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

GEF

Colorado State University

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

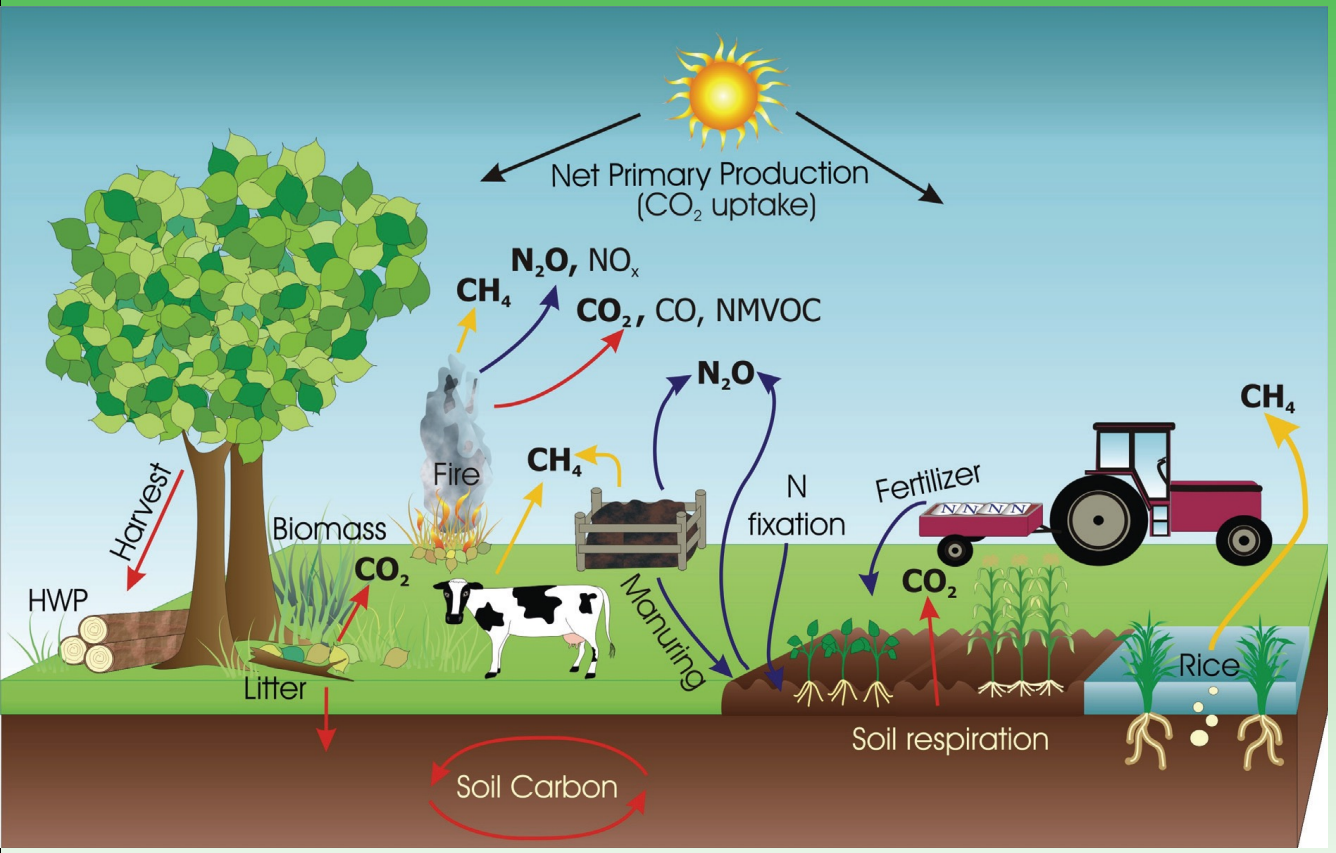
Institut de Recherche pour le Développement

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 livetsock

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:

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- reduce GHG emissions
- sequester C from the atmosphere

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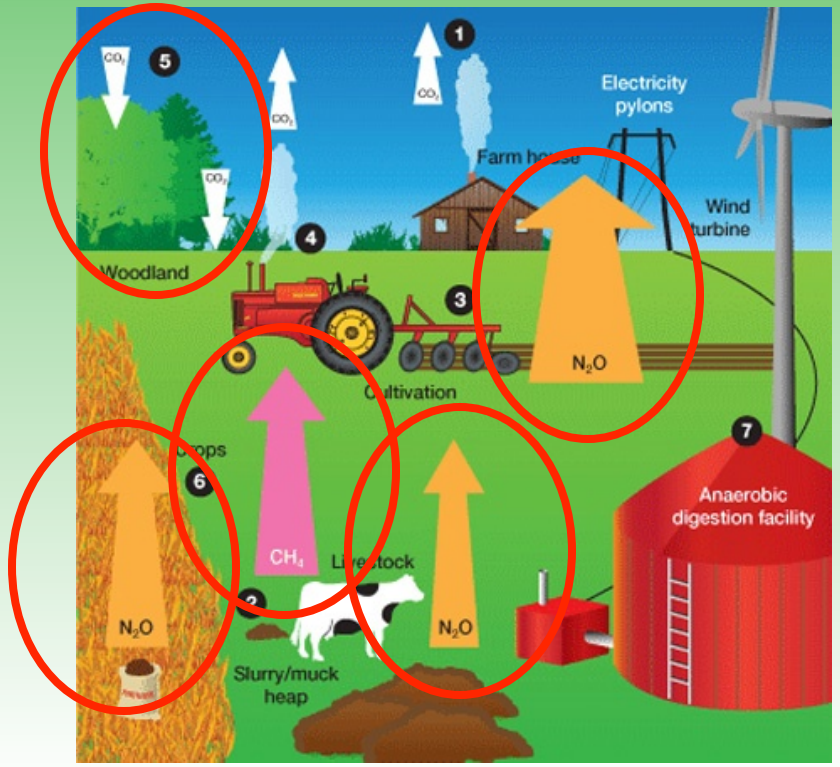
Comprehensive Greenhouse Gas Inventory

- 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

Business as usual

Soil Carbon

Woody Carbon

Enteric CH_4

Manure N_2O, CH_4

Biomass Burning (CO_2, N_2O, CH_4, CO, NOx

Synthetic Fertilizer N2O

Project scenario

Carbon Benefit

Project activities:

- Reduced grazing, protection of rangelands
- Reforestation/Afforestation

The Carbon Benefits Project

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

Estimate

Track

Report

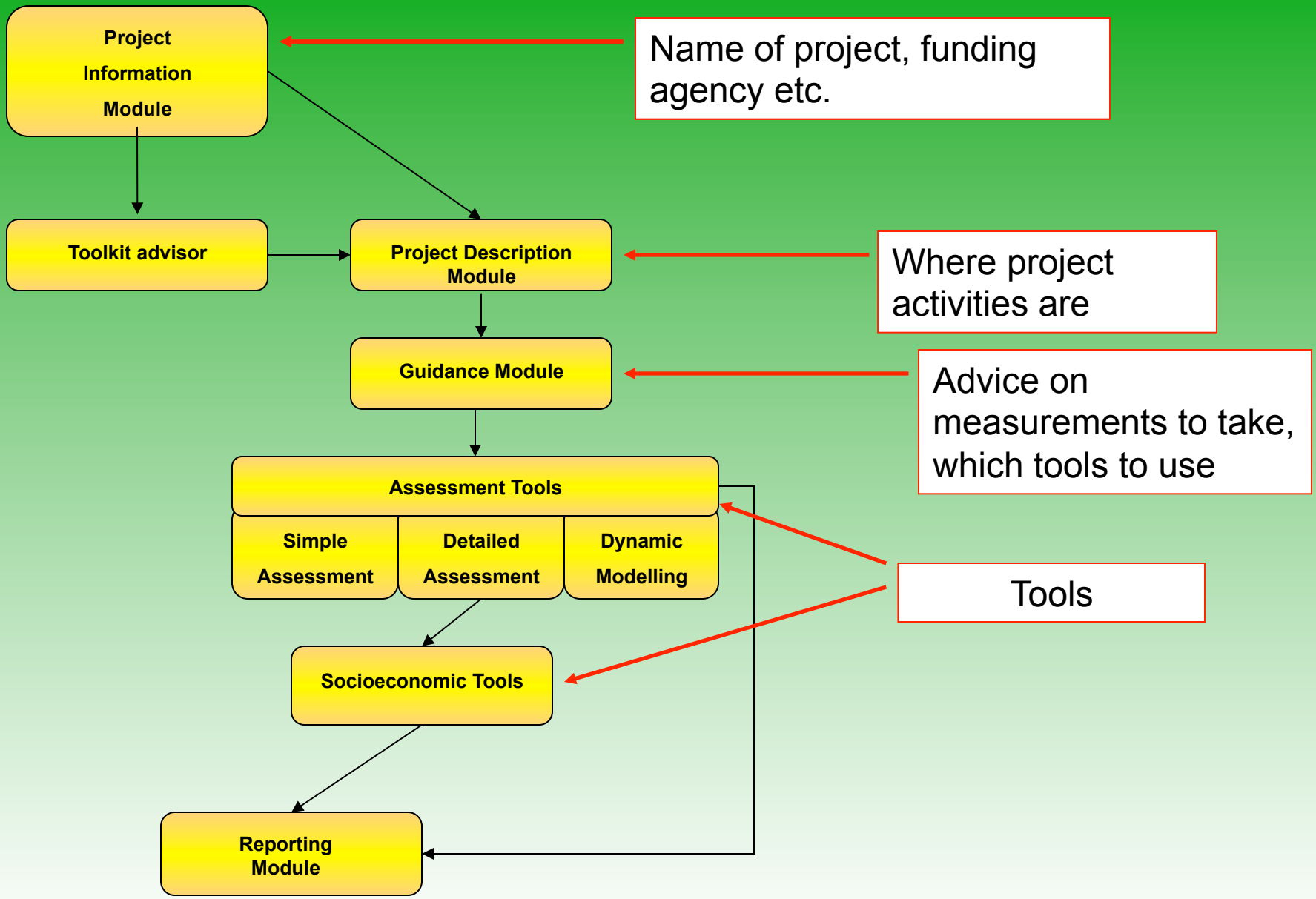
C stock changes and GHG emissions (carbon benefits) which result from the project (in comparison to a baseline)

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

Project Information Module

Name of project, funding agency etc.

Toolkit advisor

Project Description Module

Guidance Module

Assessment Tools

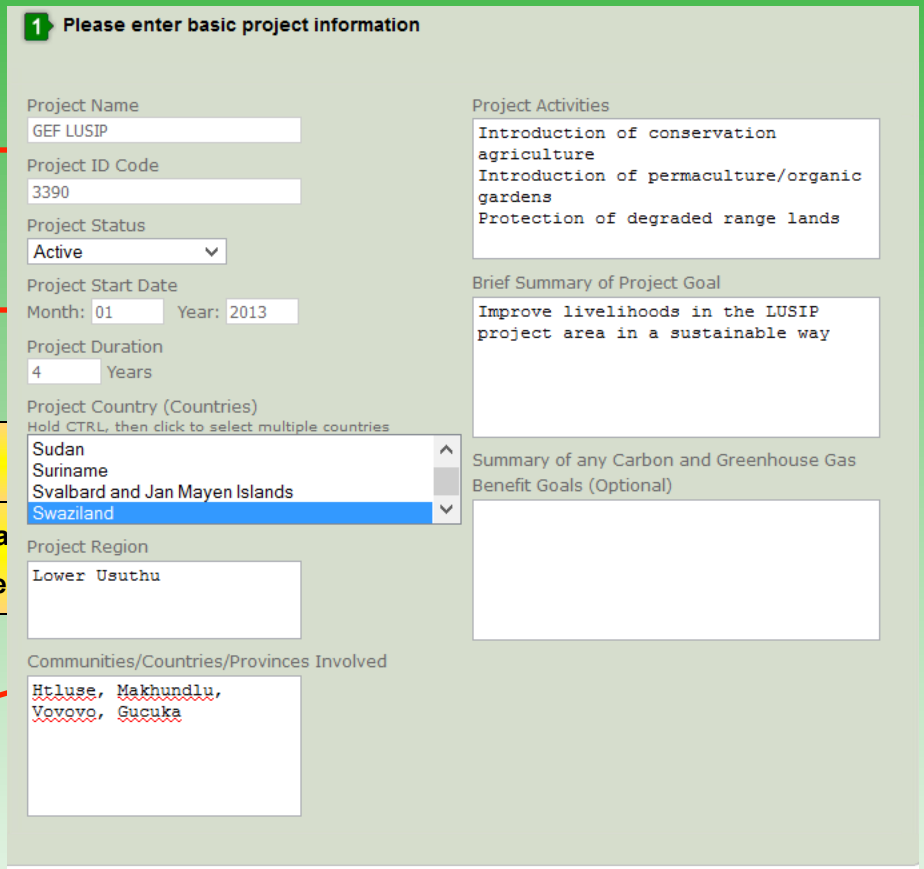
Simple Assessment

Detailed Assessment

Dyna Mode

Socioeconomic Tools

Reporting Module



Carbon Benefits Project: Modelling,Measurement and Monitoring

Project Information Module

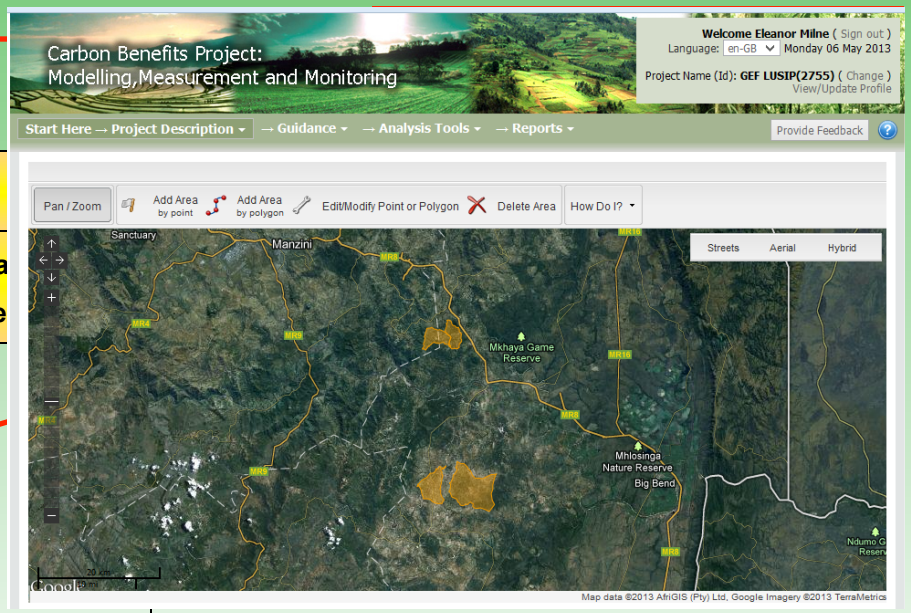
Name of project, funding agency etc.

