Exercise with the Simple Assessment of the Carbon Benefits Project Tool (Kakamega case, Kenya)

Digital Soil Organic Carbon Mapping: Towards the development of national soil organic carbon stock maps (GSP training workshop)
(6 – 23 June 2017, ISRIC, Wageningen)

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ISRIC World Soil Information

GLOBAL SOIL PARTNERSHIP

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Citation:

Batjes, N.H (Ed.). Exercise with the Simple Assessment of the Carbon Benefits Project Tool (Kakamega case, Kenya). Digital Soil Organic Carbon Mapping: towards the development of national soil organic carbon stock maps (GSP training workshop, 6 – 23 June 2017, Wageningen). ISRIC – World Soil Information, Wageningen (www.isric.org).

Photo credit: https://xn--80aaaahbbco4bxade0ca1cr.xn--p1ai/kakamega-kenya.php

Context

The Global Soil Partnership (GSP) and its Intergovernmental Technical Panel on Soils (ITPS) initiated a global effort to develop a Global Soil Organic Carbon map (GSOCMap) by the end of 2017, in support of the Sustainable Development Goal Indicator 15.3.1. The GSOCMap will be based on country-level soil datasets and nationally developed maps using harmonized specifications. As indicated by FAO (2017), "the comparability of SOC stocks between countries is important and should be considered in a bottom-up approach to enable scaling up from the national to the global level and to improve comparability between bottom-up and top-down approaches. Therefore, FAO (2017) recommends that MRV (measurement, reporting and verification) guidelines include guidance on how comparability (between countries and between bottom-up and top-down) can be achieved. Milne et al (2012) provided an overview of approaches for landscape-scale GHG (Green House Gas) quantification, covering both measurement and modelling and the reliance of one upon the other; the report covers ground-based measurement approaches for carbon stock changes in biomass and soils, methods for measuring GHG flux and the application of remote sensing techniques. Computational approaches for estimating carbon stock changes and GHG emissions are also reviewed, in addition to the use of more complex dynamic ecosystem models.

This introductory exercise for the 'GSOCMap training course 2017'[1] serves to illustrate some aspects that are important in assessments of (net) soil organic carbon stocks and changes. When managed wisely, and depending on the biophysical and socio-economic setting, soils have the potential to sequester large amounts of carbon thus contributing to climate change mitigation and adaptation, as well as to improved soil ecosystem functioning and soil health (Banwart *et al.* 2015; Batjes 1996; Levèvre *et al.* 2017; Milne *et al.* 2015; UNEP 2012).

The CBP (Carbon Benefits Project) project has developed a standardized system for GEF and other sustainable land management projects to measure, model, monitor and forecast carbon stock changes and GHG emissions. The system considers three sets of modelling tools as well as guidance on where to focus efforts when tracking carbon and greenhouse gas benefits[2].

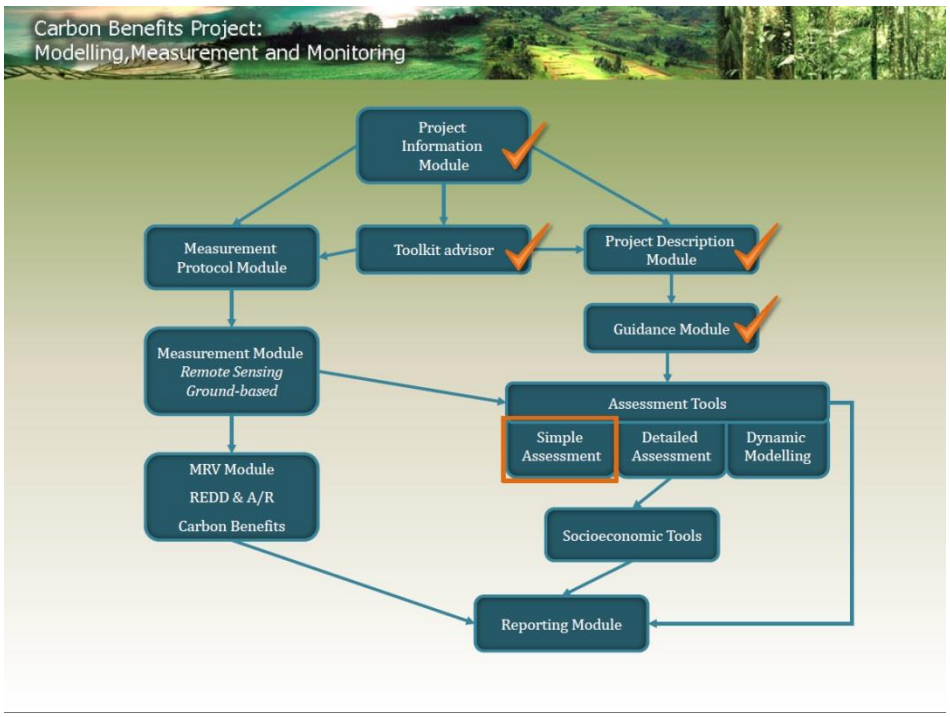
The present exercise uses the Simple Assessment of the Carbon Benefits Project) tools (CBP-CSU 2009-2012). The Simple Assessment tool assesses the impact of a user-defined project on carbon stock and greenhouse gas emissions. It was developed for a quick assessment at any project stage, including proposals. It uses default datasets for world climate and soil classes, user-defined assumptions for land use changes and/or livestock production in the project area(s), and standard information on greenhouse gas emission rates (Batjes 2011; IPCC 2006; Ravindranath and Ostwald 2008). More detailed assessments based on the Detailed Assessment and Dynamic Modelling components of the CPB system will require project-specific field measurements and more detailed descriptions of land use changes and/or livestock production in the project area.

