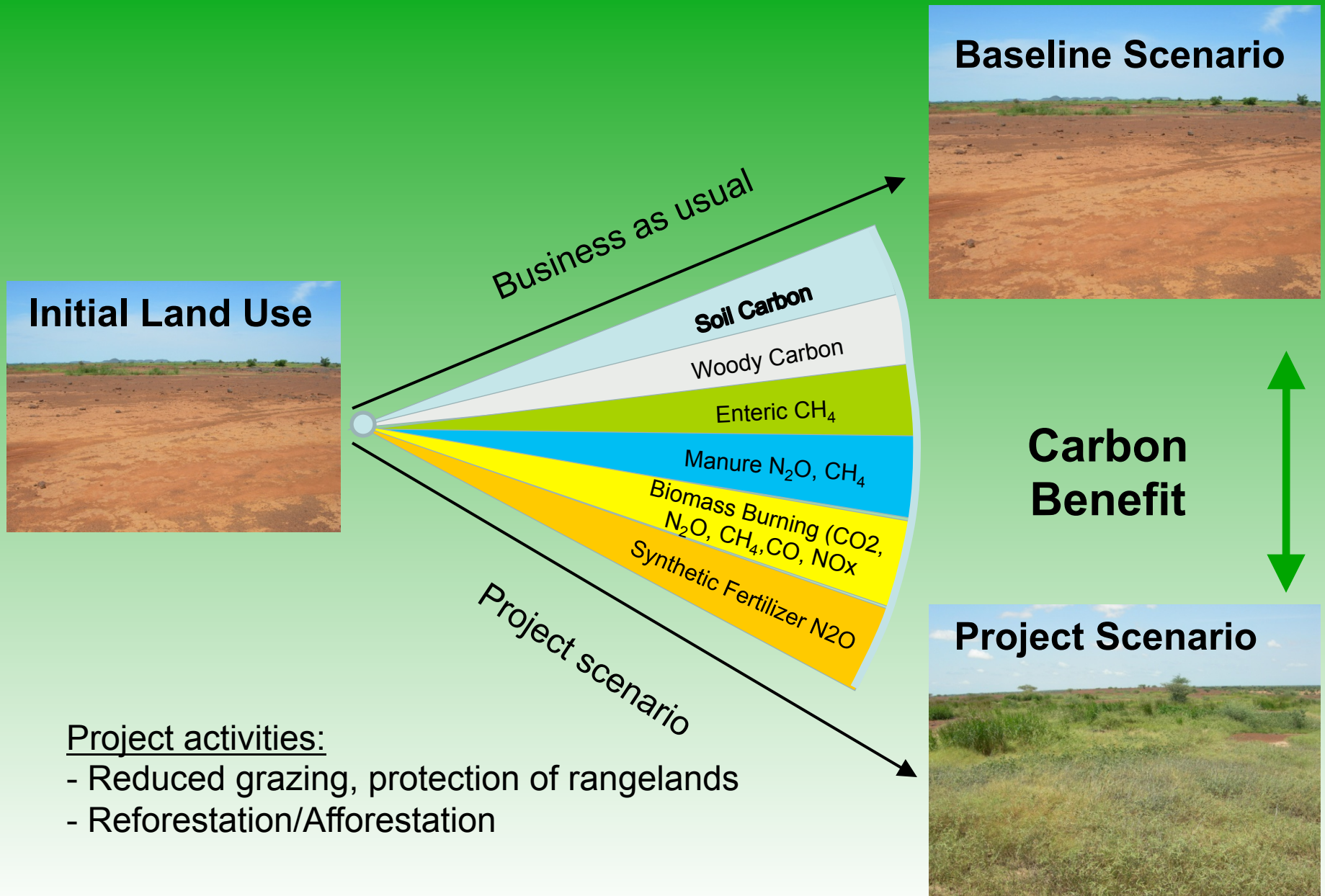
Comprehensive Greenhouse Gas Inventory

- Agencies and NGOs, including the GEF wish to know the GHG consequences of projects they are supporting.
- Many tools focus almost exclusively on forest biomass (for REDD, etc.)

- Comprehensive GHG flux assessment is necessary to assess the Net GHG benefit of land use & management changes



Impact of the project over the baseline



The Carbon Benefits Project

To provides a system for the managers of GEF and other **land management projects** to;

Estimate

Track

Report

C stock changes and GHG emissions (carbon benefits) which result from the project (in comparison to a baseline)