Toolkit advisor

Project Description Module

Where project activities are

Guidance Module



Assessment Tools

Simple Assessment

Detailed Assessment

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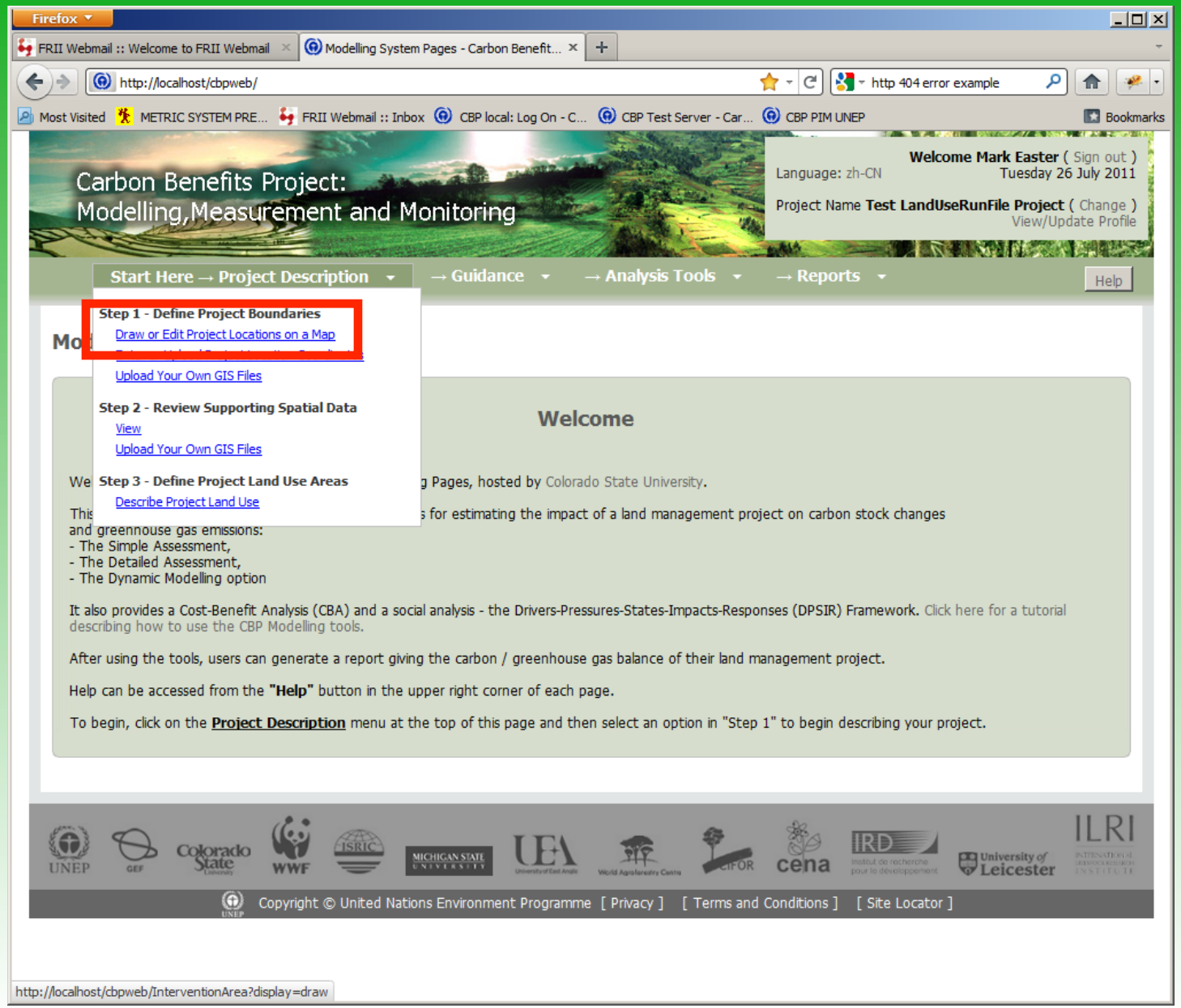
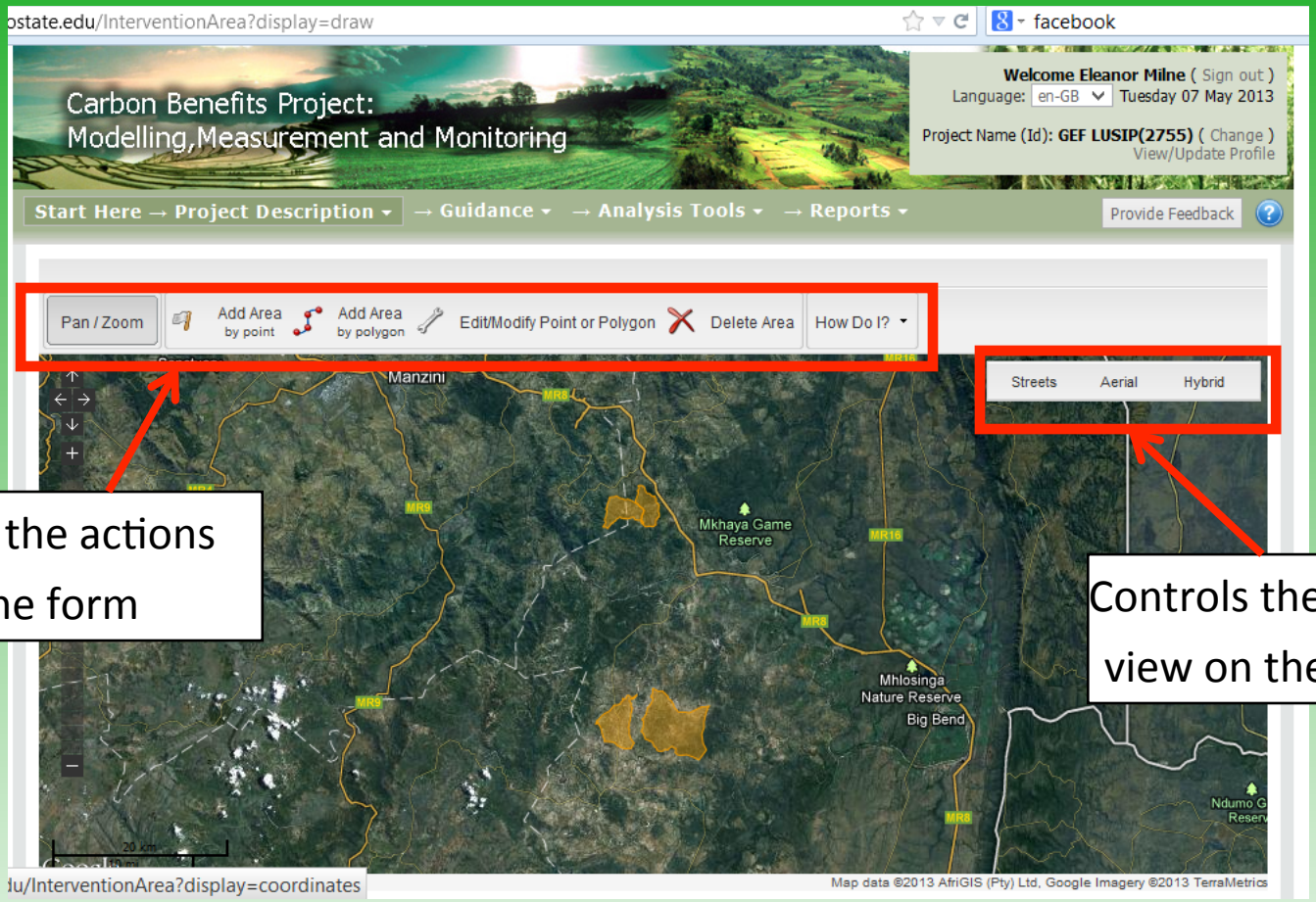
Socioeconomic Tools