[1] http://www.fao.org/global-soil-partnership/resources/events/detail/en/c/878852/
[2] http://cbp-web1.nrel.colostate.edu/pdm/GuidanceHome

Objective

To determine if project interventions (land management activities) provide a carbon/GHG (Greenhouse Gas) benefit relative to the baseline scenario ('business as usual'). For example, do the proposed land management interventions lead to an increase in carbon stocks in soils and biomass and/or a reduction in GHG emissions?[3]

The exercise will consider the following modules of the on-line GEF-CBP (Carbon Benefits Project) system.



The CBP-tools are hosted and maintained by Colorado State University and can be accessed via: http://cbp-web1.nrel.colostate.edu/.

Background information

The Simple Assessment uses pre-populated information on forest types, cropping, grassland and livestock systems and IPCC Tier 1 C stock and GHG emission factors, as well as default data sets for climate regions and soil classes.

[3] This exercise is based on training materials developed by the CBP, in particular Eleanor Milne, Mark Easter and Keith Paustian, for the review workshop for the GEF of the tools developed by the Carbon Benefits project (Voi, Kenya, Sept. 2012).

To use the tool, you must have:

- Information on project areas and (land use) activities
- Information on land use/management before project started (Initial land use)
- A baseline scenario
- A project scenario
- Enough information to choose the most similar forest type, cropping, grassland or livestock system from a drop down list.

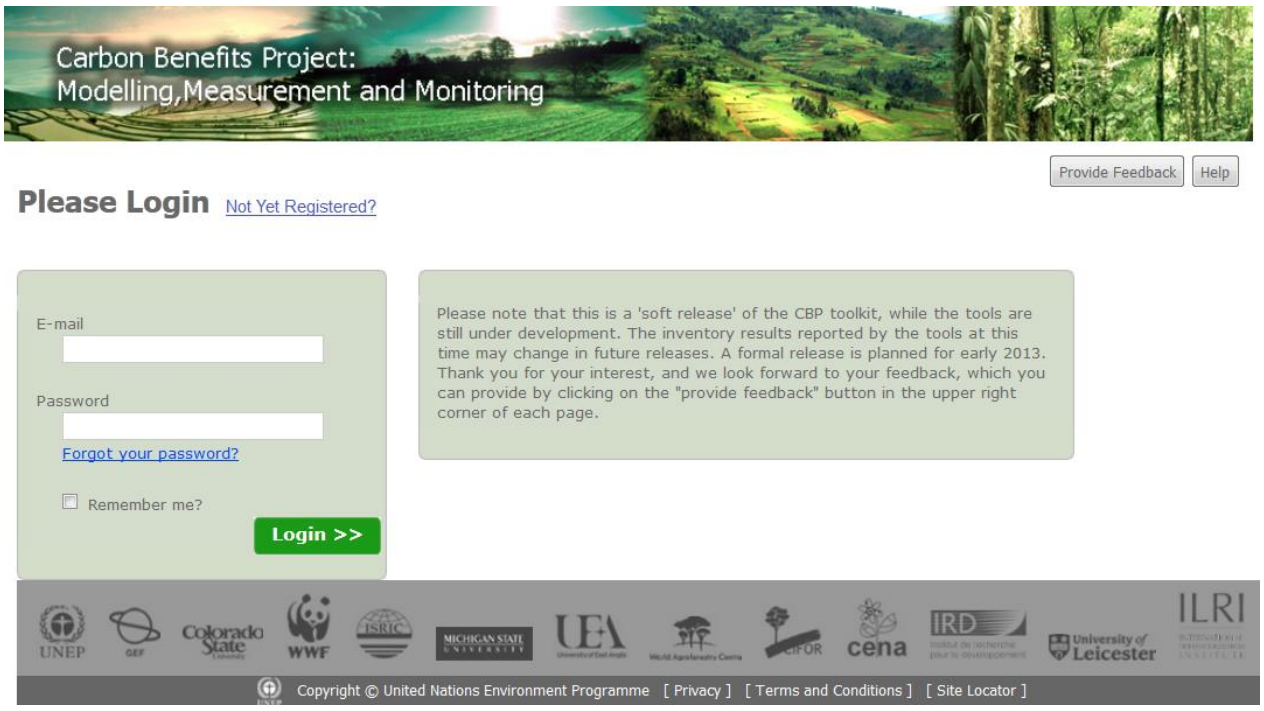
Some TIPS:

1. Click on the help icon in the top right hand corner  for further help.
2. Double click in the white boxes in the tables to activate the dropdown menus.
3. Give the system time to work (*connection may be slow at times*), if you think it is not doing anything check the connection status at the top of the page.
4. Make sure you click on the *save* buttons after entering data for each land use category.
5. If you need to remind yourself of how much land is in each land use category go to: 'Project Description>Step 3> Describe project land use'
6. In the Simple and Detailed Assessments, data for the initial land use, baseline and project scenarios may be entered in any order. For example, you *don't* need to enter all of the initial land use data before going to the baseline or project scenarios. Similarly, you might complete Stage 1 within a land use category and come back to enter Stage 2 at another time.