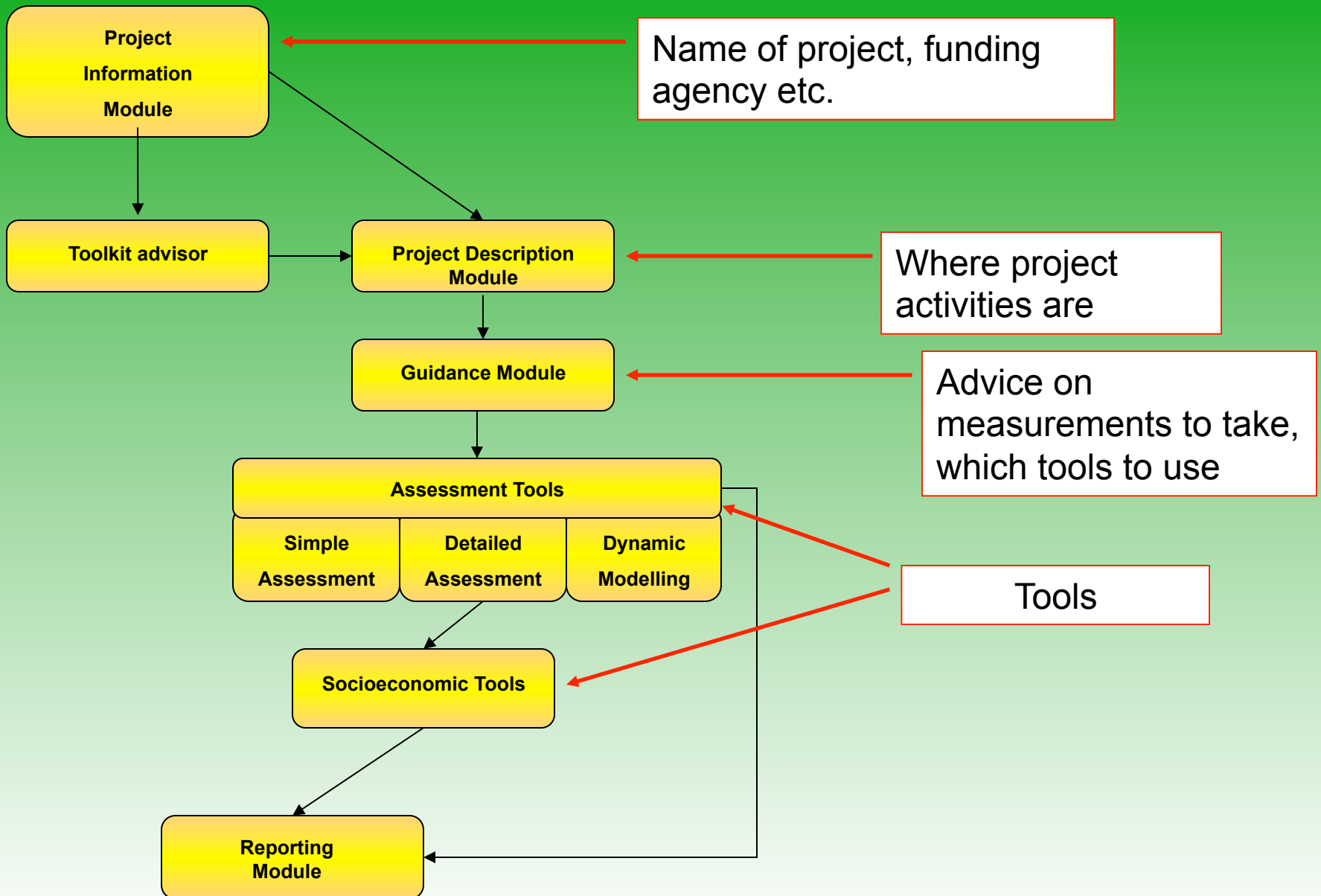
Features of the CBP System

A system that is-

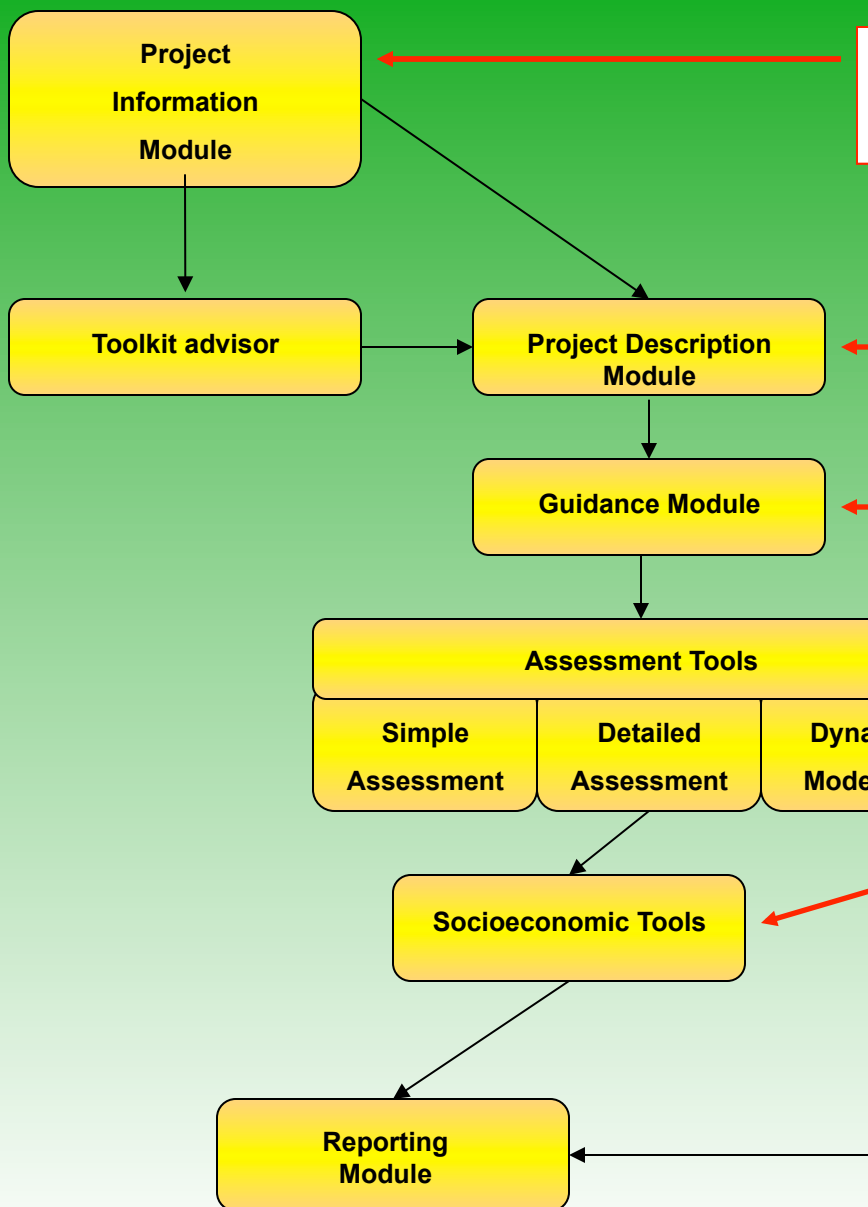
- Online
- User friendly
- Can be used at any stage of a project
- Can be used for different types of projects with different amounts of data
- Gives spatially explicit output
- Gives a report in a standard format



Carbon Benefits Project: Modelling, Measurement and Monitoring



Carbon Benefits Project: Modelling, Measurement and Monitoring



Name of project, funding agency etc.

1 Please enter basic project information

Project Name:

Project ID Code:

Project Status:

Project Start Date: Month: Year:

Project Duration: Years

Project Country (Countries): Hold CTRL, then click to select multiple countries

Project Region:

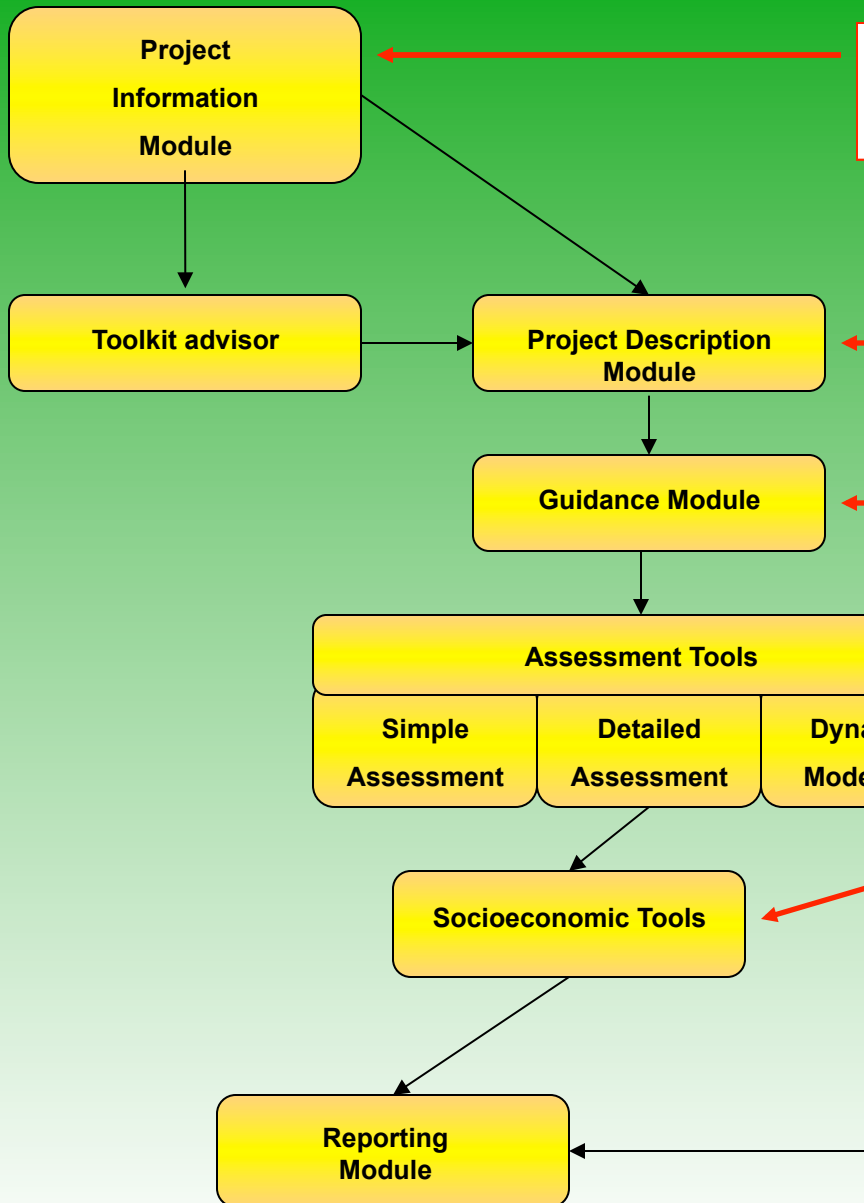
Communities/Countries/Provinces Involved:

Project Activities:

Brief Summary of Project Goal:

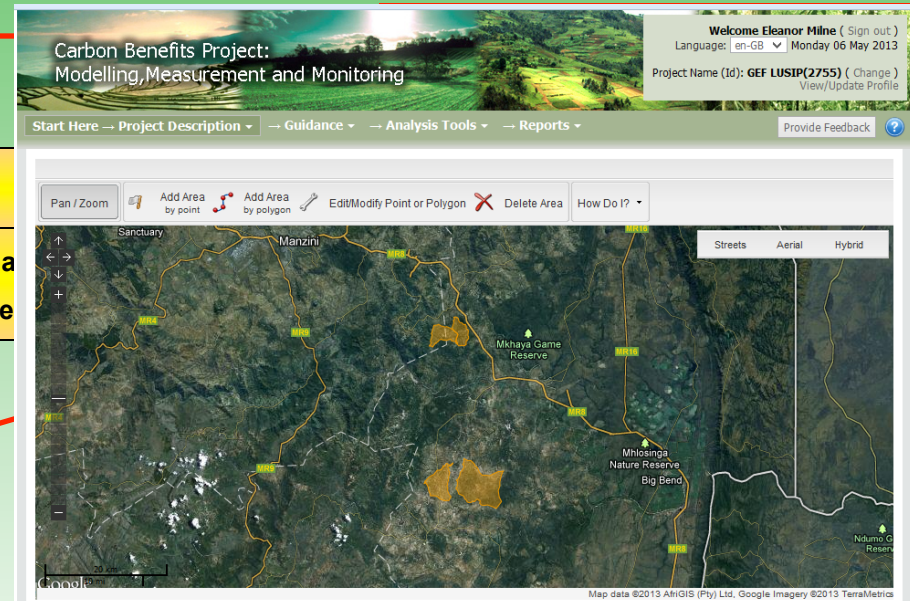
Summary of any Carbon and Greenhouse Gas Benefit Goals (Optional):

Carbon Benefits Project: Modelling, Measurement and Monitoring



Name of project, funding agency etc.