Reporting Module

Enter, Manage, and Delete a Polygon



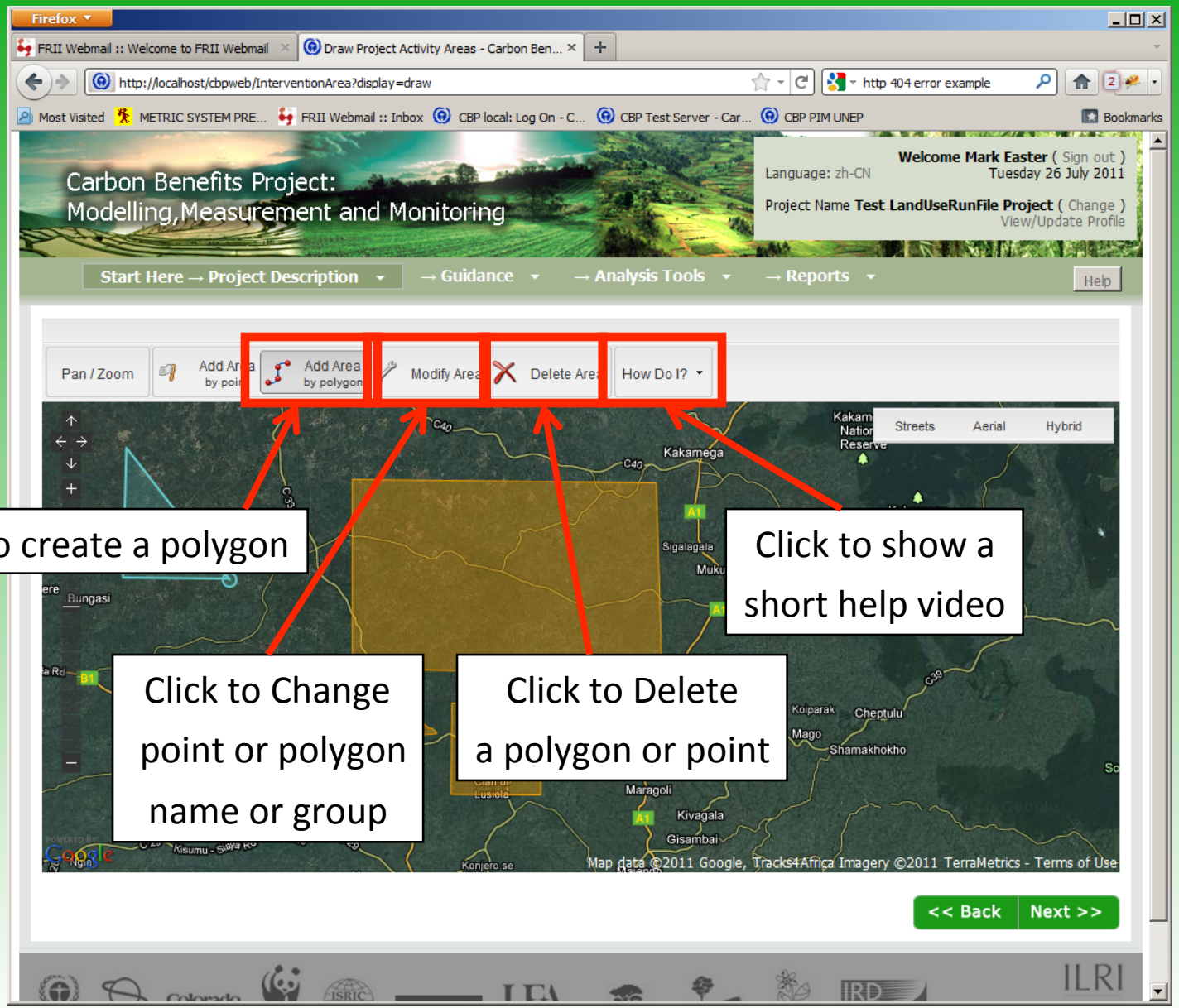
Enter, Manage, and Delete a Polygon



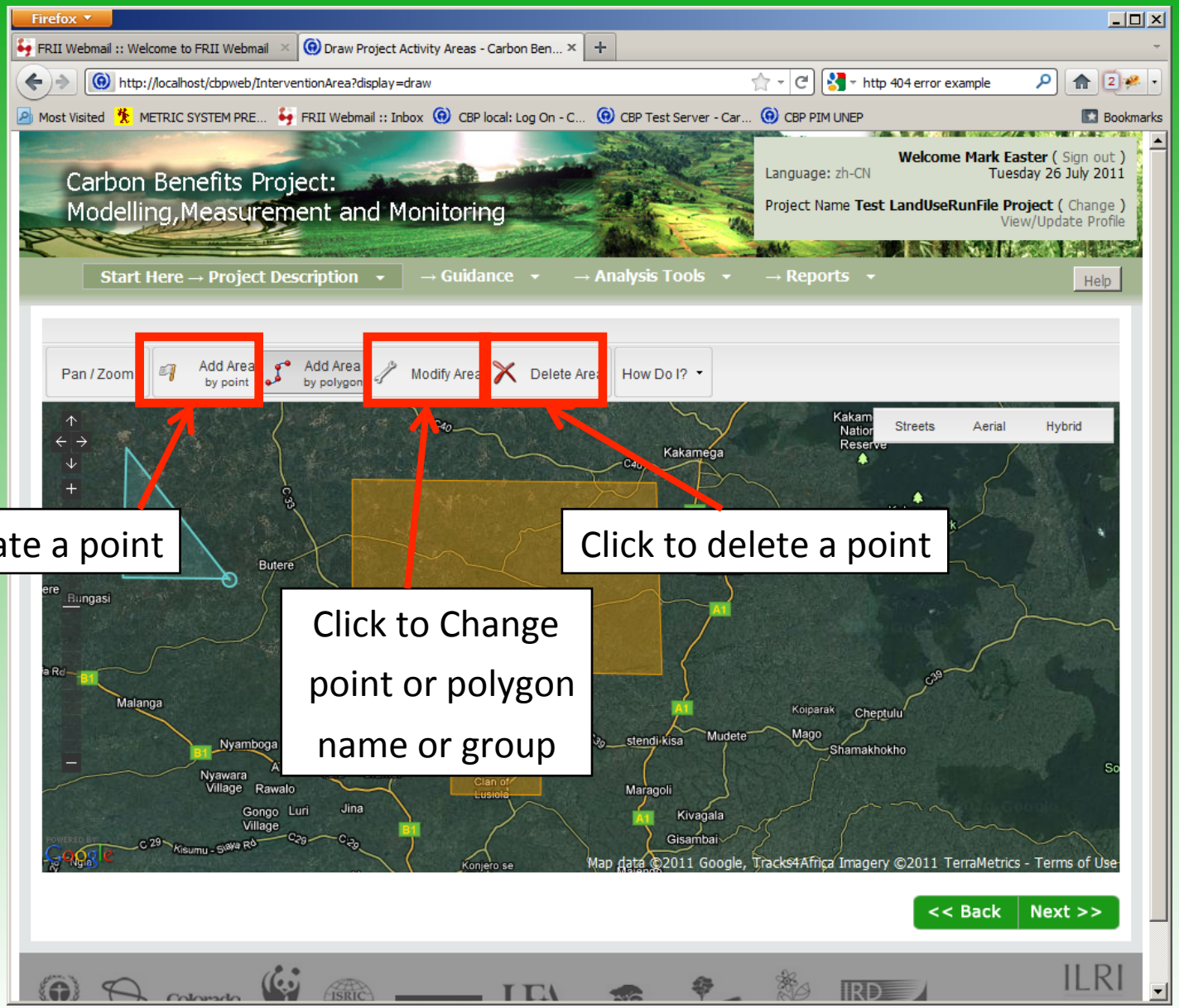
Controls the actions on the form

Controls the image view on the form

Enter, Manage, and Delete a Polygon



Enter, Manage, and Delete a Point

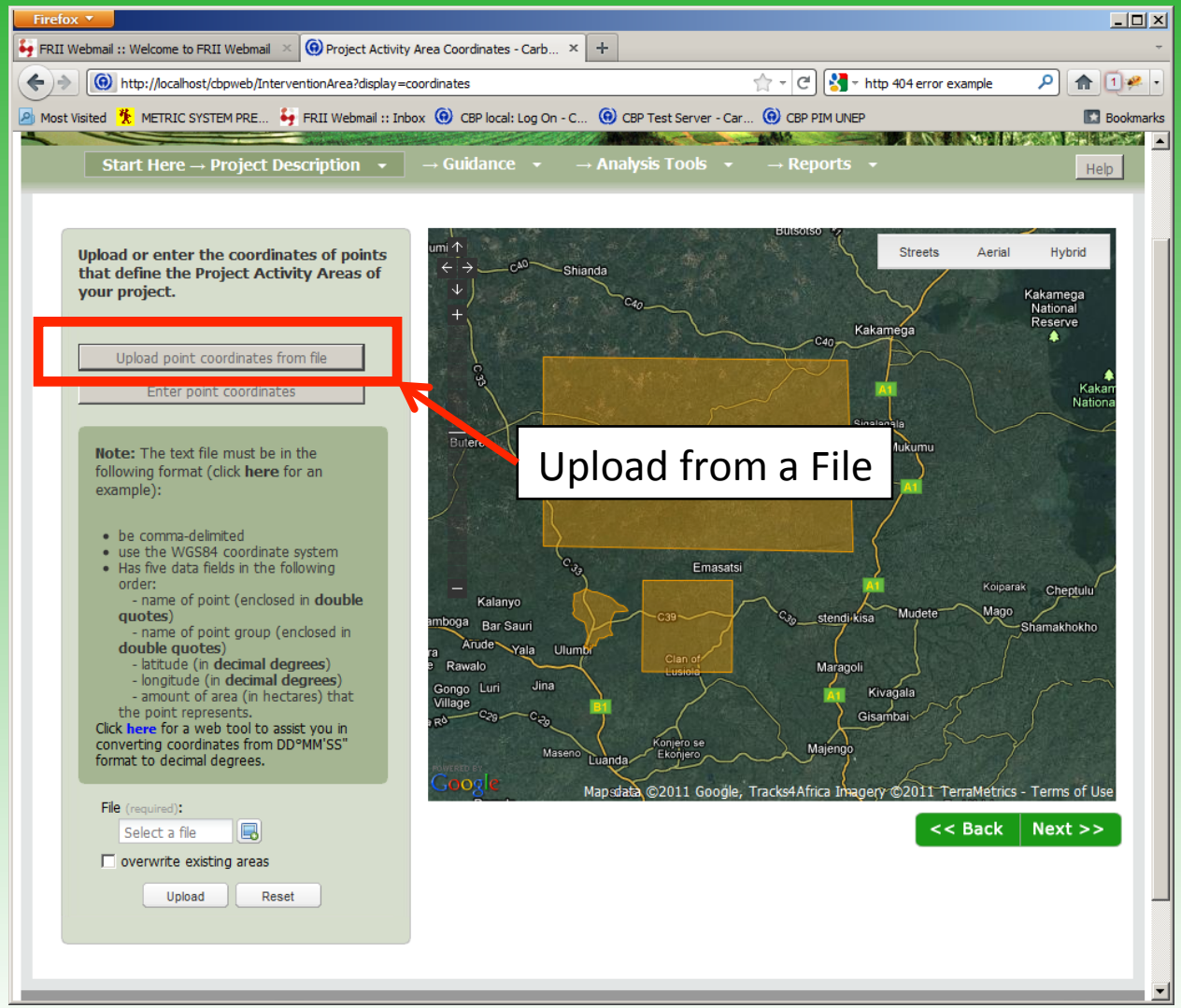


Click to create a point

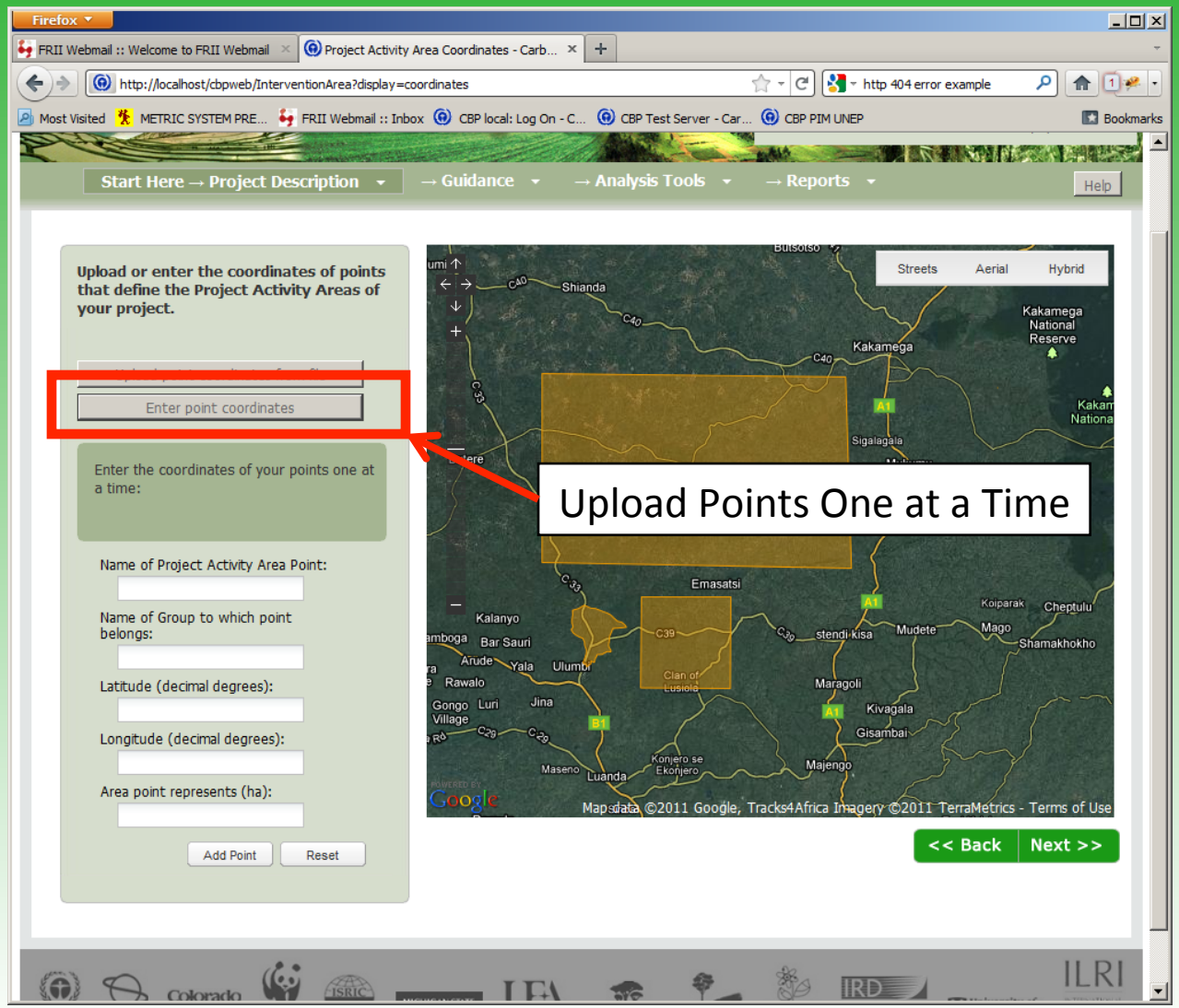
Click to Change point or polygon name or group

Click to delete a point

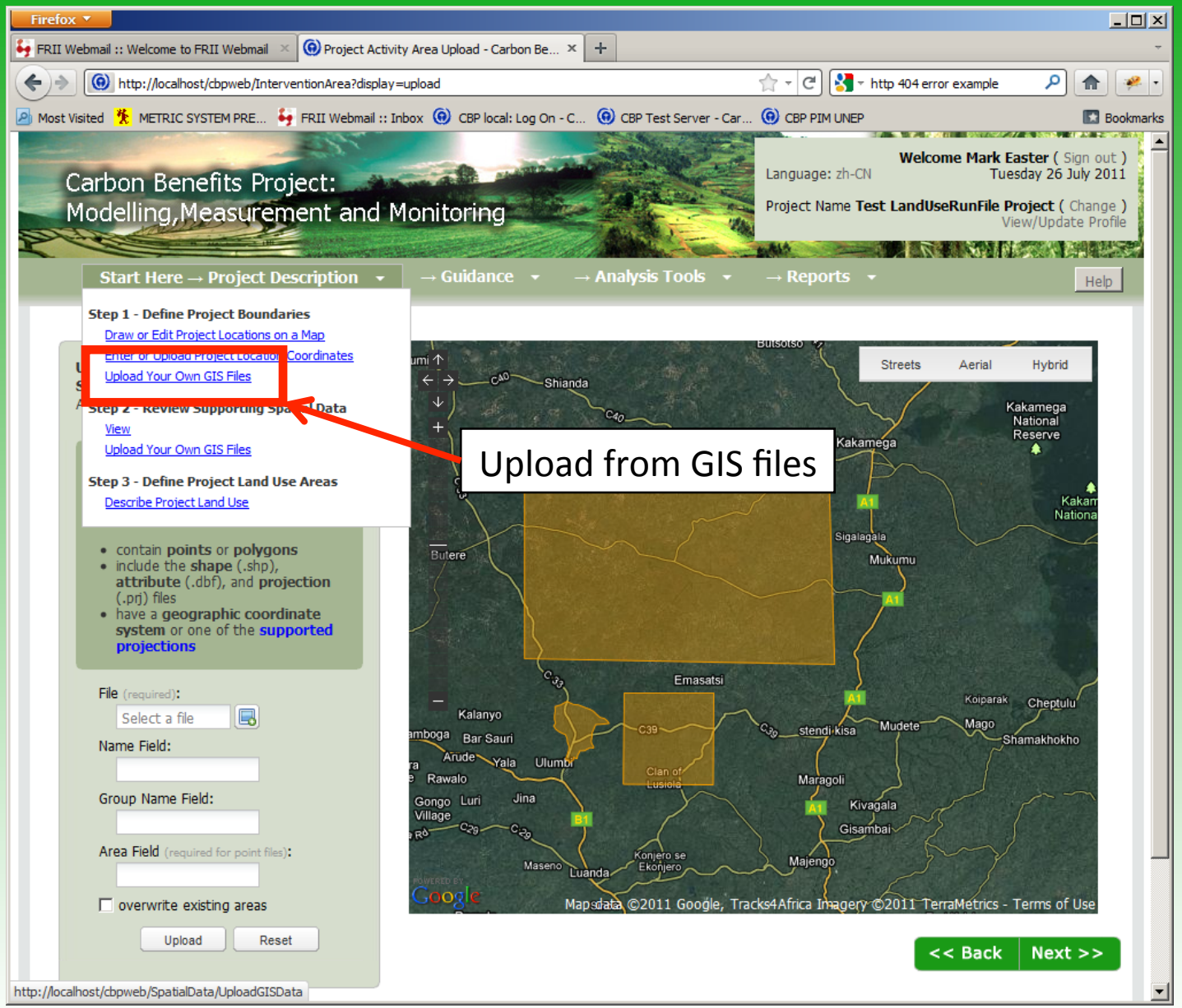
Establishing Points Using Latitude and Longitude



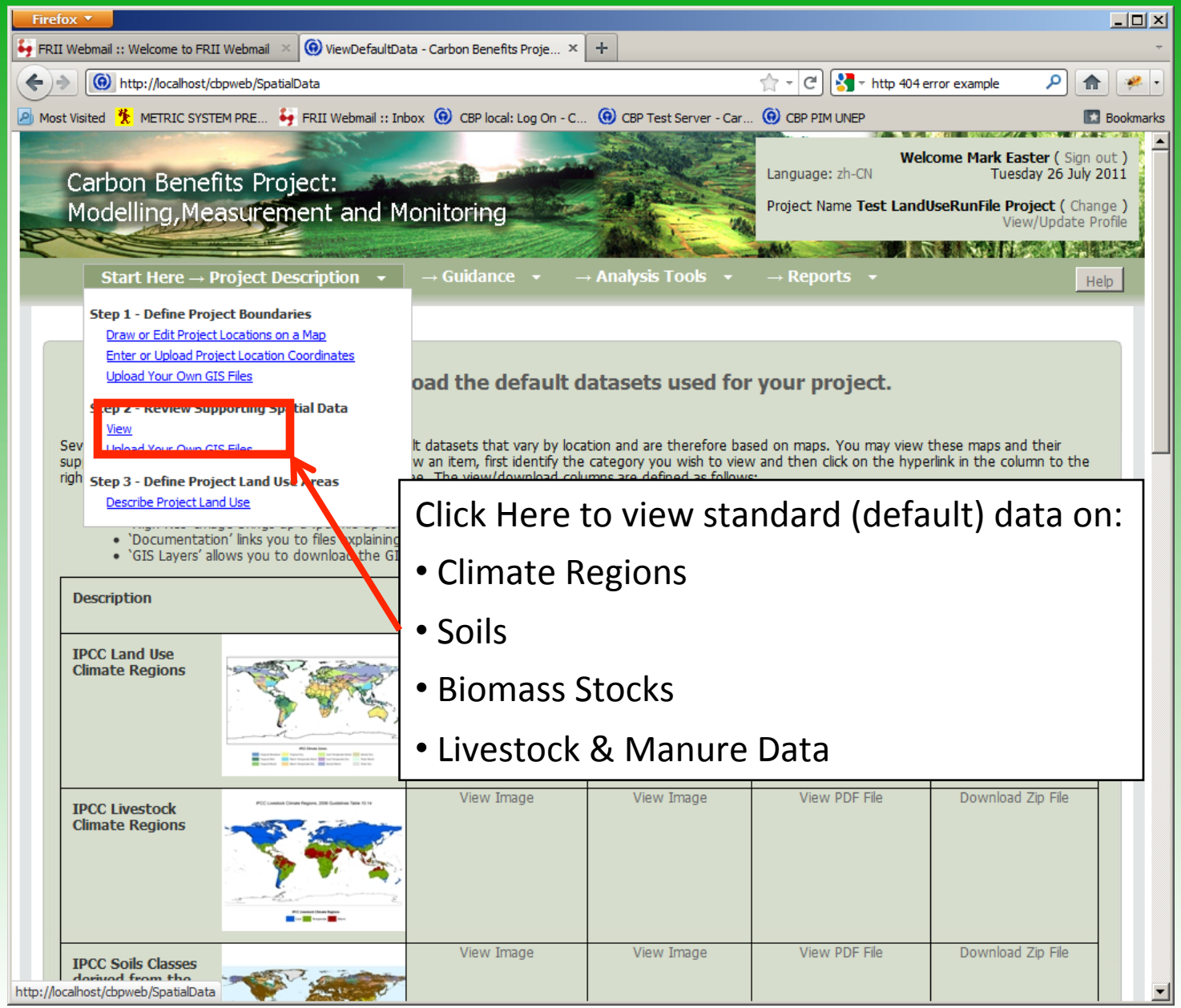
Establishing Points Using Latitude and Longitude