Getting started

The CBP tool is best used with Firefox, Chrome, or Safari.

First you must register at: http://cbp-web1.nrel.colostate.edu/



Click the 'Not Yet Registered?' button and write down your Registration Information.

Project description

For this example exercise, we will focus on the Yala River Watershed in western Kenya. The goals of much sustainable land management (SLM projects) in this region are to: decrease soil erosion, reduce deforestation, improve food security and diversify the agricultural economy.

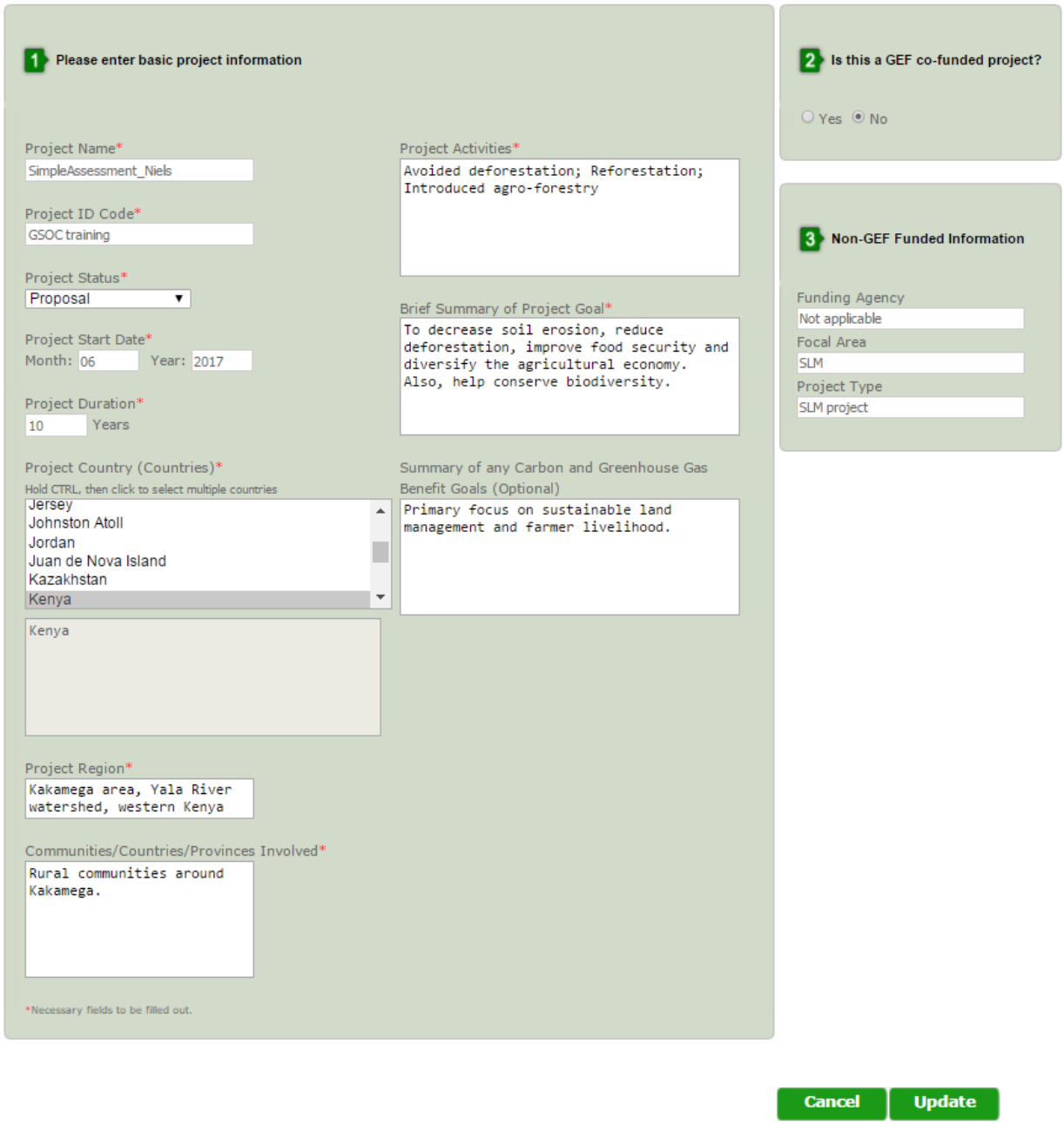
Our hypothetical example is a project which aims to do all of these things in an area of the Yala River Watershed, located near to Kakamega, through avoided deforestation, reforestation and the introduction of agroforestry.

As the project manager you are producing a report at the end of the project period (10 years). Though in this instance we are conducting the analysis at the end of the project period, it may also be done at the beginning of a project, as a projection of what would happen over the project period.

Before proceeding with the hands-on-exercise, you should familiarize yourself with the Kakamega area (see: http://www.nrel.colostate.edu/projects/glide/kenya.html). Use this information to determine the default IPCC climate region and IPCC soil class for the project area (see p. 37 in IPCC_report).

You do not have to input this information here as the default IPCC climate and soil classes are automatically read from GIS files when using the Simple Assessment based on the coordinates that you will provide for the project area (*Tip*, see: Project Description > Step 2- Review Supporting Spatial Data > View).

Create a new Project. Give your project a name, for example, "SimpleAssessment_your_name" for ease of reference, and fill out all fields.