Where project activities are



Enter, Manage, and Delete a Polygon

Firefox

FRII Webmail :: Welcome to FRII Webmail x Modelling System Pages - Carbon Benefit... x

http://localhost/cbpweb/

Most Visited METRIC SYSTEM PRE... FRII Webmail :: Inbox CBP local: Log On - C... CBP Test Server - Car... CBP PIM UNEP

Language: zh-CN **Welcome Mark Easter** (Sign out)
Tuesday 26 July 2011
Project Name **Test LandUseRunFile Project** (Change)
View/Update Profile

Start Here → Project Description → Guidance → Analysis Tools → Reports Help

Step 1 - Define Project Boundaries
[Draw or Edit Project Locations on a Map](#)
[Upload Your Own GIS Files](#)

Step 2 - Review Supporting Spatial Data
[View](#)
[Upload Your Own GIS Files](#)

Step 3 - Define Project Land Use Areas
[Describe Project Land Use](#)

Welcome

g Pages, hosted by Colorado State University.

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. Click here for a tutorial describing how to use the CBP Modelling tools.

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 **"Help"** 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.

UNEP GEF Colorado State University WWF ISRIC MICHIGAN STATE UNIVERSITY UEA World Agroforestry Centre CIFOR cena IRD Instituto de Investigación para el Desarrollo University of Leicester ILRI INTERNATIONAL INSTITUTE FOR RESEARCH IN TROPICAL FORESTS

Copyright © United Nations Environment Programme [Privacy] [Terms and Conditions] [Site Locator]

http://localhost/cbpweb/InterventionArea?display=draw

Enter, Manage, and Delete a Polygon

ostate.edu/InterventionArea?display=draw

Welcome Eleanor Milne (Sign out)
Language: en-GB Tuesday 07 May 2013
Project Name (Id): GEF LUSIP(2755) (Change)
View/Update Profile

Start Here → Project Description → Guidance → Analysis Tools → Reports → Provide Feedback

Pan / Zoom Add Area by point Add Area by polygon Edit/Modify Point or Polygon Delete Area How Do I? ▾

Streets Aerial Hybrid

Manzini Mkhaya Game Reserve Mhlosinga Nature Reserve Big Bend Ndumo G Reserve

Map data ©2013 AfriGIS (Pty) Ltd, Google Imagery ©2013 TerraMetrics

InterventionArea?display=coordinates

Controls the actions
on the form

Controls the image
view on the form

Enter, Manage, and Delete a Polygon

Firefox

FRII Webmail :: Welcome to FRII Webmail x Draw Project Activity Areas - Carbon Ben... x

http://localhost/cbpweb/InterventionArea?display=draw

Welcome Mark Easter (Sign out)
Language: zh-CN Tuesday 26 July 2011
Project Name Test LandUseRunFile Project (Change)
View/Update Profile

Start Here → Project Description → Guidance → Analysis Tools → Reports Help

Pan / Zoom Add Area by point Add Area by polygon Modify Area Delete Area How Do I? ▾

Click to create a polygon

Click to Change point or polygon name or group

Click to Delete a polygon or point

Click to show a short help video

Map data ©2011 Google, Tracks4Africa Imagery ©2011 TerraMetrics - Terms of Use

<< Back Next >>

ILRI

Enter, Manage, and Delete a Point

The screenshot displays the 'Carbon Benefits Project: Modelling, Measurement and Monitoring' web application. The browser address bar shows the URL `http://localhost/cbpweb/InterventionArea?display=draw`. The page header includes a navigation menu with 'Start Here', 'Project Description', 'Guidance', 'Analysis Tools', and 'Reports'. A user welcome message for Mark Easter is visible in the top right.

The main interface features a map with several callouts and tool buttons:

- Click to create a point:** A callout box with an arrow pointing to the 'Add Area by point' button in the top toolbar.
- Click to Change point or polygon name or group:** A callout box with an arrow pointing to the 'Modify Area' button in the top toolbar.
- Click to delete a point:** A callout box with an arrow pointing to the 'Delete Area' button in the top toolbar.

The map shows a satellite view of a region with roads and labels such as 'Kakamega', 'Butere', and 'Kakam Nation Reserve'. A yellow polygon is drawn on the map, and a blue point is visible near the top left. At the bottom of the map, there are navigation buttons: '<< Back' and 'Next >>'. The footer contains logos for various organizations including UN, ISRIC, IFA, and ILRI.

Establishing Points Using Latitude and Longitude

Firefox

FRII Webmail :: Welcome to FRII Webmail | Project Activity Area Coordinates - Carb... | http://localhost/cbpweb/InterventionArea?display=coordinates

Start Here → Project Description → Guidance → Analysis Tools → Reports

Upload or enter the coordinates of points that define the Project Activity Areas of your project.

Upload point coordinates from file

Enter point coordinates

Note: The text file must be in the following format (click [here](#) for an example):

- be comma-delimited
- use the WGS84 coordinate system
- Has five data fields in the following order:
 - name of point (enclosed in **double quotes**)
 - name of point group (enclosed in **double quotes**)
 - latitude (in **decimal degrees**)
 - longitude (in **decimal degrees**)
 - amount of area (in hectares) that the point represents.

Click [here](#) for a web tool to assist you in converting coordinates from DD°MM'SS" format to decimal degrees.

File (required):
Select a file

overwrite existing areas

Upload Reset

Upload from a File

Map data ©2011 Google, Tracks4Africa Imagery ©2011 TerraMetrics - Terms of Use

<< Back Next >>

Establishing Points Using Latitude and Longitude

The screenshot shows a web browser window displaying a web application. The browser's address bar shows the URL `http://localhost/cbpweb/InterventionArea?display=coordinates`. The application has a navigation menu with items: Start Here, Project Description, Guidance, Analysis Tools, Reports, and Help. The main content area is split into two panels. On the left is a form titled "Upload or enter the coordinates of points that define the Project Activity Areas of your project." The form contains a button labeled "Enter point coordinates" which is highlighted with a red rectangular box. Below this button is a text input field for "Enter the coordinates of your points one at a time:". Further down are fields for "Name of Project Activity Area Point:", "Name of Group to which point belongs:", "Latitude (decimal degrees):", "Longitude (decimal degrees):", and "Area point represents (ha):". At the bottom of the form are "Add Point" and "Reset" buttons. On the right is a map showing a geographical area with several yellow-outlined polygons representing project activity areas. A white text box with the text "Upload Points One at a Time" is overlaid on the map, with a red arrow pointing from the text box to the "Enter point coordinates" button. The map includes labels for various locations like Shinda, Kakamega, Sigalagala, and Maseno. At the bottom of the application, there are logos for various organizations including Colorado, ISRIC, IEA, IRD, and ILRI.

Uploading your own ESRI GIS Files

Firefox

Project Activity Area Upload - Carbon Be...

http://localhost/cbpweb/InterventionArea?display=upload

Welcome Mark Easter (Sign out)
Tuesday 26 July 2011

Language: zh-CN

Project Name **Test LandUseRunFile Project** (Change)
View/Update Profile

Start Here → Project Description → Guidance → Analysis Tools → Reports Help

Step 1 - Define Project Boundaries

- [Draw or Edit Project Locations on a Map](#)
- [Enter or Upload Project Locations Coordinates](#)
- [Upload Your Own GIS Files](#)

Step 2 - Review Supporting Spatial Data

- [View](#)
- [Upload Your Own GIS Files](#)

Step 3 - Define Project Land Use Areas

- [Describe Project Land Use](#)

- contain **points** or **polygons**
- include the **shape** (.shp), **attribute** (.dbf), and **projection** (.prj) files
- have a **geographic coordinate system** or one of the **supported projections**

File (required):
Select a file

Name Field:
[Text Input]

Group Name Field:
[Text Input]

Area Field (required for point files):
[Text Input]

overwrite existing areas

Upload Reset

Upload from GIS files

Map showing project boundaries (highlighted in brown) over a satellite view of a region. Labels include: Shianda, Kakamega, Sigalagala, Mukumu, Emasatsi, Maragoli, Kivagala, Gisambai, Majengo, Luanda, Maseno, Konjero se Ekonjero, Mudoete, stendi-kisa, Mudete, Mago, Cheptulu, Shamakhokho, Koiparak, Kakamega National Reserve, Kakam National Reserve.

Map data ©2011 Google, Tracks4Africa Imagery ©2011 TerraMetrics - Terms of Use

<< Back Next >>

http://localhost/cbpweb/SpatialData/UploadGISData

Viewing the Standard Project Data

Firefox

FRII Webmail :: Welcome to FRII Webmail x ViewDefaultData - Carbon Benefits Proje... x +

http://localhost/cbpweb/SpatialData

Most Visited METRIC SYSTEM PRE... FRII Webmail :: Inbox CBP local: Log On - C... CBP Test Server - Car... CBP PIM UNEP

Carbon Benefits Project:
Modelling, Measurement and Monitoring

Welcome Mark Easter (Sign out)
Language: zh-CN Tuesday 26 July 2011
Project Name Test LandUseRunFile Project (Change)
View/Update Profile

Start Here → Project Description → Guidance → Analysis Tools → Reports Help

Step 1 - Define Project Boundaries
[Draw or Edit Project Locations on a Map](#)
[Enter or Upload Project Location Coordinates](#)
[Upload Your Own GIS Files](#)

Step 2 - Review Supporting Spatial Data
[View](#)
[Upload Your Own GIS Files](#)

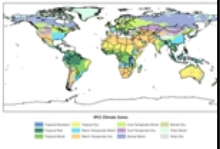
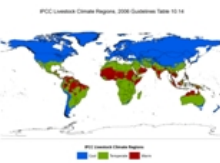

Step 3 - Define Project Land Use Areas
[Describe Project Land Use](#)

• 'Documentation' links you to files explaining
• 'GIS Layers' allows you to download the GI

Load the default datasets used for your project.