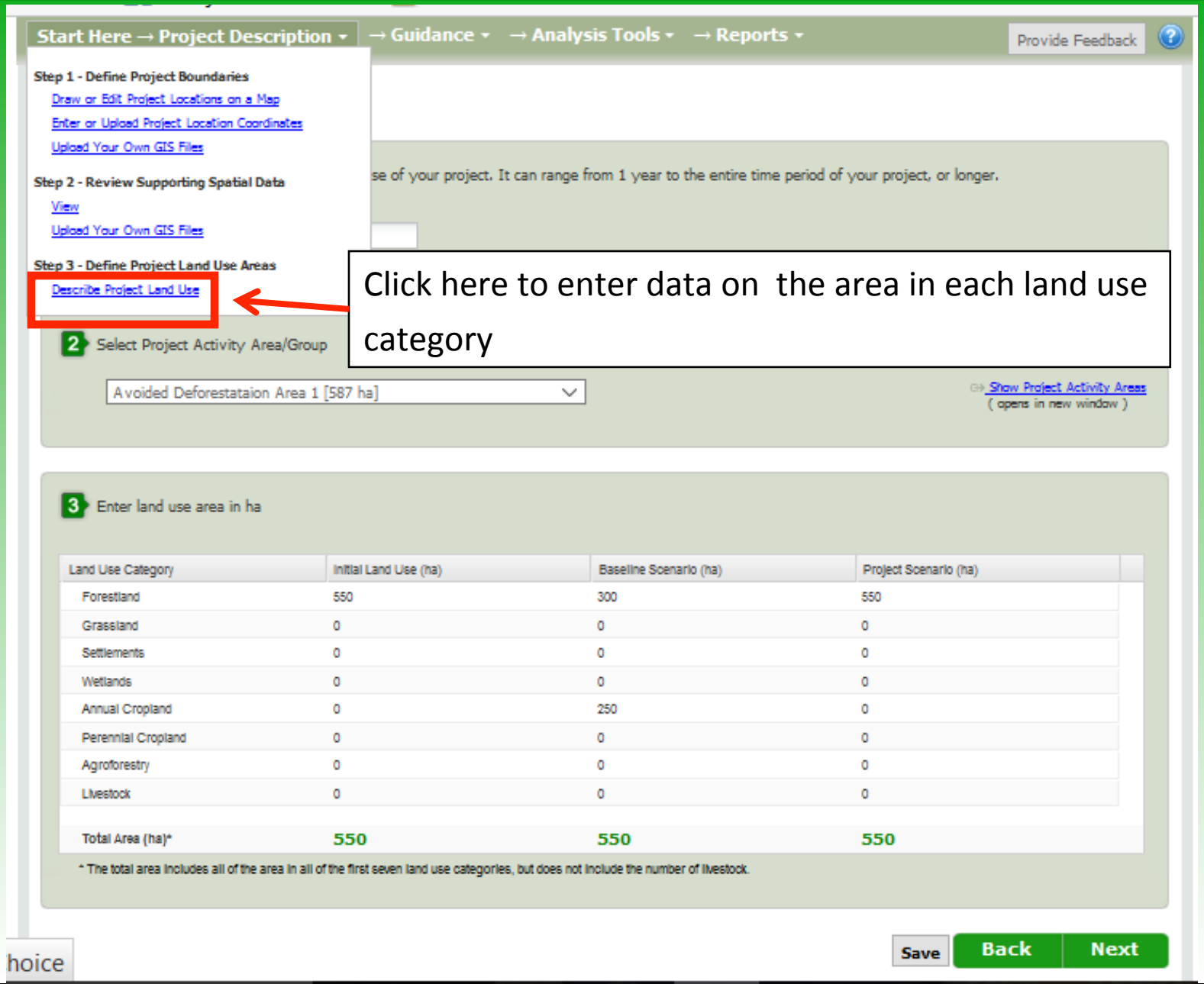
Uploading your own ESRI GIS Files



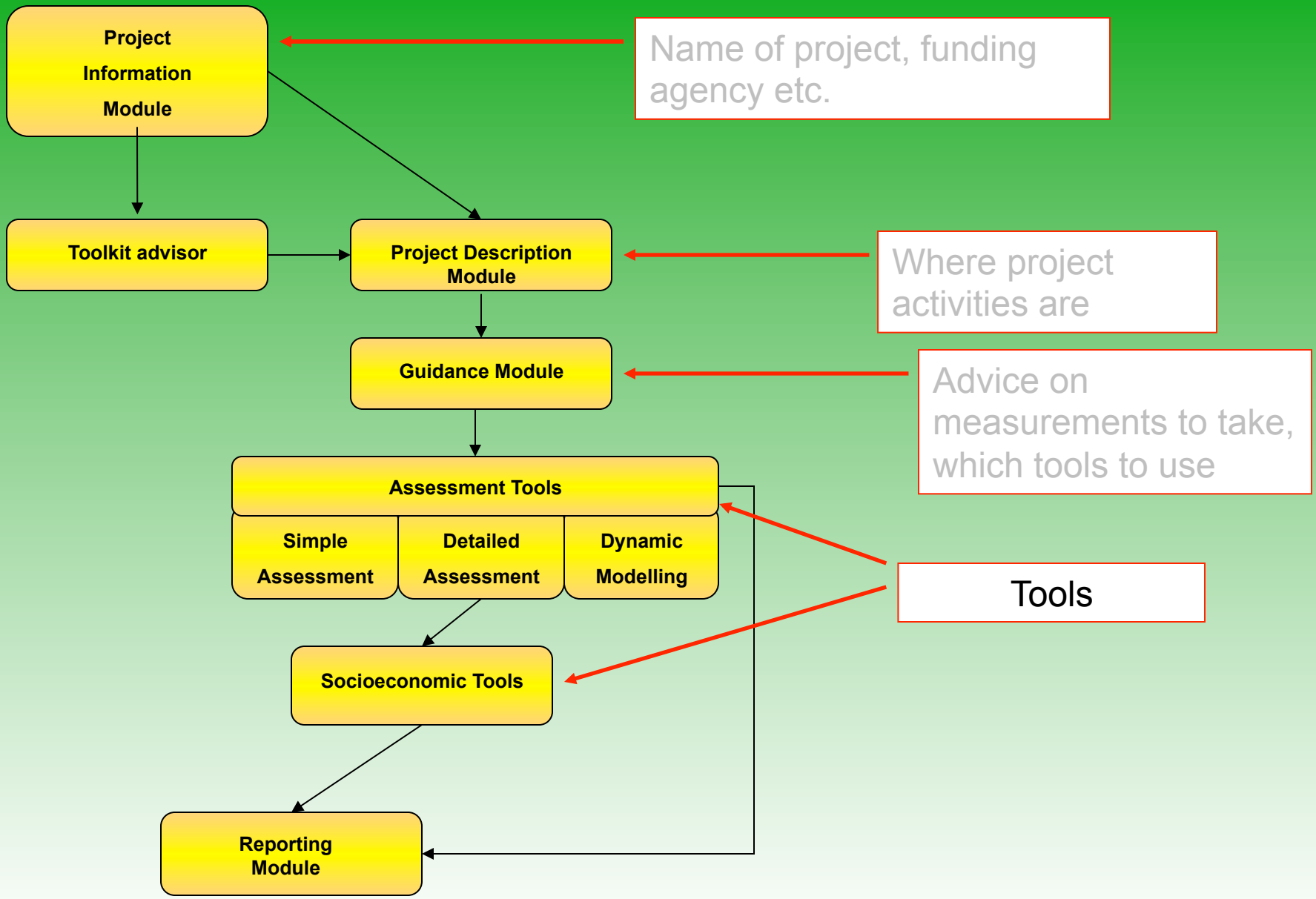
Viewing the Standard Project Data



Enter your Project Activity Data



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

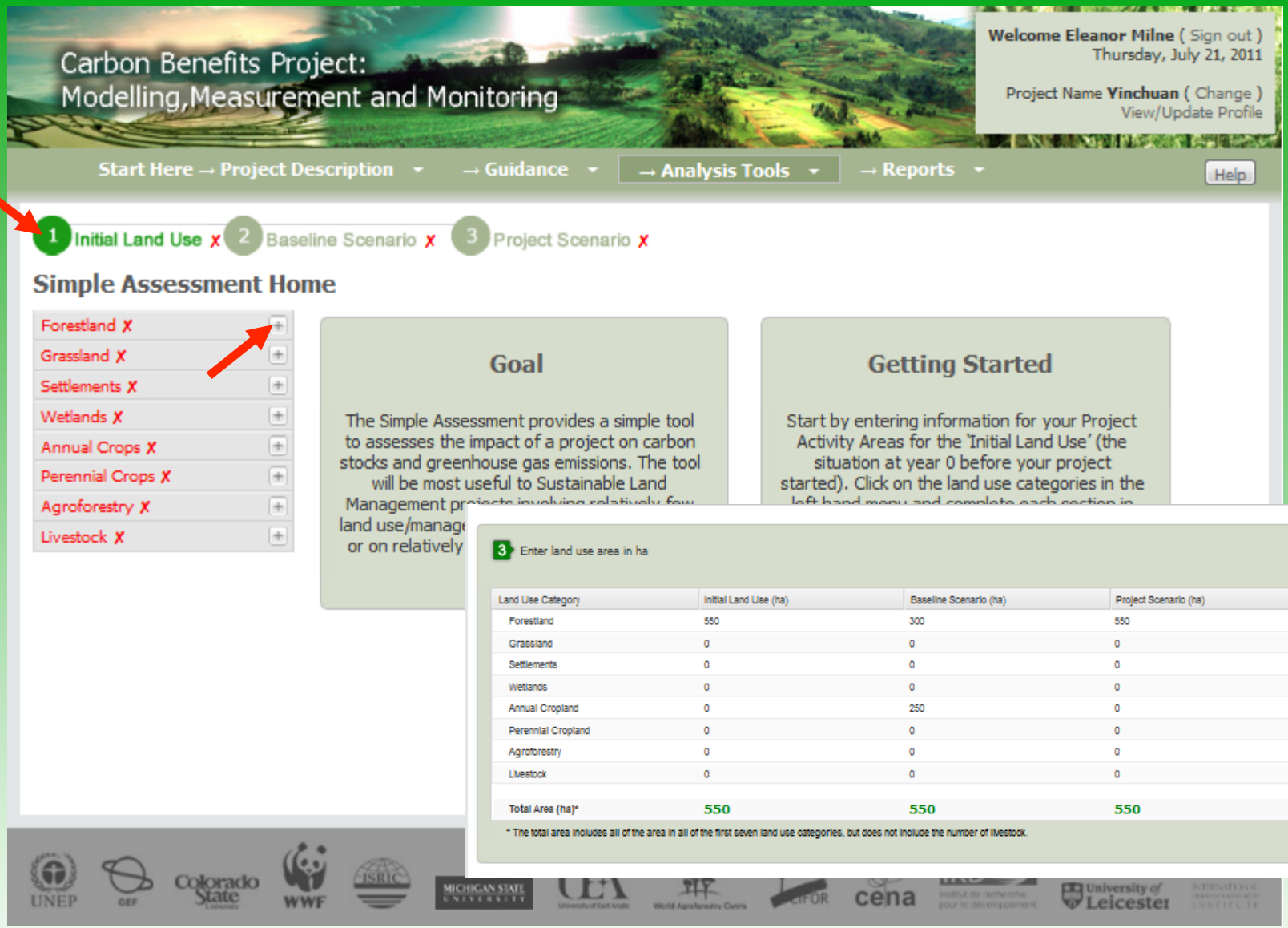
What is needed to use it?

-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

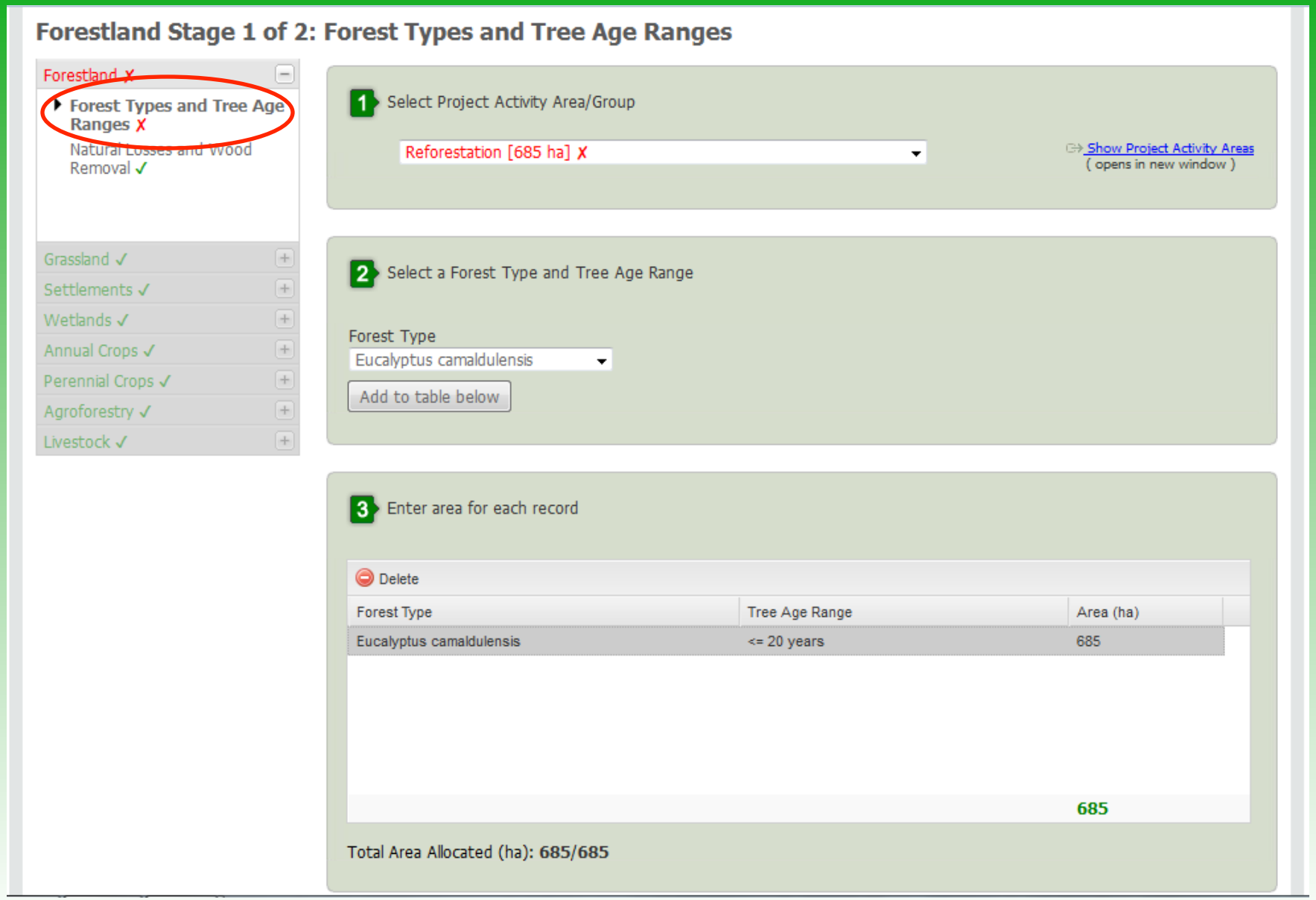
Who is it suitable for?