After entering 

you will see a list of your current projects and reports. Go to the Toolkit Advisor, and choose the Simple Assessment.

Use Step 1 'Project Description' to define the project boundaries. These may be drawn manually on-screen, but for this exercise you will download files with the location of the various Project Areas.

First, however, we will briefly describe the project area which consists of Project Area Activity Groups or polygons. The largest polygon, named "Avoided Deforestation", is an area of relatively continuous forest; however cropland agriculture is encroaching on the border of this region. Without project intervention, some of this forest would likely be converted into annual cropland. Alternatively, the two smaller polygons, named "Reforestation," represent an area that has been largely deforested and is in degraded condition. Under the project, parts of this region will be reforested. Finally, a number (16) of so-called "point" locations represent households that will diversify their operations during the project by converting annual cropland into agroforestry and livestock (Note: A "point", in CBP terms, is defined as a spatial area associated with project activities generally less than ~10 ha in size; they are geo-referenced by their centre-point). All the points have been put into a single activity area group called "Introduced Agroforestry". Please note that the area of individual points may vary, but that this will not be reflected on the map.

Uploading the Example Project Activity Areas

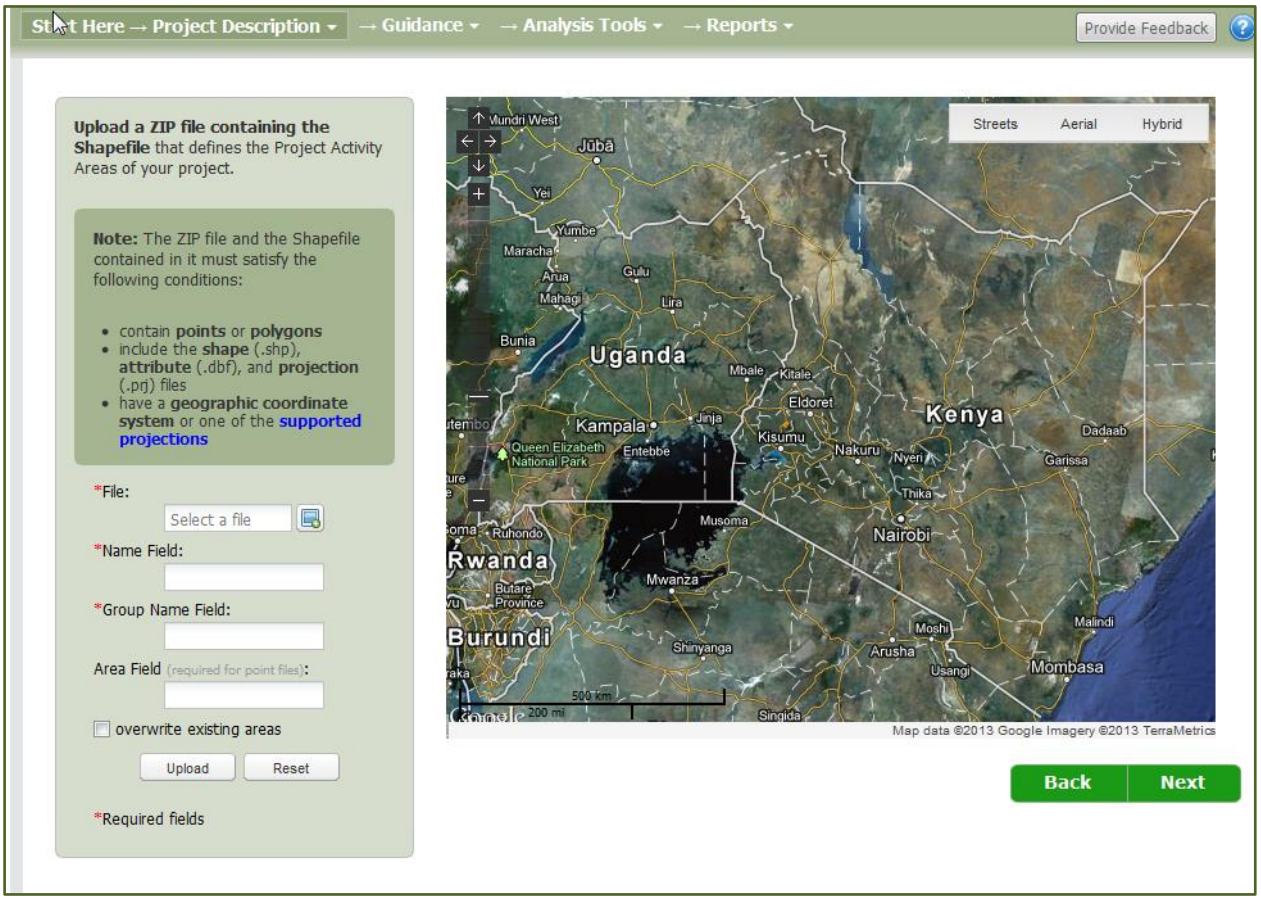
For this exercise, you must first download files for the various project activity areas. Data for the larger three polygons are provided in GIS-format (zipped), while the so-called "point" data are provided separately as a text file. The files can be accessed from:

http://www.isric.org/documents/document-type/training-material-gsoc-mapping-cbp-tools

Click on the URL to download the files to your local hard drive; record where you store the files!

The next step is to upload these to the CBP server to define the project activity areas for your project. To do so, click on the "Start Here – Project Description" link on the toolbar.