It datasets that vary by location and are therefore based on maps. You may view these maps and their
w an item, first identify the category you wish to view and then click on the hyperlink in the column to the
se. The view/download columns are defined as follows:

Description

IPCC Land Use Climate Regions		View Image	View Image	View PDF File	Download Zip File
IPCC Livestock Climate Regions		View Image	View Image	View PDF File	Download Zip File
IPCC Soils Classes derived from the		View Image	View Image	View PDF File	Download Zip File

http://localhost/cbpweb/SpatialData

Click Here to view standard (default) data on:

- Climate Regions
- Soils
- Biomass Stocks
- Livestock & Manure Data

Enter your Project Activity Data

Start Here → Project Description → Guidance → Analysis Tools → Reports → Provide Feedback ?

Step 1 - Define Project Boundaries
[Draw or Edit Project Locations on a Map](#)
[Enter or Upload Project Location Coordinates](#)
[Upload Your Own GIS Files](#)

Step 2 - Review Supporting Spatial Data
[View](#)
[Upload Your Own GIS Files](#)

Step 3 - Define Project Land Use Areas
[Describe Project Land Use](#)

2 Select Project Activity Area/Group

Avoided Deforestation Area 1 [587 ha] [Show Project Activity Areas](#) (opens in new window)

3 Enter land use area in ha

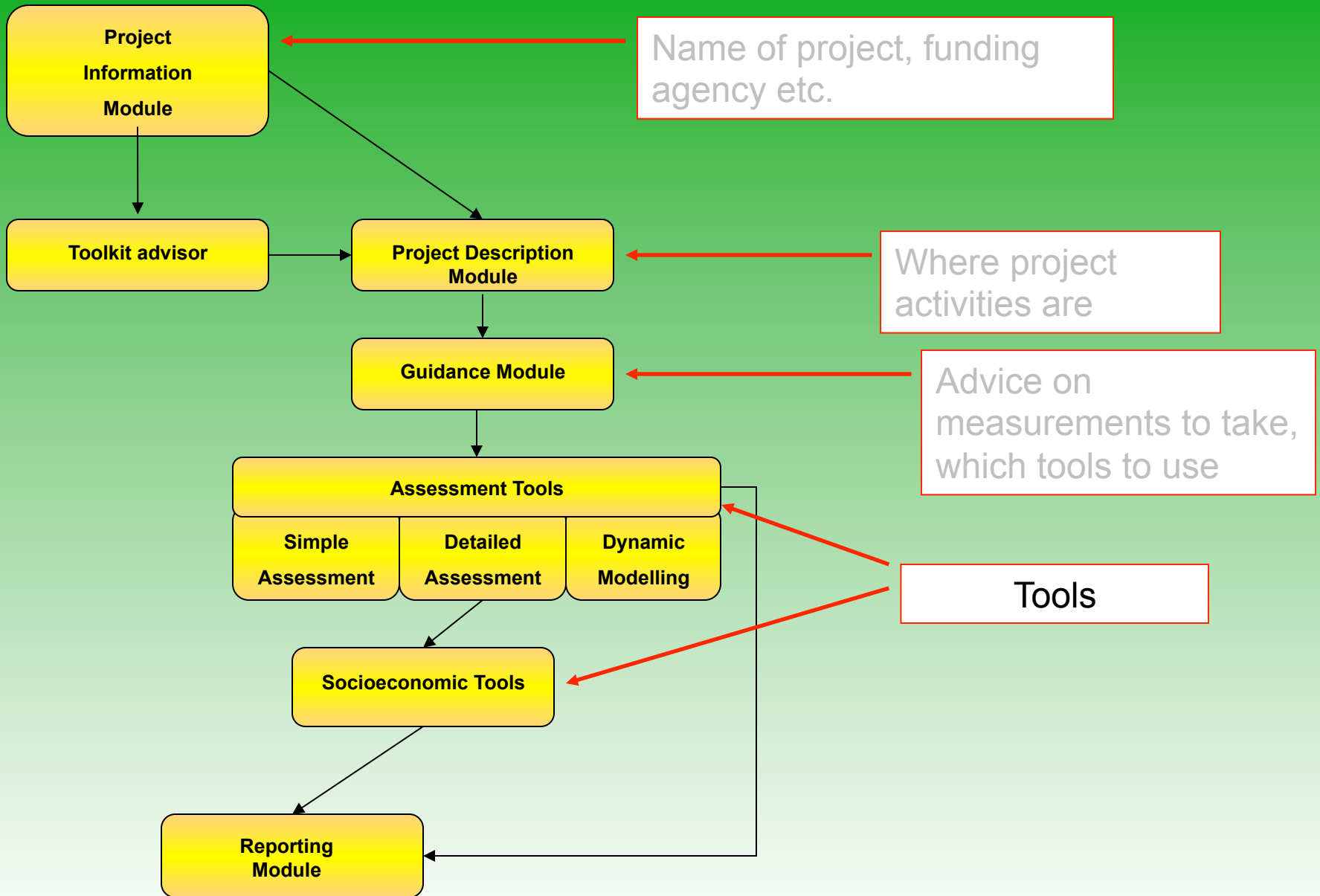
Land Use Category	Initial Land Use (ha)	Baseline Scenario (ha)	Project Scenario (ha)
Forestland	550	300	550
Grassland	0	0	0
Settlements	0	0	0
Wetlands	0	0	0
Annual Cropland	0	250	0
Perennial Cropland	0	0	0
Agroforestry	0	0	0
Livestock	0	0	0
Total Area (ha)*	550	550	550

* The total area includes all of the area in all of the first seven land use categories, but does not include the number of livestock.

choice Save Back Next

Click here to enter data on the area in each land use category

Carbon Benefits Project: Modelling, Measurement and Monitoring



The Tools



- Simple and Detailed Assessment based on the IPCC method
- Dynamic Modelling Option is an ecosystem model (Century) linked to a GIS

The Tools



Default data provided, choose from drop-down menus

What is needed to use it?

- A computer with an internet connection
- Information on land management activities and where they occur
- An idea of land use/management under a baseline and a project scenario

Who is it suitable for?

- Suitable for use in projects without many resources for C monitoring & reporting
- Also suitable for use by those developing project proposals
- Available in English, Chinese, Spanish, French and Russian (Portuguese soon)

Simple Assessment

Carbon Benefits Project:
Modelling, Measurement and Monitoring

Welcome Eleanor Milne (Sign out)
Thursday, July 21, 2011

Project Name **Vinchuan** (Change)
View/Update Profile

Start Here → Project Description → Guidance → Analysis Tools → Reports Help

1 Initial Land Use x 2 Baseline Scenario x 3 Project Scenario x

Simple Assessment Home

- Forestland x
- Grassland x
- Settlements x
- Wetlands x
- Annual Crops x
- Perennial Crops x
- Agroforestry x
- Livestock x

Goal

The Simple Assessment provides a simple tool to assess the impact of a project on carbon stocks and greenhouse gas emissions. The tool will be most useful to Sustainable Land Management projects involving relatively few land use/management or on relatively

Getting Started

Start by entering information for your Project Activity Areas for the 'Initial Land Use' (the situation at year 0 before your project started). Click on the land use categories in the left hand menu and complete each section in

3 Enter land use area in ha

Land Use Category	Initial Land Use (ha)	Baseline Scenario (ha)	Project Scenario (ha)
Forestland	550	300	550
Grassland	0	0	0
Settlements	0	0	0
Wetlands	0	0	0
Annual Cropland	0	250	0
Perennial Cropland	0	0	0
Agroforestry	0	0	0
Livestock	0	0	0
Total Area (ha)*	550	550	550

* The total area includes all of the area in all of the first seven land use categories, but does not include the number of livestock.

UNEP GEF Colorado State WWF ISRIC MICHIGAN STATE UNIVERSITY CEA University of East Angles World Agroforestry Centre CIFOR cena Institut de recherche pour le développement University of Leicester INSTITUTE FOR SUSTAINABLE DEVELOPMENT

Simple Assessment - Forestland

Forestland Stage 1 of 2: Forest Types and Tree Age Ranges

- Forestland X
 - Forest Types and Tree Age Ranges X**
 - Natural Losses and wood Removal ✓
- Grassland ✓
- Settlements ✓
- Wetlands ✓
- Annual Crops ✓
- Perennial Crops ✓
- Agroforestry ✓
- Livestock ✓

1 Select Project Activity Area/Group

Reforestation [685 ha] X

[Show Project Activity Areas](#)
(opens in new window)

2 Select a Forest Type and Tree Age Range

Forest Type

Eucalyptus camaldulensis

Add to table below

3 Enter area for each record

Delete

Forest Type	Tree Age Range	Area (ha)
Eucalyptus camaldulensis	<= 20 years	685
		685

Total Area Allocated (ha): 685/685

Simple Assessment – Forestland

Start Here → Project Description ▾ → Guidance ▾ → Analysis Tools ▾ → Reports ▾ Provide Feedback ?