- 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)

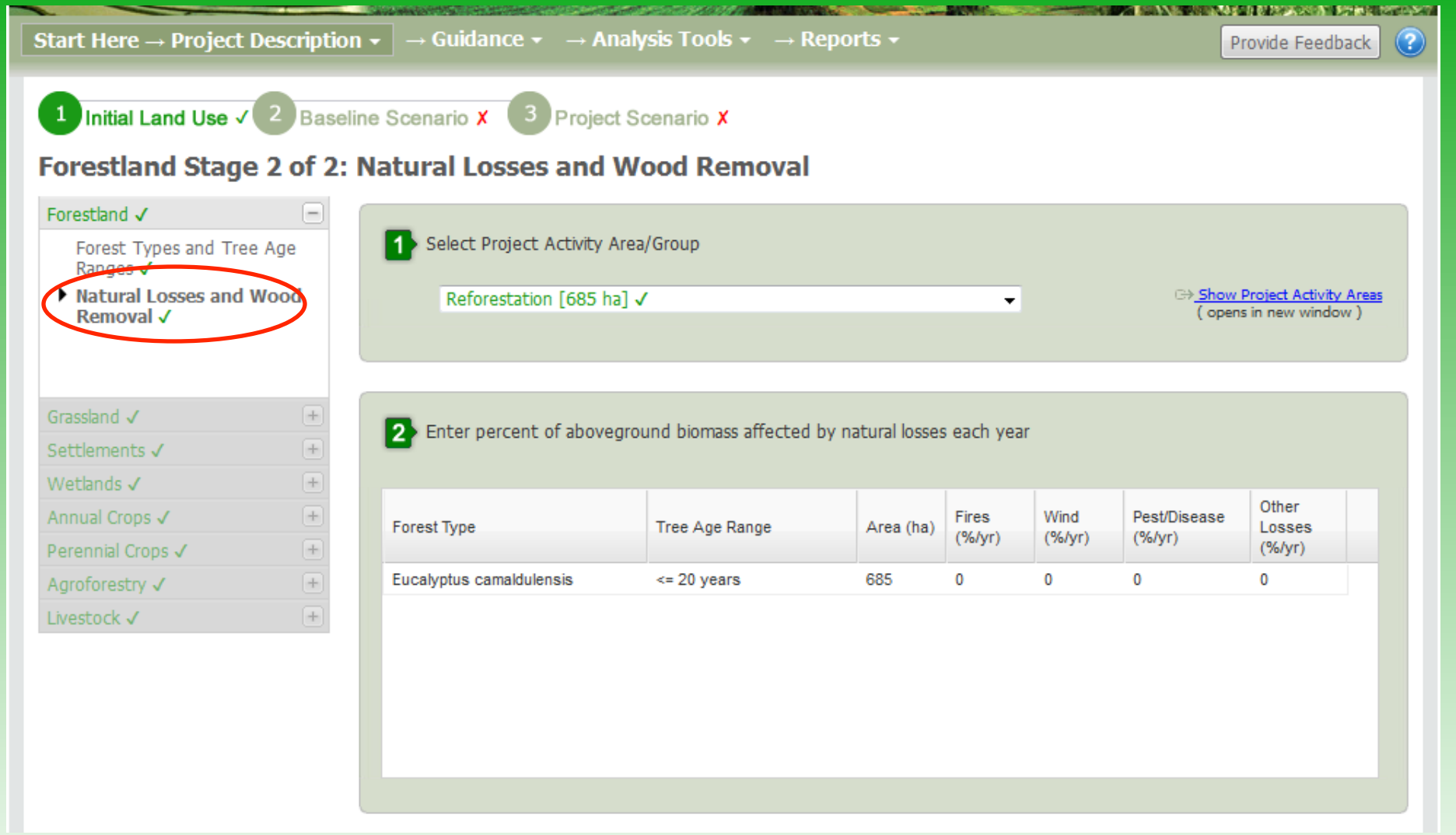
Simple Assessment



Simple Assessment - Forestland



Simple Assessment – Forestland



Simple Assessment – Forestland

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

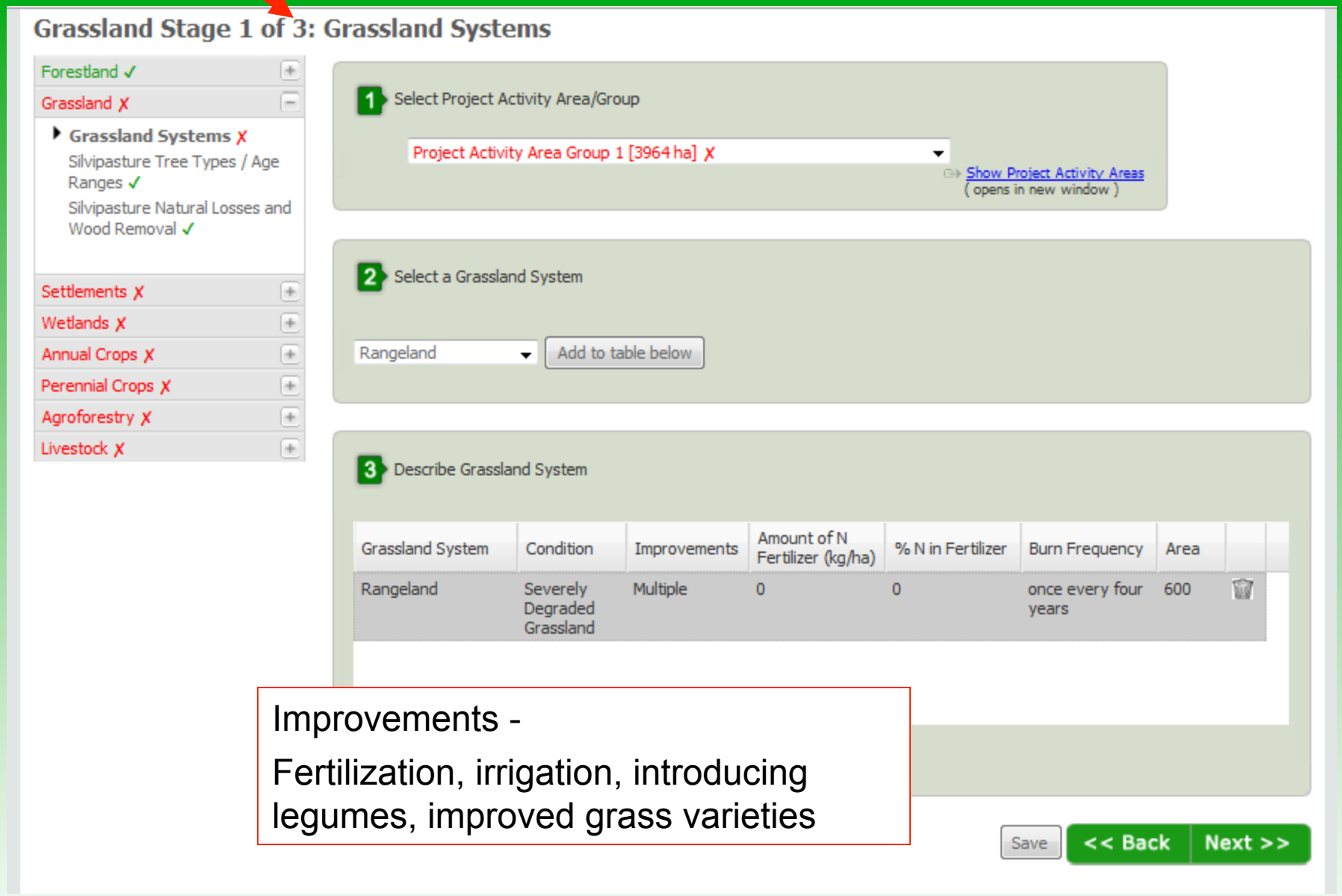
Forest Type	Tree Age Range	Area (ha)	Timber Harvest (m^3/yr)	Fuelwood Gathering (m^3/yr)
Eucalyptus camaldulensis	<= 20 years	685	0	0