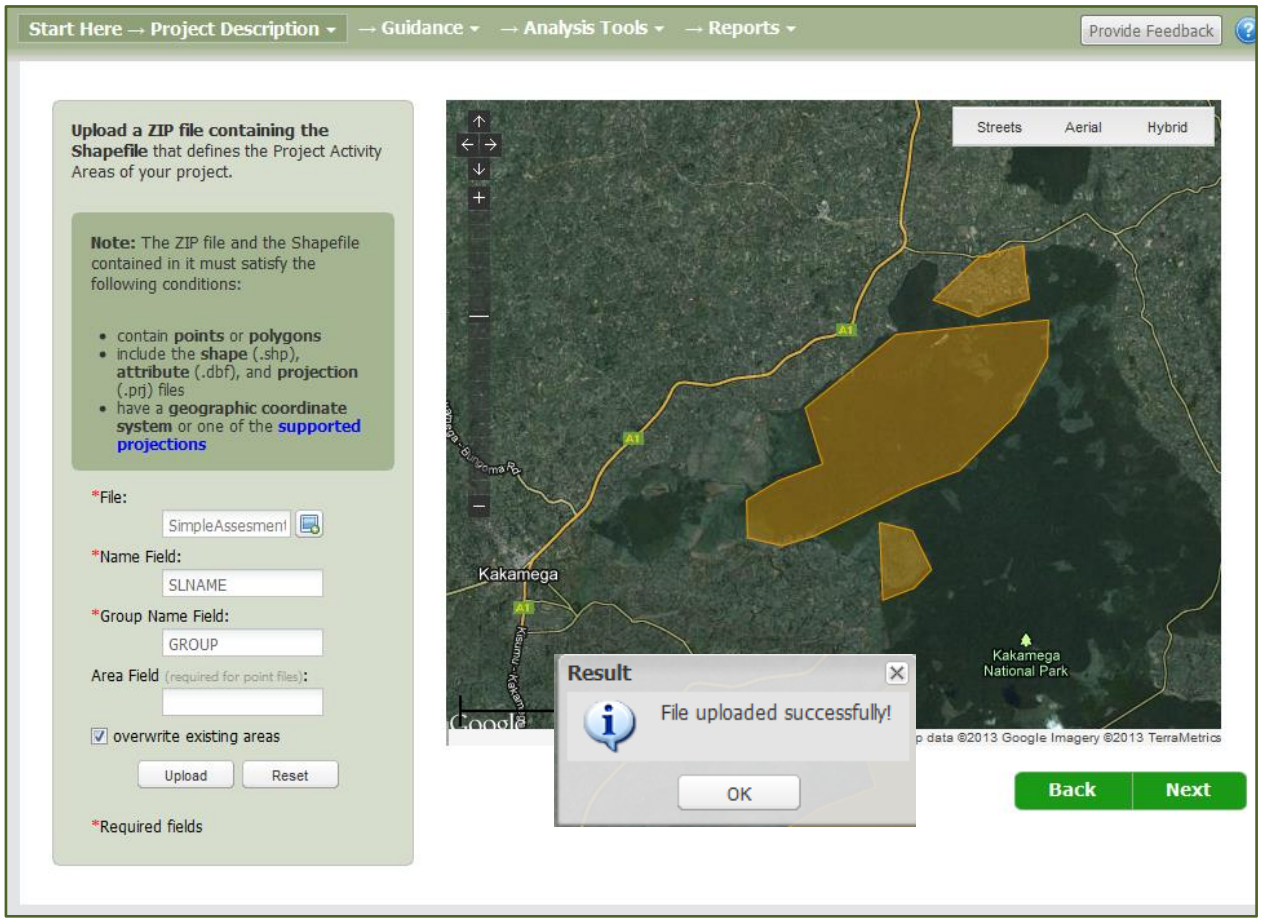
First, select the option "Upload your own GIS Files". You should now see a page that looks like the image below:



Clicking on the small file upload icon next to the "File:" field will bring up a windows file manager window. Locate the file named *SimpleAssessment_ProjectAreaPolygons.zip* which you just downloaded and click on the "Open" button at the bottom-right corner of the window.

Next, fill in the "Name Field:" and "Group Name Field:" text fields on the screen:

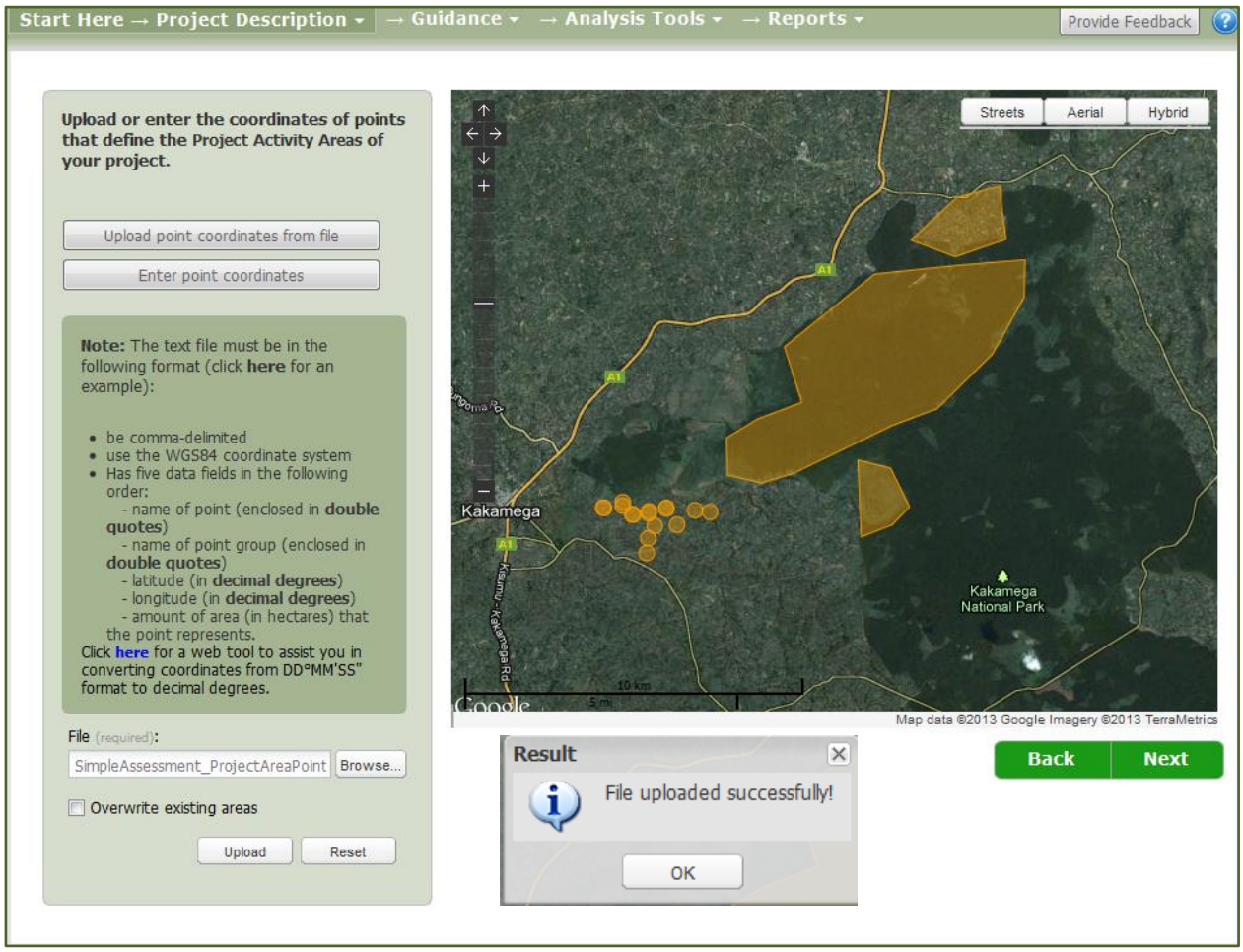
- In the "Name" Field, type SLNAME. There is a dbase (.dbf) file included in the .zip file, and this tells the CBP system that there is a field in that .dbf file named "SLNAME" which contains the names (or numbers) of the different project activity areas.
- In the "Group Name Field", type GROUP. This informs the CBP system that there is a field in the above dBase (* .dbf) file named "GROUP" which contains the names of the project activity area groups (PAAG).
- You can leave the "Area Field" blank since there are no points used in this GIS file (these are provided in a separate file, see below).
- Click the "overwrite existing areas" check box.
- Finally, click the "Upload" button to upload the file. The map will be updated and display three polygons.



Next, upload the locations of the so-called "Points". The point coordinates are stored in a comma delimited text file, called *SimpleAssessment_ProjectAreaPoints.txt*. This file has a fixed format: Point number, descriptive name for PAAG, latitude (DD), Longitude (DD), and the area (ha). For this example, the file contains:

1, PAAG3-Introduced Agroforestry, 0.283436, 34.779686, 9
2, PAAG3-Introduced Agroforestry, 0.284025, 34.784740, 7
3, PAAG3-Introduced Agroforestry, 0.281670, 34.787341, 10
4, PAAG3-Introduced Agroforestry, 0.282023, 34.7916275, 8
5, PAAG3-Introduced Agroforestry, 0.283319, 34.796409, 5
6, PAAG3-Introduced Agroforestry, 0.282848, 34.804157, 1
7, PAAG3-Introduced Agroforestry, 0.278608, 34.793347, 8
8, PAAG3-Introduced Agroforestry, 0.275311, 34.791581, 6
9, PAAG3-Introduced Agroforestry, 0.283466, 34.779486, 8
10, PAAG3-Introduced Agroforestry, 0.285025, 34.784760, 6
11, PAAG3-Introduced Agroforestry, 0.281640, 34.787951, 9
12, PAAG3-Introduced Agroforestry, 0.282523, 34.7917275, 2
13, PAAG3-Introduced Agroforestry, 0.283419, 34.796480, 3
14, PAAG3-Introduced Agroforestry, 0.282348, 34.808157, 1
15, PAAG3-Introduced Agroforestry, 0.278908, 34.7275347, 8
16, PAAG3-Introduced Agroforestry, 0.271311, 34.791181, 4

Click on the "OK" button.



All your project activity areas are now ready for you to continue with the exercise. Please keep in mind that this project is an example for demonstration purposes; the polygons were digitized somewhat arbitrarily and rather coarsely.

Click on the "Next" button to continue with the tutorial to define the project land use areas.