1 Initial Land Use ✓ 2 Baseline Scenario ✗ 3 Project Scenario ✗

Forestland Stage 2 of 2: Natural Losses and Wood Removal

Forestland ✓

- Forest Types and Tree Age Ranges ✓
- Natural Losses and Wood Removal ✓**

Grassland ✓ +

Settlements ✓ +

Wetlands ✓ +

Annual Crops ✓ +

Perennial Crops ✓ +

Agroforestry ✓ +

Livestock ✓ +

1 Select Project Activity Area/Group

Reforestation [685 ha] ✓ [Show Project Activity Areas](#)
(opens in new window)

2 Enter percent of aboveground biomass affected by natural losses each year

Forest Type	Tree Age Range	Area (ha)	Fires (%/yr)	Wind (%/yr)	Pest/Disease (%/yr)	Other Losses (%/yr)
Eucalyptus camaldulensis	<= 20 years	685	0	0	0	0

Simple Assessment – Forestland

3 Enter volume of wood removed by timber harvest, fuel wood gathering, pruning or any other manmade process.

Forest Type	Tree Age Range	Area (ha)	Timber Harvest (m ³ /yr)	Fuelwood Gathering (m ³ /yr)
Eucalyptus camaldulensis	<= 20 years	685	0	0

4 Enter annual deforestation rate if applicable.

Forest Type	Tree Age Range	Area (ha)	Area Cleared without Burning (ha/yr)	Area Cleared with Burning (ha/yr)
Eucalyptus camaldulensis	<= 20 years	685	0	0

Save

Back

Finished

Simple Assessment - Grasslands

Grassland Stage 1 of 3: Grassland Systems

- Forestland ✓
- Grassland X
 - Grassland Systems X
 - Silvipasture Tree Types / Age Ranges ✓
 - Silvipasture Natural Losses and Wood Removal ✓
 - Settlements X
 - Wetlands X
 - Annual Crops X
 - Perennial Crops X
 - Agroforestry X
 - Livestock X

1 Select Project Activity Area/Group

Project Activity Area Group 1 [3964 ha] X

[Show Project Activity Areas](#)
(opens in new window)

2 Select a Grassland System

Rangeland

Add to table below

3 Describe Grassland System

Grassland System	Condition	Improvements	Amount of N Fertilizer (kg/ha)	% N in Fertilizer	Burn Frequency	Area	
Rangeland	Severely Degraded Grassland	Multiple	0	0	once every four years	600	

Improvements -
Fertilization, irrigation, introducing legumes, improved grass varieties

Save

<< Back

Next >>

Simple Assessment Annual Crops

1 Initial Land Use x 2 Baseline Scenario x 3 Project Scenario x

Annual Crops Stage 1 of 1 : Cropping Systems

Forestland ✓ +
Grassland ✓ +
Settlements X +
Wetlands ✓ +
AnnualCrops ✓ -
▶ Cropping Systems ✓
Perennial Crops X +
Agroforestry X +
Livestock X +

1 Select Project Activity Area/Group

Project Activity Area Group 1 [3964 ha] ✓ [Show Project Activity Areas](#)
(opens in new window)

2 Select an Annual Cropping System

Annual Cropping System
Continuous root crop

Add to table below

3 Describe Selected Annual Cropping Systems

Annual Crop Name	Improved?	Tillage	Amount of N Fertilizer (kg/ha)	% N in Fertilizer	Residue Management	Area	
Continuous root crop	<input checked="" type="checkbox"/>	Full	40	46	Collected	350	
Continuous vegetables	<input checked="" type="checkbox"/>	Reduced	60	46	Grazed	350	

Improvements -
Fertilization, irrigation, cover crops,
legumes in rotation, use of high-
yielding varieties

Save Finished

Simple Assessment - Agroforestry

Start Here → Project Description → Guidance → Analysis Tools → Reports Help

1 Initial Land Use x 2 Baseline Scenario x 3 Project Scenario x

Agroforestry Stage 1 of 4: Agroforestry Systems

Forestland ✓ +

Grassland ✓ +

Settlements X +

Wetlands ✓ +

Annual Crops ✓ +

Perennial Crops ✓ +

Agroforestry X -

- Agroforestry Systems ✓
 - Annual Crops ✓
 - Tree Age Ranges X
 - Natural Losses and Wood Removal ✓

Livestock X +

1 Select Project Activity Area/Group

Project Activity Area Group 1 [3964 ha] ✓ [Show Project Activity Areas](#)
(opens in new window)

2 Create an Agroforestry System

Name
Peach/vegetable

Add to table below

3 Enter an Area for each Record

Agroforestry System	Area (ha)	
Peach/vegetable	60	

Total Area Allocated (ha): 60/

Simple Assessment – Agroforestry

- Forestland ✓
- Grassland ✓
- Settlements X
- Wetlands ✓
- Annual Crops ✓
- Perennial Crops ✓
- Agroforestry X
 - Agroforestry Systems ✓
 - ▶ Annual Crops ✓
 - Tree Age Ranges X
 - Natural Losses and Wood Removal ✓
- Livestock X

1 Select Project Activity Area/Group

Project Activity Area Group 1 [3964 ha] ✓ [Show Project Activity Areas](#)
(opens in new window)

2 Select an Agroforestry System

Peach/vegetable ▼

3 Select a Cropping System

Continuous vegetables ▼

4 Describe Selected Annual Cropping Systems

Annual Crop Name	Improved?	Tillage	Amount of N Fertilizer (kg/ha)	% N in Fertilizer	Residue Management	
Continuous vegetables	<input checked="" type="checkbox"/>	Reduced	60	46	Grazed ▼	

Simple Assessment - Livestock

Carbon Benefits Project:
Modelling, Measurement and Monitoring

Welcome Eleanor Milne (Sign out)
Friday, July 22, 2011

Project Name **Yinchuan** (Change)
View/Update Profile

Start Here → Project Description → Guidance → Analysis Tools → Reports Help

1 Initial Land Use x 2 Baseline Scenario x 3 Project Scenario x

Livestock Stage 1 of 2: Livestock Categories

Forestland ✓ +

Grassland ✓ +

Settlements X +

Wetlands ✓ +

Annual Crops ✓ +

Perennial Crops ✓ +

Agroforestry X +

Livestock X -

► Livestock Data X

Manure Management ✓

1 Select Project Activity Area/Group

Project Activity Area Group 1 [3964 ha] X [Show Project Activity Areas](#)
(opens in new window)

2 Describe Livestock Categories

Livestock Category	Population	Months/Year in Area
Dairy Cattle	200	12
Non-Dairy Working Cattle	0	0
Buffalo	0	0
Swine	0	0
Goats	0	0

Save << Back Next >>

Simple Assessment - Livestock

1 Initial Land Use x 2 Baseline Scenario x 3 Project Scenario x

Livestock Stage 2 of 2: Manure Management

Forestland ✓ +

Grassland ✓ +

Settlements X +

Wetlands ✓ +

Annual Crops ✓ +

Perennial Crops ✓ +

Agroforestry X +

Livestock X -

Livestock Data X

▶ Manure Management ✓

1 Select Project Activity Area/Group

Project Activity Area Group 1 [3964 ha] ✓ [Show Project Activity Areas](#)
(opens in new window)

2 Select a Livestock Category

Dairy Cattle ▾

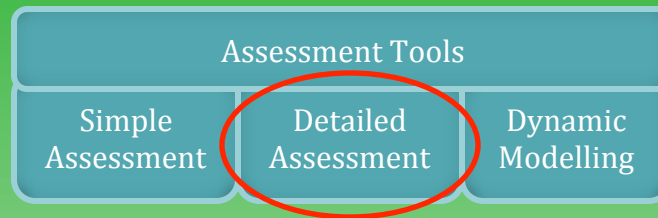
3 Enter Manure Management Allocations

Manure Name	Percent
Anaerobic Digester	100
Pasture/Range/Paddock	0
Dry Lot	0
Anaerobic Lagoon	0
Burned for Fuel	0

Total Allocated (%): 100/100

<< Back Finished

The Tools



Can create own crop/ grass/ forest/ agroforestry types and systems
Can use project specific emission factors

What is needed to use it?

Same as Simple Assessment plus:

- Specific information on crop/grass/forest species and systems
- Optional measurements to improve emission factors
- Resources and facilities for field sampling and lab analysis (to varying extents)

Who is it suitable for?