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

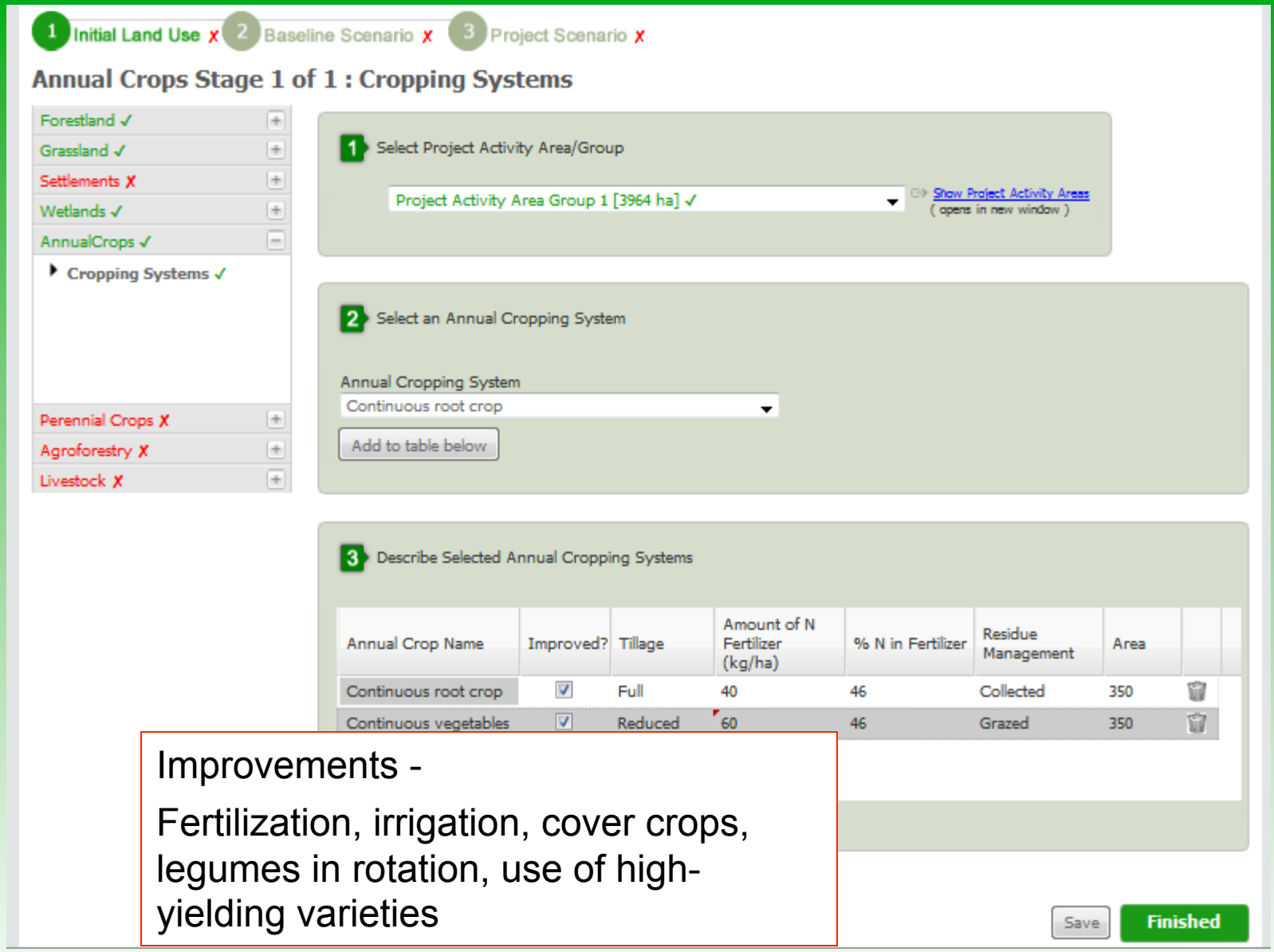
Simple Assessment - Grasslands



Improvements -

Fertilization, irrigation, introducing legumes, improved grass varieties

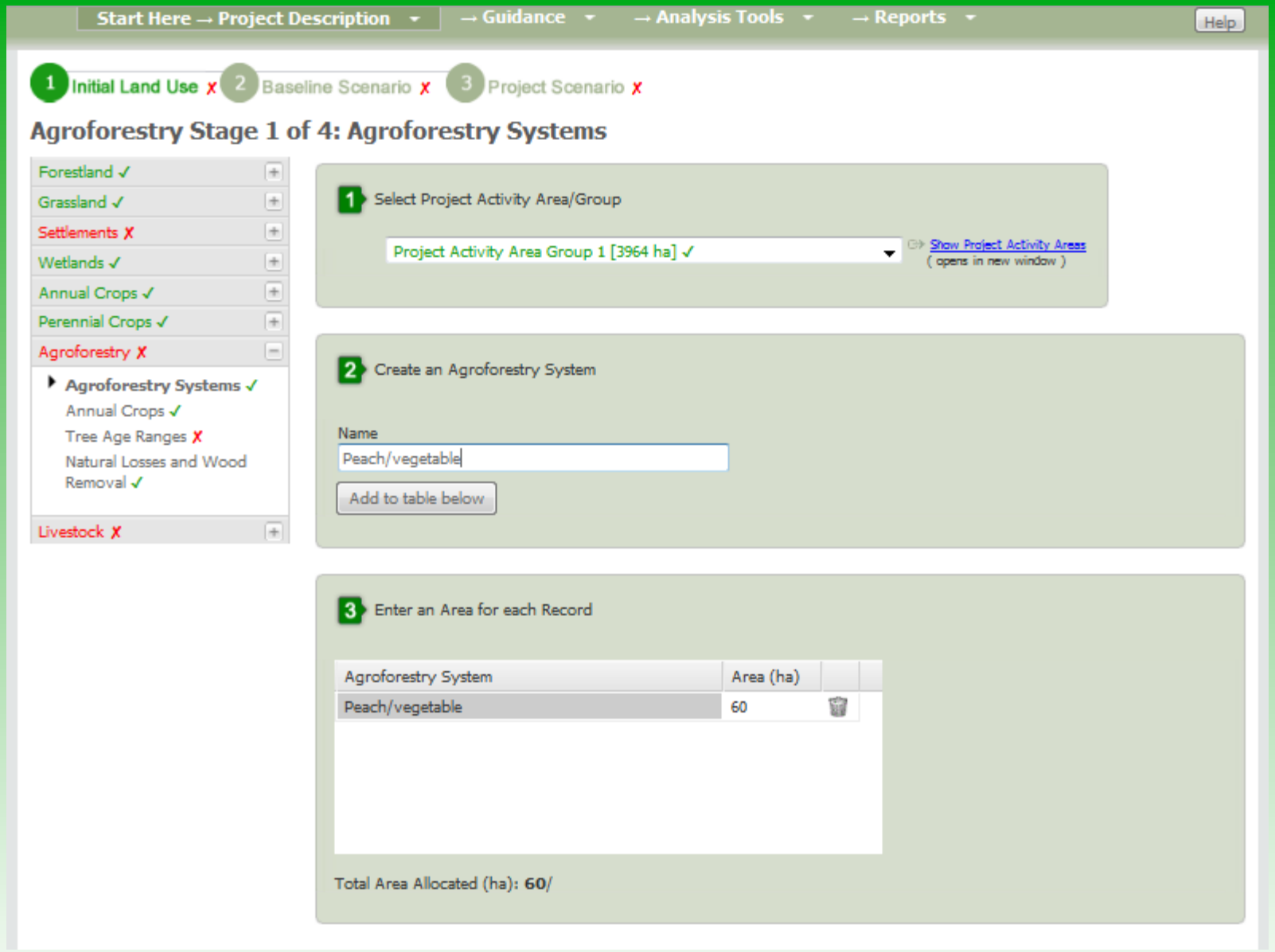
Simple Assessment Annual Crops



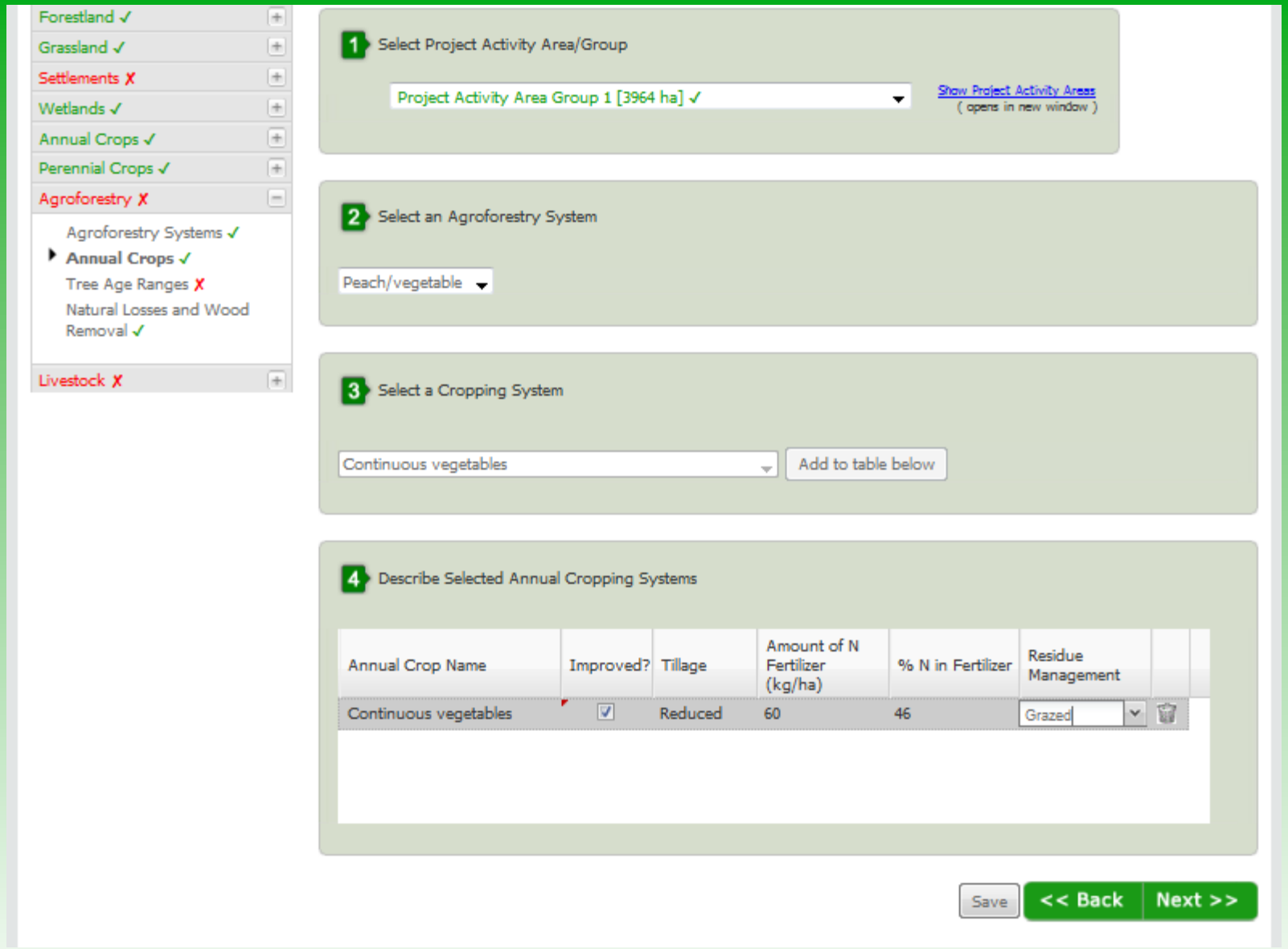
Improvements -

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

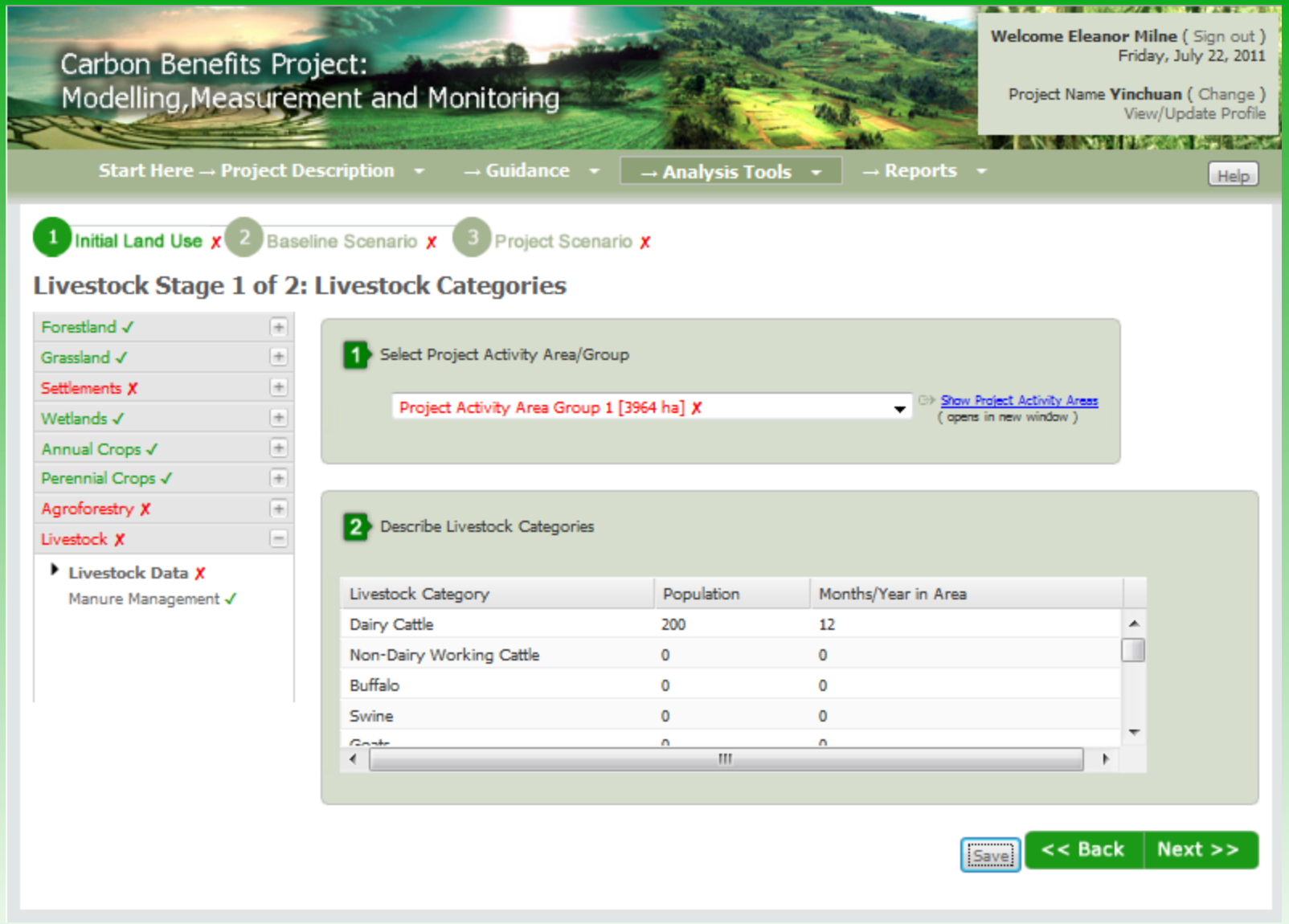
Simple Assessment - Agroforestry



Simple Assessment – Agroforestry



Simple Assessment - Livestock



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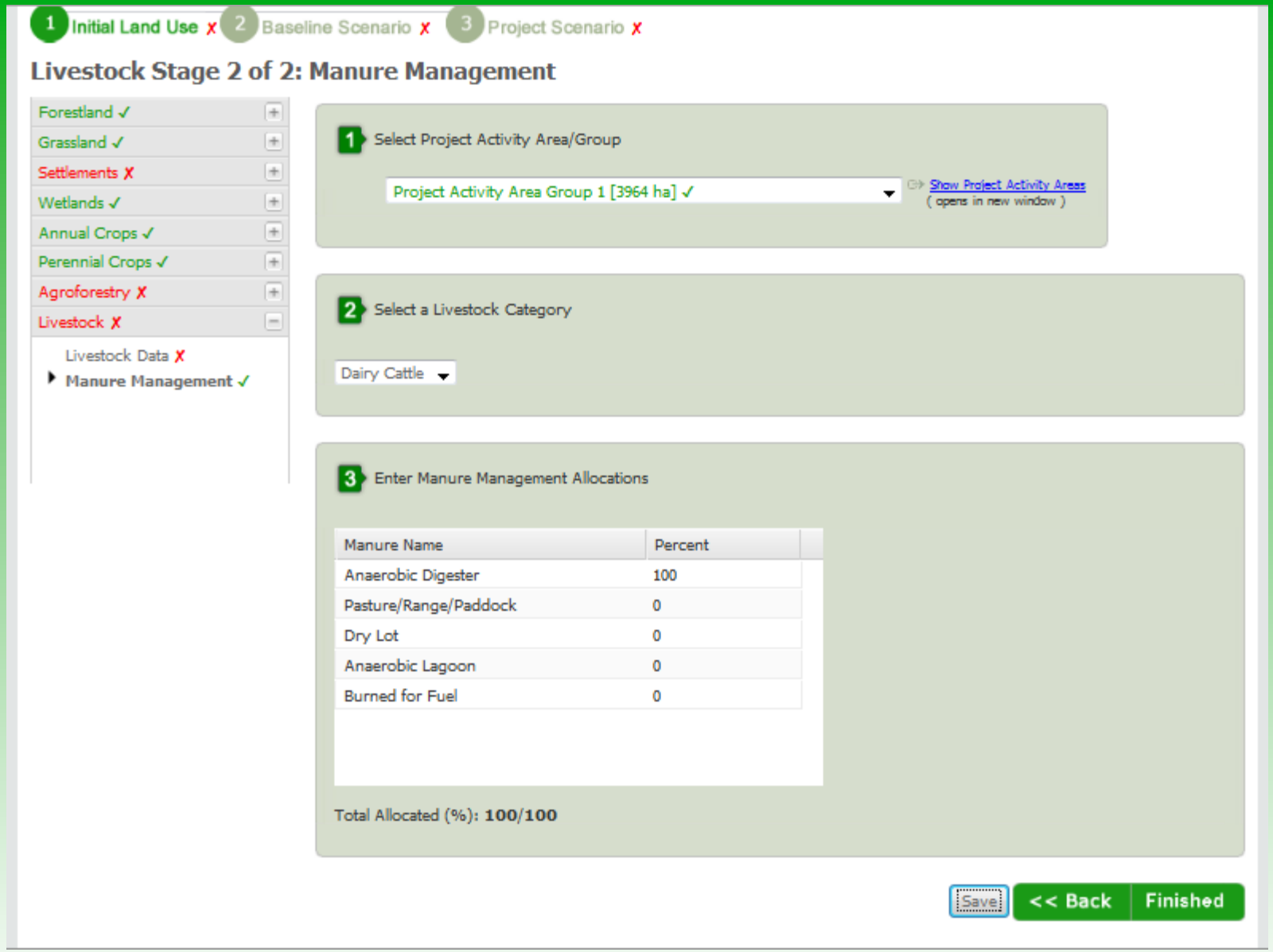


The Tools

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

What is needed to use it?

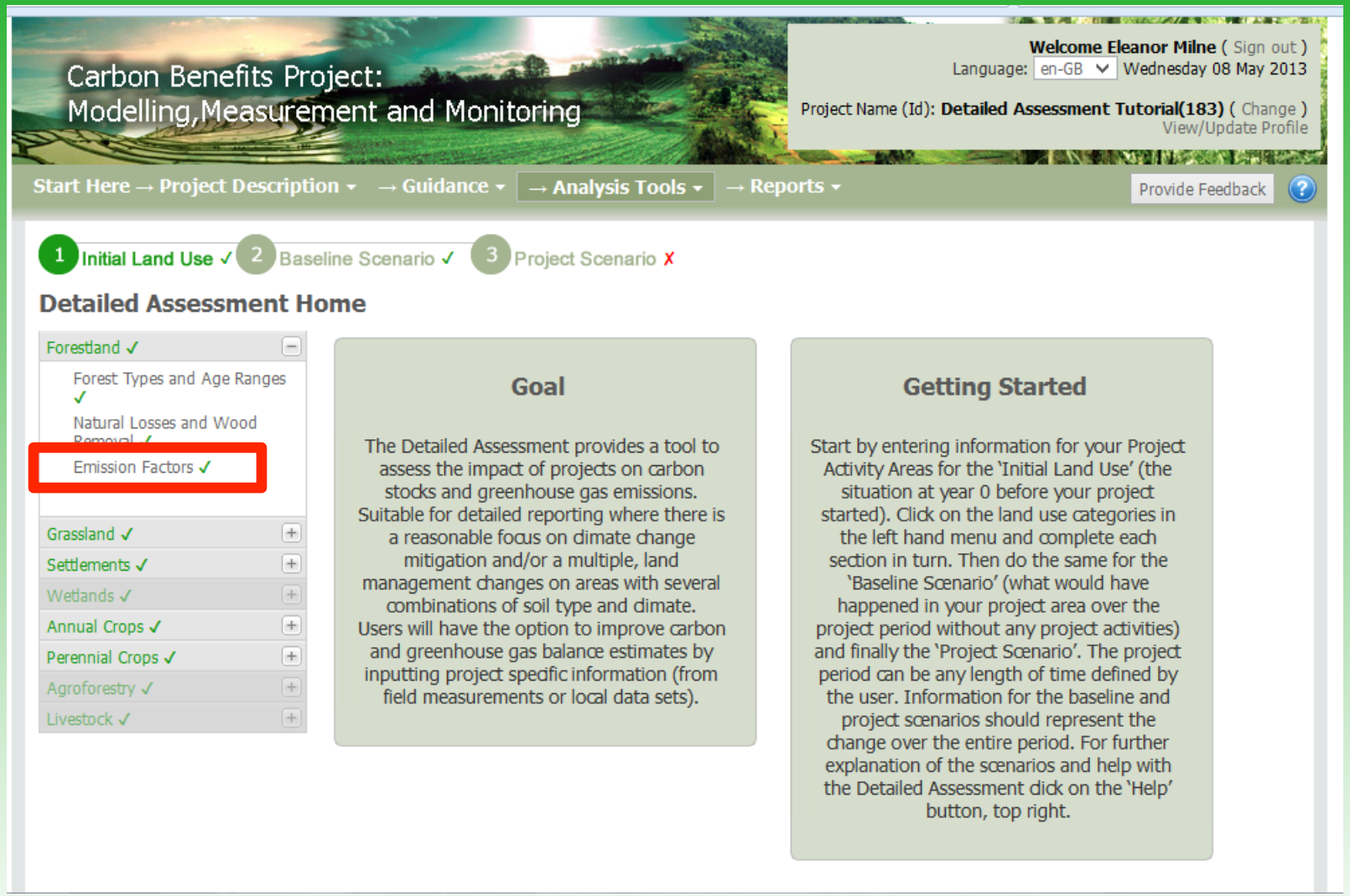
Same as Simple Assessment plus:

- 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)

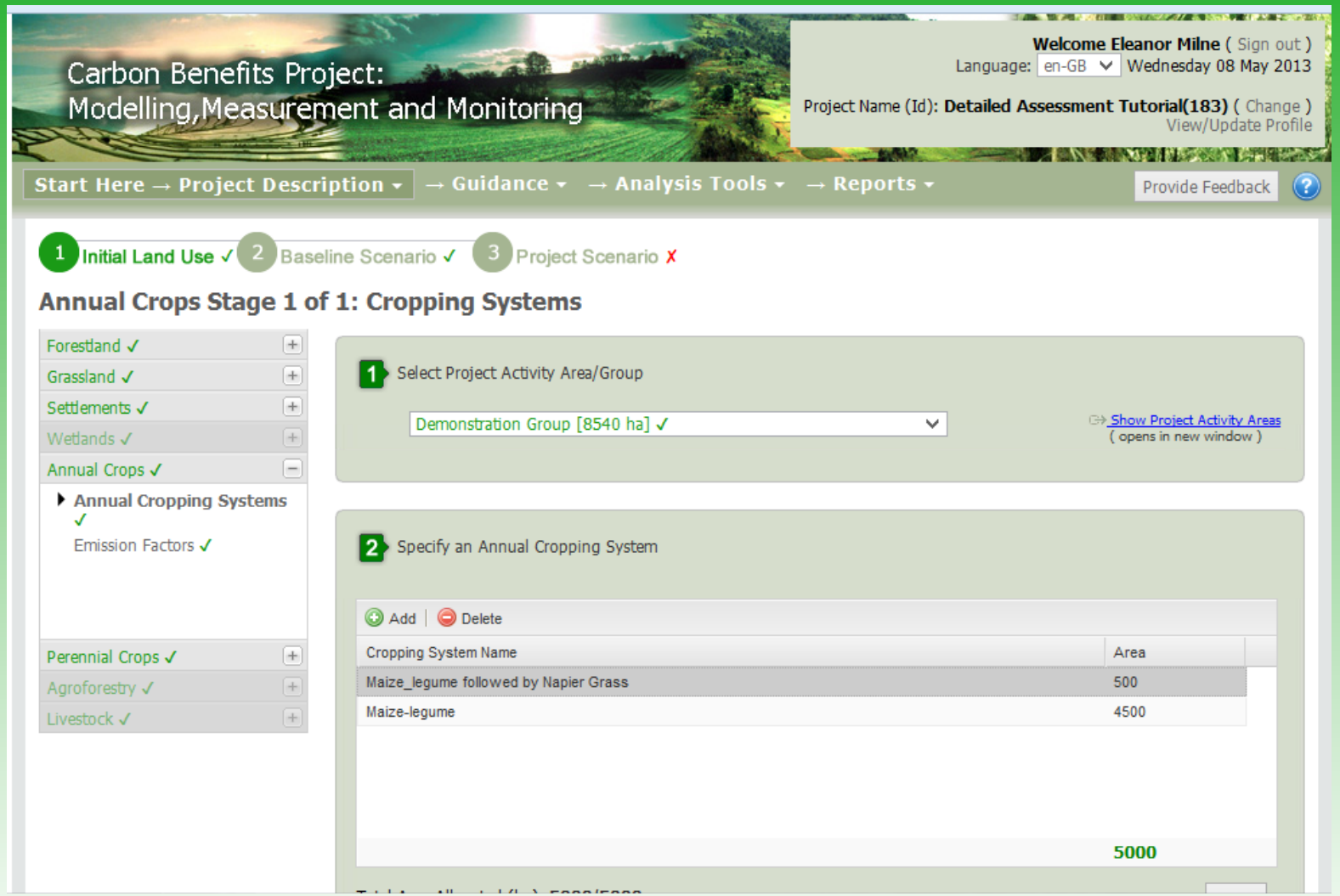
Who is it suitable for?