Note that that the project covers three Project Activity Area Groups (PAAG) that cover 3702 ha:

1) A large polygon, 'Project Activity Area Group 1', named "Avoided Deforestation" (3017 ha). [Tip: For more complex projects, it may be easier to use a mnemonic name for the Group Name rather that "Project Activity Area Group 1"].
2) Two smaller polygons for PAAG2, named "Reforestation" (590 ha)

3) Some point locations, of varying size, named "Introduced Agroforestry" (here 16 locations, totalling 95 ha), corresponding with PAAG3.

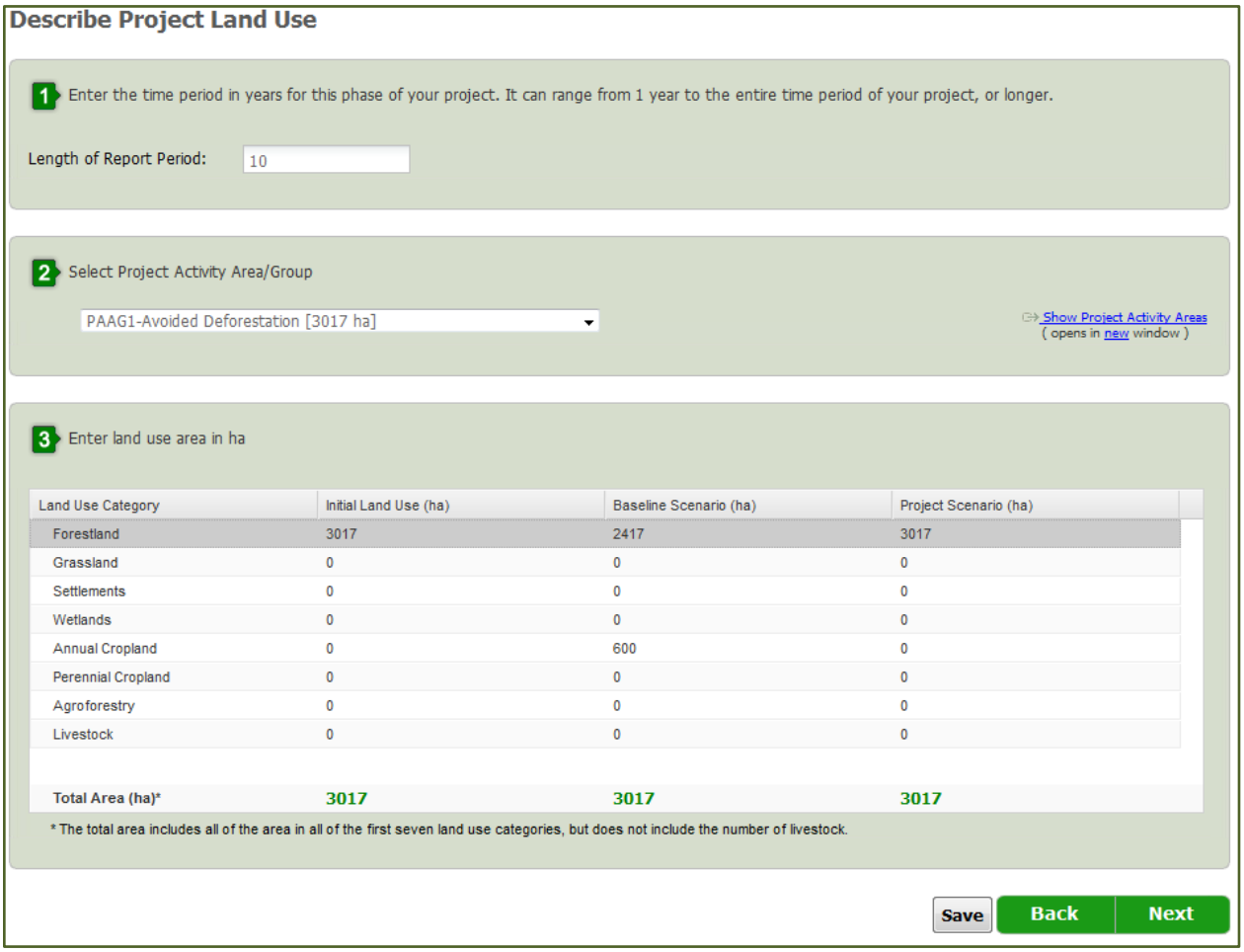
Next, the area (number of hectares) for each land use category (forestland, grassland, annual cropland, etc.) for each Project Activity Area needs to be entered under Step 3 in the Project Description, for the initial, baseline and project scenarios.

Project description module

Project Description > Step 3 – Define Project Land Use Areas
Hover cursor over 'Project Description' in the main menu and then select 'Describe Project Land Use' under Step 3.

1. In Step 1, enter the length of the reporting period for the project (10 year). Note: Set up to default to the project period entered in the project information page, however you can change it to whatever time period is appropriate for you greenhouse gas assessments).
2. In step 2, select the Project Activity Area corresponding with "Avoided Deforestation."
3. In Step 3, enter the land areas in the table as described for this project and click "Save":

   In this project activity area, the whole area (3017 ha for this example) was in forest at the beginning of the project (Initial Land Use). In the baseline scenario, at the end of the report period (10 years), we estimate 600 ha would have been converted to annual cropland while the remainder would remain in forest. In the project scenario, none of the forest land is converted to annual cropland the whole remain as forestland at the end of the 10 year period.