- Projects wanting to reduce uncertainties in emissions estimations
- Suitable for use in projects with more emphasis on C benefits

Detailed Assessment Home Page

The screenshot shows the 'Detailed Assessment Home' page. At the top, there is a banner with the text 'Carbon Benefits Project: Modelling, Measurement and Monitoring'. To the right of the banner, a user profile box displays 'Welcome Eleanor Milne (Sign out)', 'Language: en-GB', and 'Wednesday 08 May 2013'. Below the banner, a navigation bar contains 'Start Here → Project Description → Guidance → Analysis Tools → Reports' and a 'Provide Feedback' button. A progress indicator shows three steps: '1 Initial Land Use ✓', '2 Baseline Scenario ✓', and '3 Project Scenario ✗'. The main content area is titled 'Detailed Assessment Home' and features a left-hand menu with categories: 'Forestland ✓', 'Grassland ✓', 'Settlements ✓', 'Wetlands ✓', 'Annual Crops ✓', 'Perennial Crops ✓', 'Agroforestry ✓', and 'Livestock ✓'. Under 'Forestland', sub-items include 'Forest Types and Age Ranges ✓', 'Natural Losses and Wood Removal ✓', and 'Emission Factors ✓', which is highlighted with a red box. Two main content boxes are present: 'Goal' and 'Getting Started'. The 'Goal' box explains that the tool assesses project impacts on carbon stocks and emissions, suitable for detailed reporting on climate change mitigation. The 'Getting Started' box provides instructions on how to use the tool, starting with 'Initial Land Use' and 'Baseline Scenario' information.

Carbon Benefits Project:
Modelling, Measurement and Monitoring

Welcome Eleanor Milne (Sign out)
Language: en-GB Wednesday 08 May 2013
Project Name (Id): Detailed Assessment Tutorial(183) (Change)
View/Update Profile

Start Here → Project Description → Guidance → Analysis Tools → Reports Provide Feedback ?

1 Initial Land Use ✓ 2 Baseline Scenario ✓ 3 Project Scenario ✗

Detailed Assessment Home

- Forestland ✓
 - Forest Types and Age Ranges ✓
 - Natural Losses and Wood Removal ✓
 - Emission Factors ✓
- Grassland ✓
- Settlements ✓
- Wetlands ✓
- Annual Crops ✓
- Perennial Crops ✓
- Agroforestry ✓
- Livestock ✓

Goal

The Detailed Assessment provides a tool to assess the impact of projects on carbon stocks and greenhouse gas emissions. Suitable for detailed reporting where there is a reasonable focus on climate change mitigation and/or a multiple, land management changes on areas with several combinations of soil type and climate. Users will have the option to improve carbon and greenhouse gas balance estimates by inputting project specific information (from field measurements or local data sets).

Getting Started

Start by entering information for your Project Activity Areas for the 'Initial Land Use' (the situation at year 0 before your project started). Click on the land use categories in the left hand menu and complete each section in turn. Then do the same for the 'Baseline Scenario' (what would have happened in your project area over the project period without any project activities) and finally the 'Project Scenario'. The project period can be any length of time defined by the user. Information for the baseline and project scenarios should represent the change over the entire period. For further explanation of the scenarios and help with the Detailed Assessment click on the 'Help' button, top right.

Annual Cropland in DA

Carbon Benefits Project:
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1 Initial Land Use ✓ 2 Baseline Scenario ✓ 3 Project Scenario ✗

Annual Crops Stage 1 of 1: Cropping Systems

- Forestland ✓
- Grassland ✓
- Settlements ✓
- Wetlands ✓
- Annual Crops ✓
 - ▶ Annual Cropping Systems ✓
 - Emission Factors ✓
- Perennial Crops ✓
- Agroforestry ✓
- Livestock ✓

1 Select Project Activity Area/Group

Demonstration Group [8540 ha] ✓ [Show Project Activity Areas](#)
(opens in new window)

2 Specify an Annual Cropping System

+ Add | - Delete

Cropping System Name	Area
Maize_legume followed by Napier Grass	500
Maize-legume	4500
5000	

Annual Cropland in DA

3 Cropping System Planting Sequences

+ Add - Delete

< New Crop > ^

- alfalfa
- barley
- beans
- cassava
- castor oil seed
- clover
- cotton
- fallow

Crop 2: legumes and pulses, dried

Crop 3:

Create New Crop

Name:


Grass? Wetland Rice? Nitrogen Fixing? Low Residue? Fallow?

Save Cancel

Year	Planting Sequence	Crop Name	Residue Management*	Tillage System*	Fert	Amount of N Fertilizer (kg/ha)*	% of nitrogen (N) in fertilizer*	Org
1	1	maize, dry	Collected	Full	<input checked="" type="checkbox"/>	60	46	<input type="checkbox"/>
1	2	legumes and pulses, dried	Retained	Reduced	<input type="checkbox"/>	0	0	<input type="checkbox"/>
2	1	Napier Grass	Collected	None	<input type="checkbox"/>	0	0	<input type="checkbox"/>

Annual Cropland in DA

Start Here → Project Description → Guidance → Analysis Tools → Reports

Provide Feedback 

1 Initial Land Use **X** 2 Baseline Scenario **X** 3 Project Scenario **X**

Emission Factors

- Forestland **X** +
- Grassland ✓ +
- Settlements ✓ +
- Wetlands ✓ +
- Annual Crops ✓ -
- Annual Cropping Systems ✓
- ▶ Emission Factors ✓
- Perennial Crops **X** +
- Agroforestry ✓ +
- Livestock ✓ +

1 Select a Factor

Show List of Greenhouse Gas Equations and Factors

- Factors in **green text** are good candidates for improvement through a measurement and monitoring program. They can be edited.
- Factors in **black text** are more complex and/or expensive to measure though they can be improved through a measurement and monitoring program. They can be edited.
- Factors in **red text** are either very difficult and/or expensive to measure, or they are well understood and cannot be improved upon, or they are physical constants. They cannot be edited.

Factor Name	Factor Type	Units	Source Category	SubSource Category
CF: Carbon Fraction	Complex Measurement	tonnes C/tonnes dm	Soil Nitrous Oxide	Cropland Residue
dCg: Change in Herbaceous Biomass C from Growth	Field Measurement	tonnes CO2/ha	Biomass C Stocks	Herbaceous Biomass (Land Use Change)
EF: Direct Emission Factor for Crop Residues	Recommend Default Only	Kg N2O-N/Kg N	Soil Nitrous Oxide	Cropland Residue
EF: Direct Emission Factor for Cultivated Organic Soil	Recommend Default Only	Kg N2O-N/ha/yr	Soil Nitrous Oxide	Mineralization of Cultivated Organic Soils
EF: Direct Emission Factor for N Fertilizers	Recommend Default Only	Kg N2O-N/Kg N	Soil Nitrous Oxide	Synthetic N Fertilizer
DMF: Dry Matter Fraction of Residue	Laboratory Measurement	tonnes dm/tonnes residue	Soil Nitrous Oxide	Cropland Residue

SFs: Scaling Factor for Soil Type	Recommend Default Only	unitless	Rice Methane	
SFw: Scaling Factor for Water Management	Recommend Default Only	unitless	Rice Methane	
CropYield: crop yield	Field Measurement	Mg/ha	Biomass Burning	Cropland Residue
CropYield: crop yield	Field Measurement	Mg/ha	Soil Nitrous Oxide	Cropland Residue
Gef(CO): CO Emission Factor for Burning	Complex Measurement	g kg-1 dry matter burnt	Biomass Burning	Cropland Residue
Gef(CH4): CH4 Emission Factor for Burning	Complex Measurement	g kg-1 dry matter burnt	Biomass Burning	Cropland Residue
Gef(N2O): N2O Emission Factor for Burning	Complex Measurement	g kg-1 dry matter burnt	Biomass Burning	Cropland Residue

2 View/Update Factor Values and Confidence Intervals

Annual Crop Type	ProjectCountry	Factor Value	Factor Type	Uncertainty (+/- %)
legumes and pulses, dried	Ethiopia	0.9600	Field Measurement	50.0000
maize, dry	Ethiopia	1.9800	Field Measurement	50.0000
Napier Grass	Ethiopia	0.7332	Field Measurement	90.0000

Notes for this factor record:

3 Recommended Measurement and Monitoring Protocols

FAOSTAT database -> <http://faostat3.fao.org/faostat-gateway/go/to/home/E>

Forestland in DA

Start Here → Project Description → Guidance → Analysis Tools → Reports → Provide Feedback ?