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

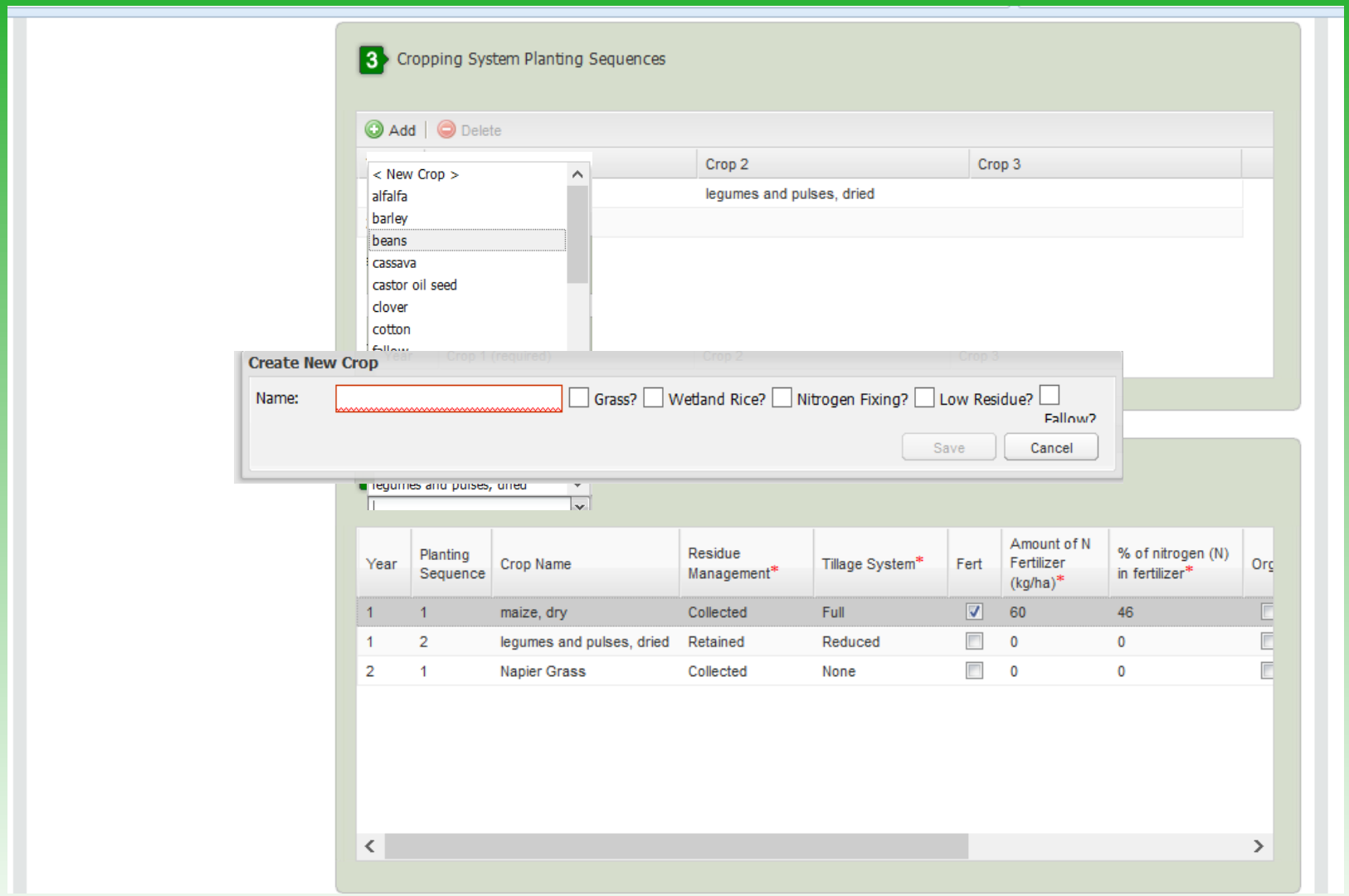
Detailed Assessment Home Page



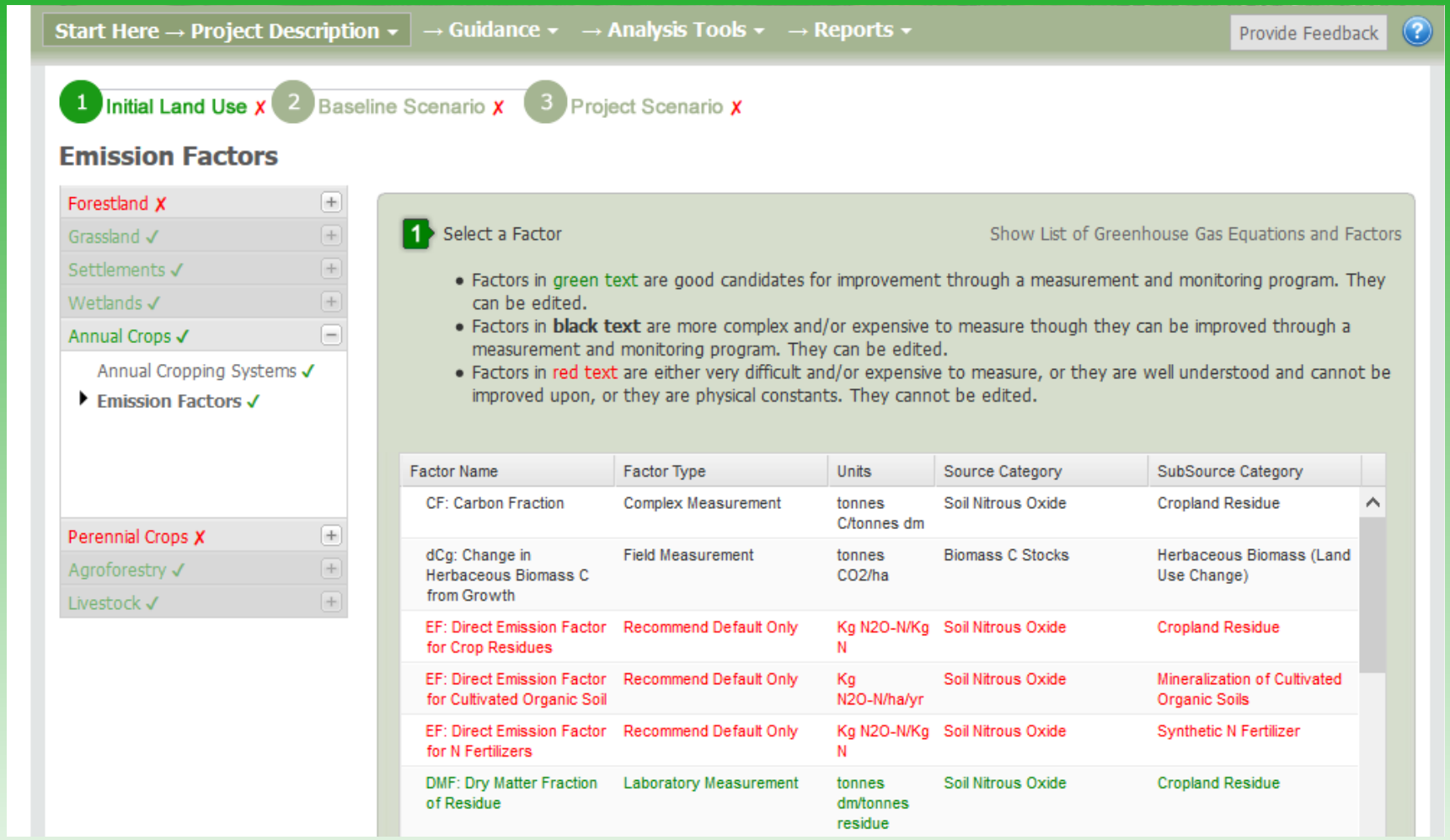
Annual Cropland in DA



Annual Cropland in DA



Annual Cropland in DA



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

2 View/Update Factor Values and Confidence Intervals

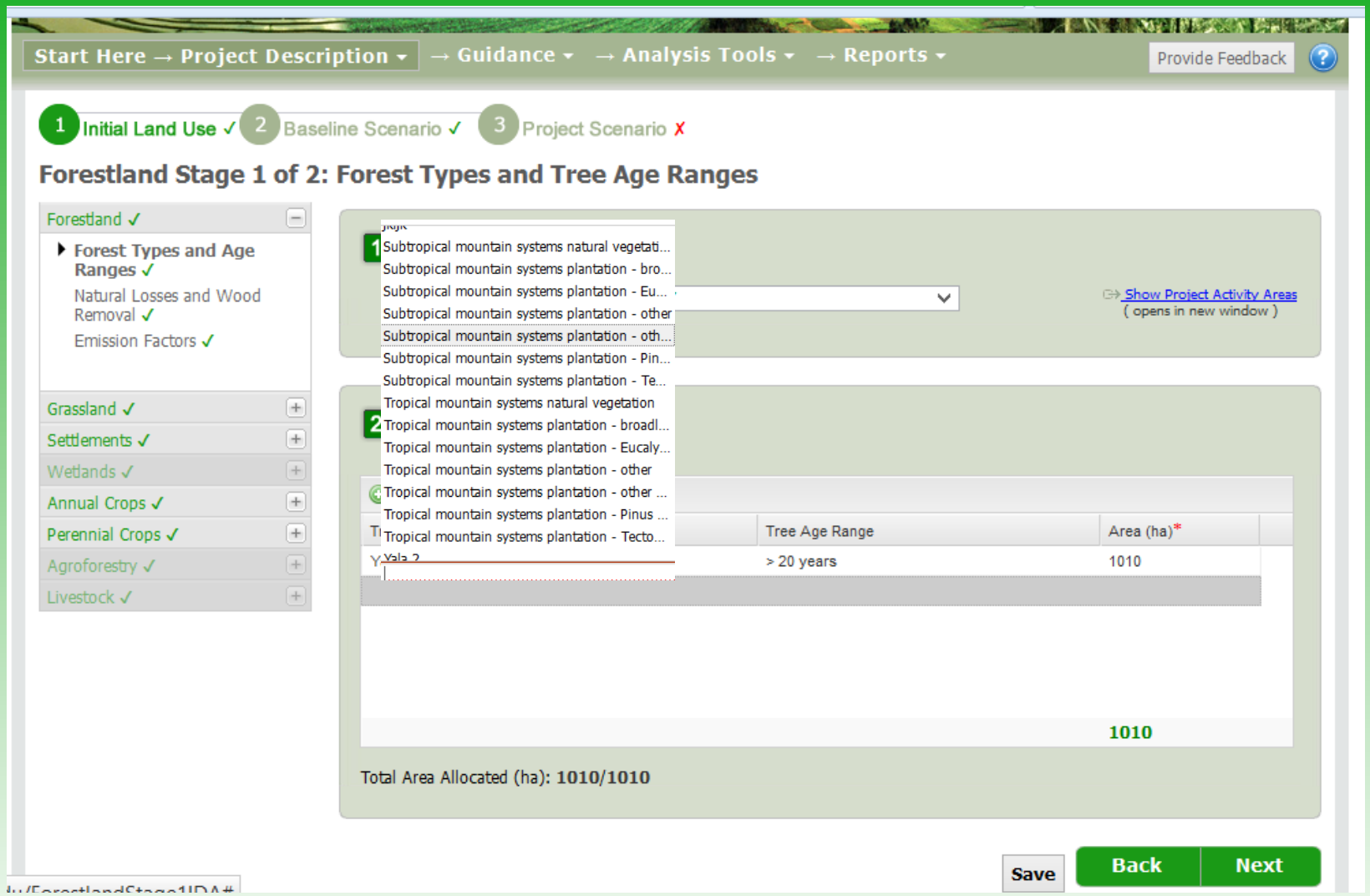
Annual Crop Type	ProjectCountry	Factor Value	Factor Type	Uncertainty (+/- %)
legumes and pulses, dried	Ethiopia	0.9600	Field Measurement	50.0000
maize, dry	Ethiopia	1.9800	Field Measurement	50.0000
Napier Grass	Ethiopia	0.7332	Field Measurement	90.0000

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



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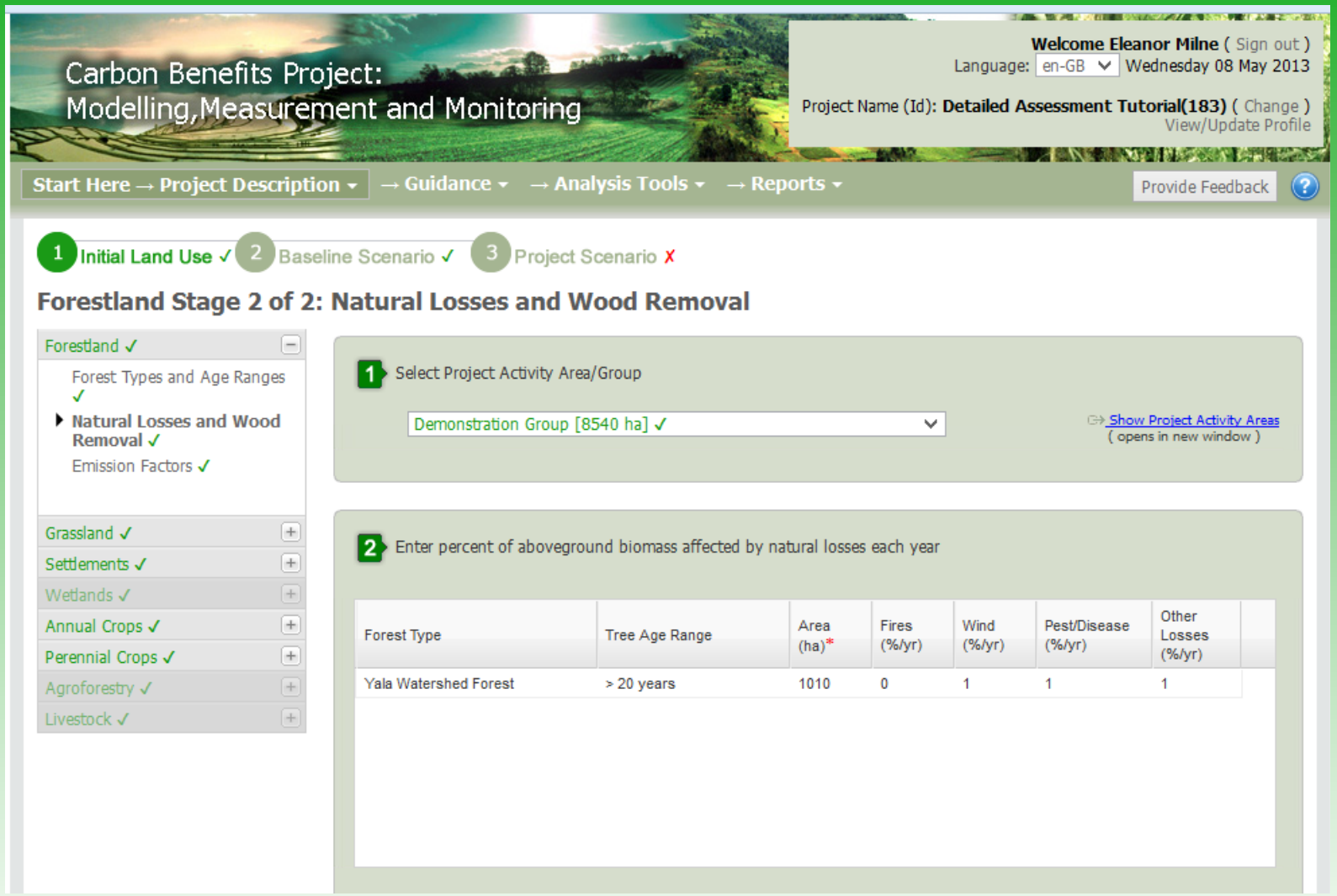