1 Initial Land Use ✓ 2 Baseline Scenario ✓ 3 Project Scenario ✗

Forestland Stage 1 of 2: Forest Types and Tree Age Ranges

Forestland ✓

- Forest Types and Age Ranges ✓
 - Natural Losses and Wood Removal ✓
 - Emission Factors ✓
- Grassland ✓ +
- Settlements ✓ +
- Wetlands ✓ +
- Annual Crops ✓ +
- Perennial Crops ✓ +
- Agroforestry ✓ +
- Livestock ✓ +

1 Subtropical mountain systems natural vegetati...
Subtropical mountain systems plantation - bro...
Subtropical mountain systems plantation - Eu...
Subtropical mountain systems plantation - other...
Subtropical mountain systems plantation - oth...
Subtropical mountain systems plantation - Pin...
Subtropical mountain systems plantation - Te...
2 Tropical mountain systems natural vegetation
Tropical mountain systems plantation - broadl...
Tropical mountain systems plantation - Eucaly...
Tropical mountain systems plantation - other...
3 Tropical mountain systems plantation - other ...
Tropical mountain systems plantation - Pinus ...
Tropical mountain systems plantation - Tecto...

Tree Age Range	Area (ha)*
> 20 years	1010

1010

Total Area Allocated (ha): 1010/1010

Save Back Next

lv/ForestlandStage1DA#

Forestland in DA

Carbon Benefits Project:
Modelling, Measurement and Monitoring

Welcome Eleanor Milne (Sign out)
Language: en-GB Wednesday 08 May 2013
Project Name (Id): Detailed Assessment Tutorial(183) (Change)
View/Update Profile

Start Here → Project Description → Guidance → Analysis Tools → Reports → Provide Feedback ?

1 Initial Land Use ✓ 2 Baseline Scenario ✓ 3 Project Scenario ✗

Forestland Stage 2 of 2: Natural Losses and Wood Removal

Forestland ✓

- Forest Types and Age Ranges ✓
- ▶ Natural Losses and Wood Removal ✓
- Emission Factors ✓

Grassland ✓ +

Settlements ✓ +

Wetlands ✓ +

Annual Crops ✓ +

Perennial Crops ✓ +

Agroforestry ✓ +

Livestock ✓ +

1 Select Project Activity Area/Group

Demonstration Group [8540 ha] ✓ [Show Project Activity Areas](#) (opens in new window)

2 Enter percent of aboveground biomass affected by natural losses each year

Forest Type	Tree Age Range	Area (ha)*	Fires (%/yr)	Wind (%/yr)	Pest/Disease (%/yr)	Other Losses (%/yr)
Yala Watershed Forest	> 20 years	1010	0	1	1	1

Forestland in DA

3 Enter volume of wood removed by timber harvest, fuel wood gathering, pruning or any other manmade process.

Forest Type	Tree Age Range	Area (ha)*	Timber Harvest (m ³ /yr)	Fuelwood Gathering (m ³ /yr)
Yala Watershed Forest	> 20 years	1010	3600	3600

4 Enter annual deforestation rate if applicable.


Forest Type	Tree Age Range	Area (ha)*	Area Cleared without Burning (ha/yr)	Area Cleared with Burning (ha/yr)	Reforestation / Afforestation Area (ha/yr)
Yala Watershed Forest	> 20 years	1010	100	0	0

Save

Back


Next

Emission Factors and Uncertainty


Start Here → Project Description → Guidance → Analysis Tools → Reports → [Provide Feedback](#) 


1 Initial Land Use ✓ 2 **Baseline Scenario** ✓ 3 Project Scenario ✗


Emission Factors


Forestland ✓ 


- Forest Types and Age Ranges ✓
- Natural Losses and Wood Removal ✓
- ▶ **Emission Factors** ✓


Grassland ✓ 


Settlements ✓ 

Wetlands ✓ 

Annual Crops ✓ 

Perennial Crops ✓ 

Agroforestry ✓ 

Livestock ✓ 

1 Select a Factor Show List of Greenhouse Gas Equations and Factors

- Factors in **green text** are good candidates for improvement through a measurement and monitoring program. They can be edited.
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- Factors in **red text** are either very difficult and/or expensive to measure, or they are well understood and cannot be improved upon, or they are physical constants. They cannot be edited.

Factor Name	Factor Type	Units	Source Category	SubSource Category ▲	
Bw: Aboveground Biomass Stock	Field Measurement	tonnes dm/ha	Biomass C Stocks	Forestland	↑
CF: Carbon Fraction	Complex Measurement	tonnes C/tonnes dm	Biomass C Stocks	Forestland	
MF: Mass of Fuel	Laboratory Measurement	tonnes dm/ha	Biomass Burning	Forestland	
ER(NOx): NOx Emission Ratio	Recommend Default Only	tonnes NOx-N/ton... N	Biomass Burning	Forestland	
R: Root:Shoot Ratio	Complex Measurement	unitless	Biomass C Stocks	Forestland	
Gef(CO): CO Emission Factor for Burning	Complex Measurement	g kg-1 dry matter burnt	Biomass Burning	Forestland	
Gef(CH4): CH4 Emission Factor for Burning	Complex Measurement	g kg-1 dry matter burnt	Biomass Burning	Forestland	
Gef(N2O): N2O Emission Factor for Burning	Complex Measurement	g kg-1 dry matter burnt	Biomass Burning	Forestland	
Gef(NOx): NOx Emission Factor for Burning	Complex Measurement	g kg-1 dry matter burnt	Biomass Burning	Forestland	
Cf: Combustion Factor	Laboratory Measurement	q burned q-1	Biomass Burning	Forestland	

Forestland in DA

2 View/Update Factor Values and Confidence Intervals

Land Use Climate Region	Tree Type	Age Range	Factor Value	Factor Type	Uncertainty (+/- %)
Tropical Montane	Yala Watershed Forest	<= 20 years	13.0000	Field Measurement	53.0000

Notes for this factor record:

3 Recommended Measurement and Monitoring Protocols

[Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu.](http://www.goes.msu.edu)

[2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, Table 3.3.2, p. 3.71](#)

[Forest Carbon Measurement Guidelines, Module 1 of 5: Guidelines for Ex Ante Forest Carbon Calculations. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu.](http://www.goes.msu.edu)

[Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Forest Carbon for Afforestation and Reforestation Projects. Global Observatory for Ecosystem Services, Department of Forestry, Michigan State University. Http://www.goes.msu.edu.](http://www.goes.msu.edu)

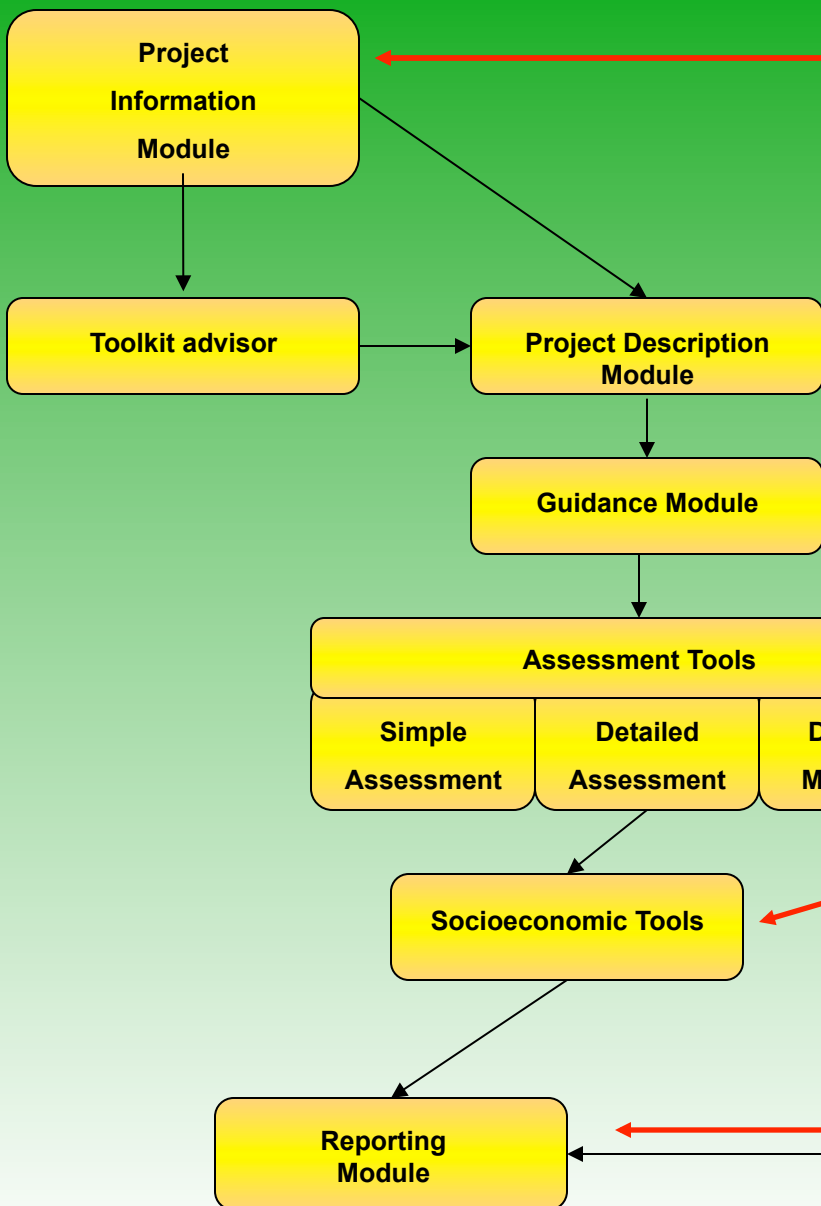
Tools

Increasing Accuracy, Increasing Time Requirements

- **Simple Assessment** allows rapid assessment of total carbon / greenhouse gas balance for a project, using generalized cropping system descriptions and standard / default equation factors.
- **Detailed Assessment** allows more specific descriptions of cropping systems, crop yields, grassland management, and allows use of project-specific equation factors.
- **Dynamic Modelling** allows highly specific cropping systems, detailed climate and soil datasets, uses dynamic models, produces highly accurate and precise results.

Decreasing Complexity & Information Requirements

Carbon Benefits Project: Modelling, Measurement and Monitoring



Name of project, funding agency etc.

Where project activities are

Table 3.2 Expanded Report showing Carbon Emissions by IPCC AFOLU Source Categories. Continued.

Source category	Source sub-category	Without Project (Baseline scenario)			With Project (Project scenario)			Incremental difference (Project scenario minus baseline)		
		tonnes CO ₂ e	tonnes CO ₂ e / yr	Uncertainty	tonnes CO ₂ e	tonnes CO ₂ e / yr	Uncertainty	tonnes CO ₂ e	tonnes CO ₂ e / yr	Uncertainty
	Forest Land	0	0	0	0	0	0	0	0	0
	Grassland/Savanna	0	0	0	-608642.1	-60864.21	0	-608642.1	-60864.21	0
	Annual Cropland	0	0	0	0	0	0	0	0	0

Table 3.1 Simple Summary Report following UNFCCC Common Reporting Guidelines.

Greenhouse Gas Source and Sink Categories	Baseline Emissions (2010)				Project Emissions (2020)				Carbon Benefits		
	CO ₂	CH ₄	N ₂ O	GHGs	CO ₂	CH ₄	N ₂ O	GHGs	Total tCO ₂ e	tCO ₂ e / ha	tCO ₂ e / ha / yr
Total Biomass Burning	tonnes CO ₂ equivalent				tonnes CO ₂ equivalent						
Agriculture											
A. Enteric Methane		2698.5				6746.25			40477.5	1.686563	0.1686563
B. Manure Management		116.34	2046			290.85	5115		32435.1	1.351462	0.1351462
C. Rice Cultivation		0				0			0	0	0
D. Agricultural Soils	0	0	2480.93		0	0	6201.96		37209.3	1.550388	0.1550388
E. Prescribed Burning of Savannas		0	0			0	0		0	0	0
F. Field Burning of Agricultural Residues		0	0	0		0	0		0	0	0
G. Other		0	0	0		0	0		0	0	0
Land Use Change and Forestry											
A. Forest and other Woody Biomass Stocks	0										
B. Forest and Grassland Conversion	0	0	0	0	0	0	0	0	0	0	0
C. Abandonment of Managed Lands	0				0				0	0	0
D. CO ₂ Emissions and Removals from Soil	0								-41800	-17.41667	-1.741667
E. Other		0	0	0		0	0		0	0	0
Total	0	2814.84	4526.93	0	-105669.6	7037.1	11316.86	0	-946574.4	-39.4406	-3.94406

ake,

Report

Clipboard Alignment Number Styles Cells Editing

A1 Mineral Soils C Stocks

A	B	C	D	E	F	G
1 Mineral Soils C Stocks						
2 Source: Soil C Stocks						
3 Subsource: Mineral Soils						
4 Project Name: SA Exercise						
5 Start Date: 01/06/2004						
6 Duration: 10 years						
7 Assessment Type: Simple IPCC Assessment						
8 Assessment Step: Project Scenario						
9 Version Time Stamp: 27/06/2014 07:57:53						
10						
11 Equation:						
12 $SOC = A * SO_{Cref} * Flu * Fi * Fmg * CO2-C$						
13						
14 Legend:						
Abbreviation	Description	Units	Type			
SOC	Mineral Soils C Stocks	tonnes C	Equation Result			
Uncertainty (%)	Uncertainty in Equation Result	Percent	Result Uncertainty			
A	Area	ha	Quantity Value			
Fi	Input Factor	unitless	Factor Value			
Fi-uncert (%)	Uncertainty in Fi	Percent	Factor Uncertainty			
Fmg	Management Factor	unitless	Factor Value			
Fmg-uncert (%)	Uncertainty in Fmg	Percent	Factor Uncertainty			
Flu	Land Use Factor	unitless	Factor Value			
Flu-uncert (%)	Uncertainty in Flu	Percent	Factor Uncertainty			

Enteric CH4 Manure CH4 Manure N2O Manure Amend Direct N2O Manure Amend Atmos Dep N2O Manure Amend Leach-Runoff N2O Manure PRP Direct N2O

A1 Mineral Soils C Stocks

A	B	C	D	E	F	G
Project Activity Area	Project Activity Area Group Name		Stratum			
Climate	Climate		Stratum			
Soil	Soil		Stratum			
Category	Activity Data Category		Stratum			
SubCategory	Activity Data Subcategory		Stratum			
MgmtSoilCls	Management Soil Class		Stratum			
InputSoilCls	Input Soil Class		Stratum			
LUSoilCls	Land Use Soil Class		Stratum			
AgeRange	Age Range		Stratum			
CropTreeType	Crop/Tree Type		Stratum			
39 Results:						
Project Activity Area	Climate	Soil	Category	SubCategory	MgmtSoilCls	InputSoilCls
Introduced Agroforestry	Tropical Montane	Low Activity Clay Mineral	Agroforestry		Reduced Tillage	Inputs with Manure Amender
Reforestation Area 1	Tropical Montane	Low Activity Clay Mineral	Forestland	mountain systems plantation - E	N/A	N/A
Reforestation Area 1	Tropical Montane	Low Activity Clay Mineral	Forestland	mountain systems plantation -	N/A	N/A
Reforestation Area 1	Tropical Montane	Low Activity Clay Mineral	Forestland	mountain systems plantation -	N/A	N/A
voided Deforestation Area	Tropical Montane	Low Activity Clay Mineral	Forestland	mountain systems natural ve	N/A	N/A
46 Total						
47 *GWP are 100-year time horizon based on estimates from the IPCC 4th Assessment Report						

Enteric CH4 Manure CH4 Manure N2O Manure Amend Direct N2O Manure Amend Atmos Dep N2O Manure Amend Leach-Runoff N2O Manure PRP Direct N2O

-What carbon science information do you need/want to support your work/project?

Forestland: Better estimates of above ground biomass in tropical and sub-tropical forests, especially secondary forests in reforested areas.

Grasslands: Estimates of tree/shrub cover, woody AGB (and BGB) in different types and ages of savannahs in Sub Saharan Africa.

Settlements: Better estimates of 'typical' tree cover (and associated AGB) in rural villages and settlements particularly in Africa.

Cropland: Crop management info in developing countries, who is growing what where and how! (outside of CMS activities)
Estimates of woody biomass in croplands (hedge rows, shade trees, erosion bunds) in small holder landscapes.

Wetlands: Show presence and timing of flooding – to ID rice area and also observe drainage and re-flooding management

-When and how should the carbon science information be delivered?

-Online resource with free access and easy searching function which can be linked to other non-NASA tools.

-Are you interested in any particular CMS projects or products?

-Carbon Monitoring of Agricultural Lands: Developing a Globally Consistent Estimate of Carbon Stocks and Fluxes

-Total Carbon Estimation in African Mangroves and Coastal Wetlands in Preparation for REDD and Blue Carbon Credits

-Reducing Uncertainties in Satellite-Derived Forest Aboveground Biomass Estimates Using a High Resolution Forest Cover Map

-Long-Term Carbon Consequences of Amazon Forest Degradation

-Are you interested in any particular CMS projects or products?

-Indonesian peat swamp inventory

-Time Series Fusion of Optical and Radar Imagery for Improved Monitoring of Activity Data, and Uncertainty Analysis of Emission Factors for Estimation of Forest Carbon Flux

-Developing Statistically Rigorous Sampling Design and Analysis Methods to Reduce and Quantify Uncertainties Associated with Carbon Monitoring Systems

-- Provide global country-level estimates of mean aboveground forest biomass per hectare in support of the 2015 UN Food and Agriculture Association Forest Resources Assessment.

-Spatially Explicit Sources and Sinks of Carbon from Deforestation, Reforestation, Growth and Degradation in the Tropics: Development of a Method and a 10 Year Data Set 2000-2010

-Estimating Global Inventory-Based Net Carbon Exchange from Agricultural Lands for Use in the NASA Flux Pilot Study

Thank-you!

www.unep.org/cbp_pim

Tools currently undergoing an overhaul