Forestland in DA

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

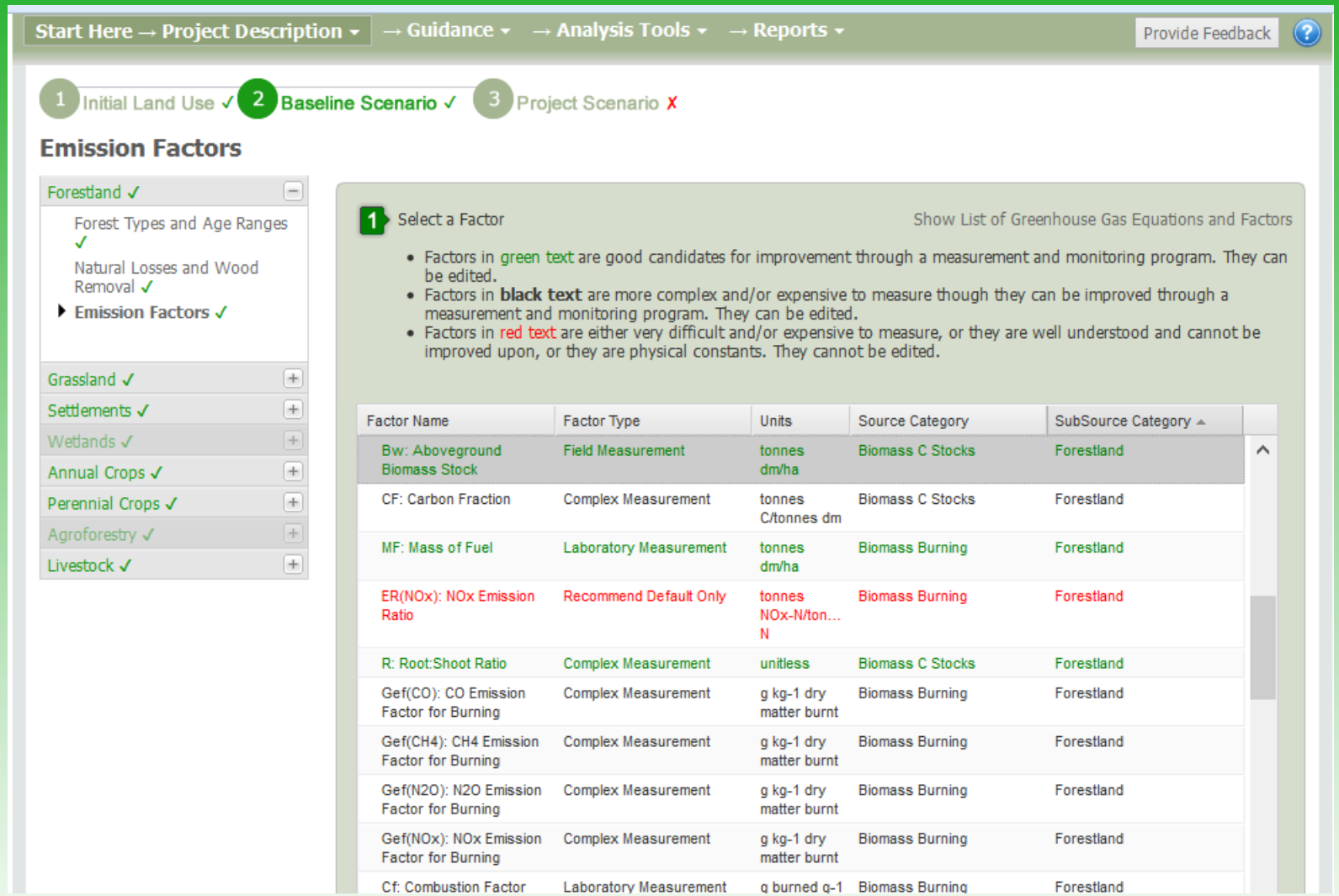
Forest Type	Tree Age Range	Area (ha)*	Timber Harvest (m^3/yr)	Fuelwood Gathering (m^3/yr)
Yala Watershed Forest	> 20 years	1010	3600	3600

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



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.

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.

Forest Carbon Measurement Guidelines, Module 2 of 5: Guidelines for Measuring Forest Carbon for Afforestation and Reforestation

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

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Name of project, funding agency etc.

Toolkit advisor

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D M

Socioeconomic Tools

Reporting Module

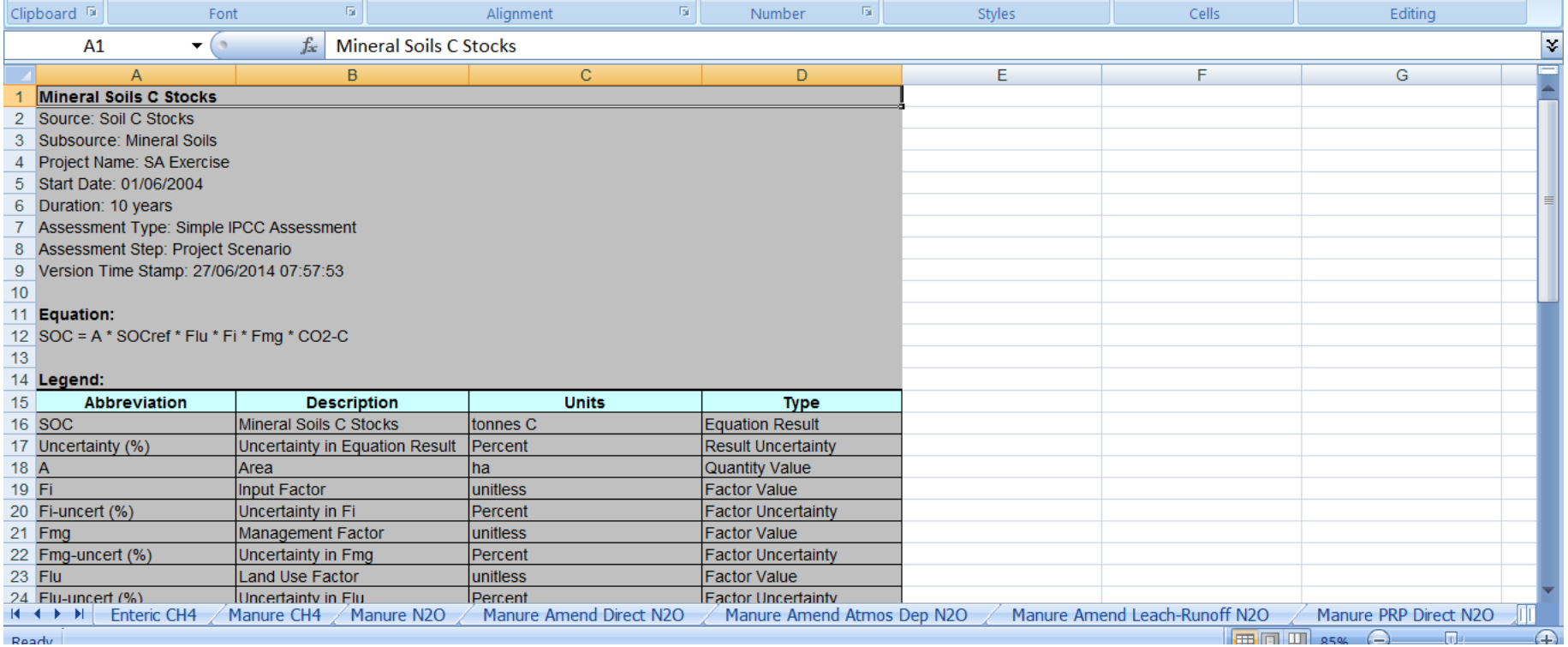
Report

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

		Without Project (Baseline scenario)			With Project (Project scenario)			Incremental difference (Project scenario minus baseline scenario)		
		tonnes CO_2 e	tonnes CO_2 e / yr		tonnes CO_2 e	tonnes CO_2 e / yr		tonnes CO_2 e	tonnes CO_2 e / yr	
Source category	Source sub-category	Total	Annual	Uncertainty	Total	Annual	Uncertainty	Total	Annual	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_2O	GHGs	CO_2	CH_4	N_2O	GHGs			
	tonnes CO_2equivalent				tonnes CO_2equivalent				Total tCO_2e	tCO_2e / ha^{-2}	tCO_2e / ha^{-1}/Yr
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	6201.86		37209.3	1.550388	0.1550387
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	0
G. Other	0	0	0	0	0	0	0	0	0	0	0
Land Use Change and Forestry											
A. Forest and other Woody Biomass Stocks	0				-63869.63				-638696.3	-26.61235	-2.661235
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. CO2 Emissions and Removals from Soil	0				-41800				-418000	-17.41667	-1.741667
E. Other	0	0	0	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



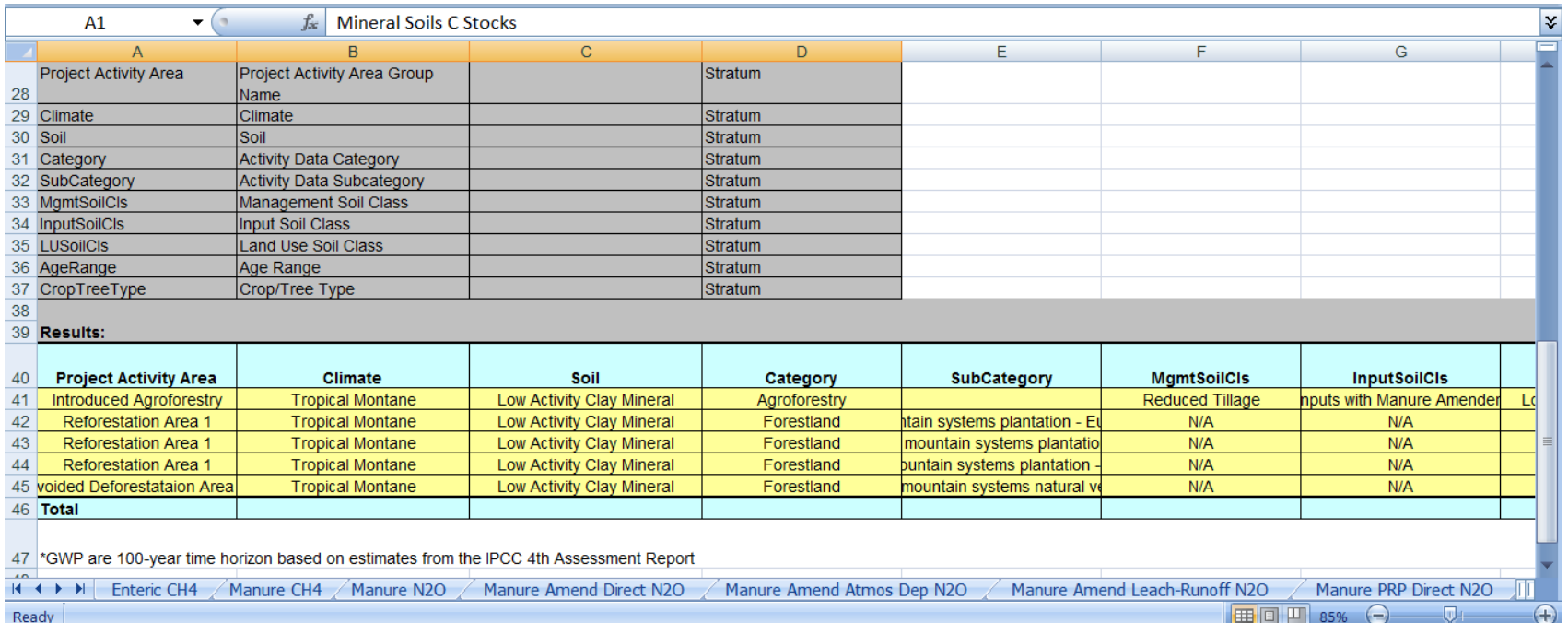
Clipboard | Font | Alignment | Number | Styles | Cells | Editing

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 * SOCref * Flu * Fi * Fmg * CO2-C						
13							
14	**Legend:**						
15	**Abbreviation**	**Description**	**Units**	**Type**			
16	SOC	Mineral Soils C Stocks	tonnes C	Equation Result			
17	Uncertainty (%)	Uncertainty in Equation Result	Percent	Result Uncertainty			
18	A	Area	ha	Quantity Value			
19	Fi	Input Factor	unitless	Factor Value			
20	Fi-uncert (%)	Uncertainty in Fi	Percent	Factor Uncertainty			
21	Fmg	Management Factor	unitless	Factor Value			
22	Fmg-uncert (%)	Uncertainty in Fmg	Percent	Factor Uncertainty			
23	Flu	Land Use Factor	unitless	Factor Value			
24	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

Ready



A1 | Mineral Soils C Stocks

	A	B	C	D	E	F	G
28	Project Activity Area	Project Activity Area Group Name		Stratum			
29	Climate	Climate		Stratum			
30	Soil	Soil		Stratum			
31	Category	Activity Data Category		Stratum			
32	SubCategory	Activity Data Subcategory		Stratum			
33	MgmtSoilCls	Management Soil Class		Stratum			
34	InputSoilCls	Input Soil Class		Stratum			
35	LUSoilCls	Land Use Soil Class		Stratum			
36	AgeRange	Age Range		Stratum			
37	CropTreeType	Crop/Tree Type		Stratum			
38							
39	**Results:**						
40	**Project Activity Area**	**Climate**	**Soil**	**Category**	**SubCategory**	**MgmtSoilCls**	**InputSoilCls**
41	Introduced Agroforestry	Tropical Montane	Low Activity Clay Mineral	Agroforestry		Reduced Tillage	nputs with Manure Amender
42	Reforestation Area 1	Tropical Montane	Low Activity Clay Mineral	Forestland	ntain systems plantation - Eu	N/A	N/A
43	Reforestation Area 1	Tropical Montane	Low Activity Clay Mineral	Forestland	mountain systems plantatio	N/A	N/A
44	Reforestation Area 1	Tropical Montane	Low Activity Clay Mineral	Forestland	buntain systems plantation -	N/A	N/A
45	voided Deforestataion 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

Ready

-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: S*how 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

Colorado State University

-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