Describe Project Land Use

1 Enter the time period in years for this phase of your project. It can range from 1 year to the entire time period of your project, or longer.

Length of Report Period: 10

2 Select Project Activity Area/Group

PAAG1-Avoided Deforestation [3017 ha]

Show Project Activity Areas
(opens in new window)

3 Enter land use area in ha

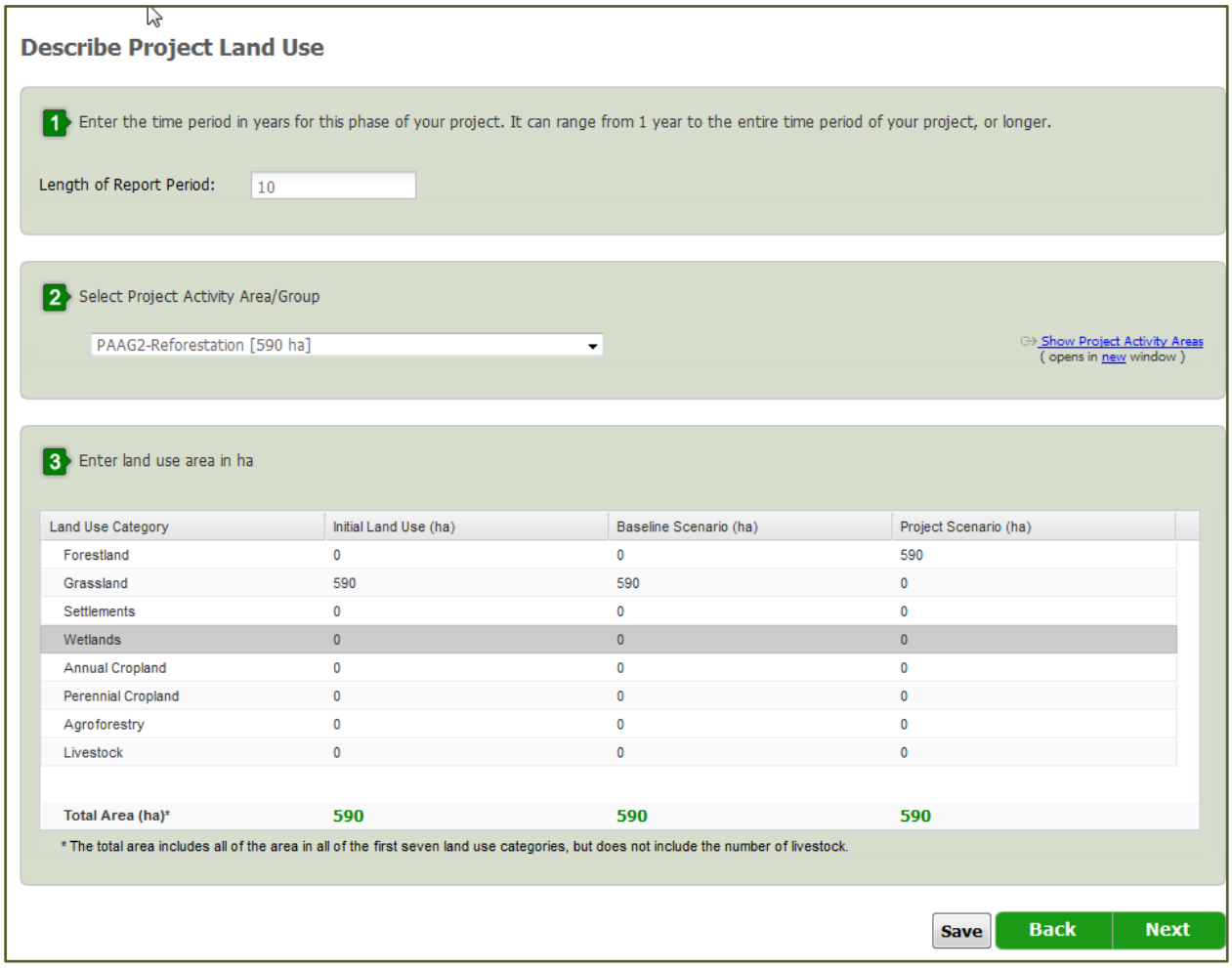
Land Use Category	Initial Land Use (ha)	Baseline Scenario (ha)	Project Scenario (ha)
Forestland	3017	2417	3017
Grassland	0	0	0
Settlements	0	0	0
Wetlands	0	0	0
Annual Cropland	0	600	0
Perennial Cropland	0	0	0
Agroforestry	0	0	0
Livestock	0	0	0
Total Area (ha)*	**3017**	**3017**	**3017**

* 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.

Save | Back | Next

Tip: When all figures are entered correctly, the row 'Total Area (ha)' will become green. Save regularly!

3. Go back to Step 1, enter project period, and select the Project Activity Area "Reforestation."
4. In Step 3, enter the land areas in the table as described for this project and click 'Save'.
   In this area, 590 ha were in grassland at the beginning of the project. In the baseline scenario, we estimate 590 ha would have remained in grassland at the end of 10 years, while in the project scenario all 590 ha is converted to forestland by the end of 10 years.



Describe Project Land Use

1 Enter the time period in years for this phase of your project. It can range from 1 year to the entire time period of your project, or longer.

Length of Report Period: 10

2 Select Project Activity Area/Group

PAAG2-Reforestation [590 ha]

Show Project Activity Areas
(opens in new window)

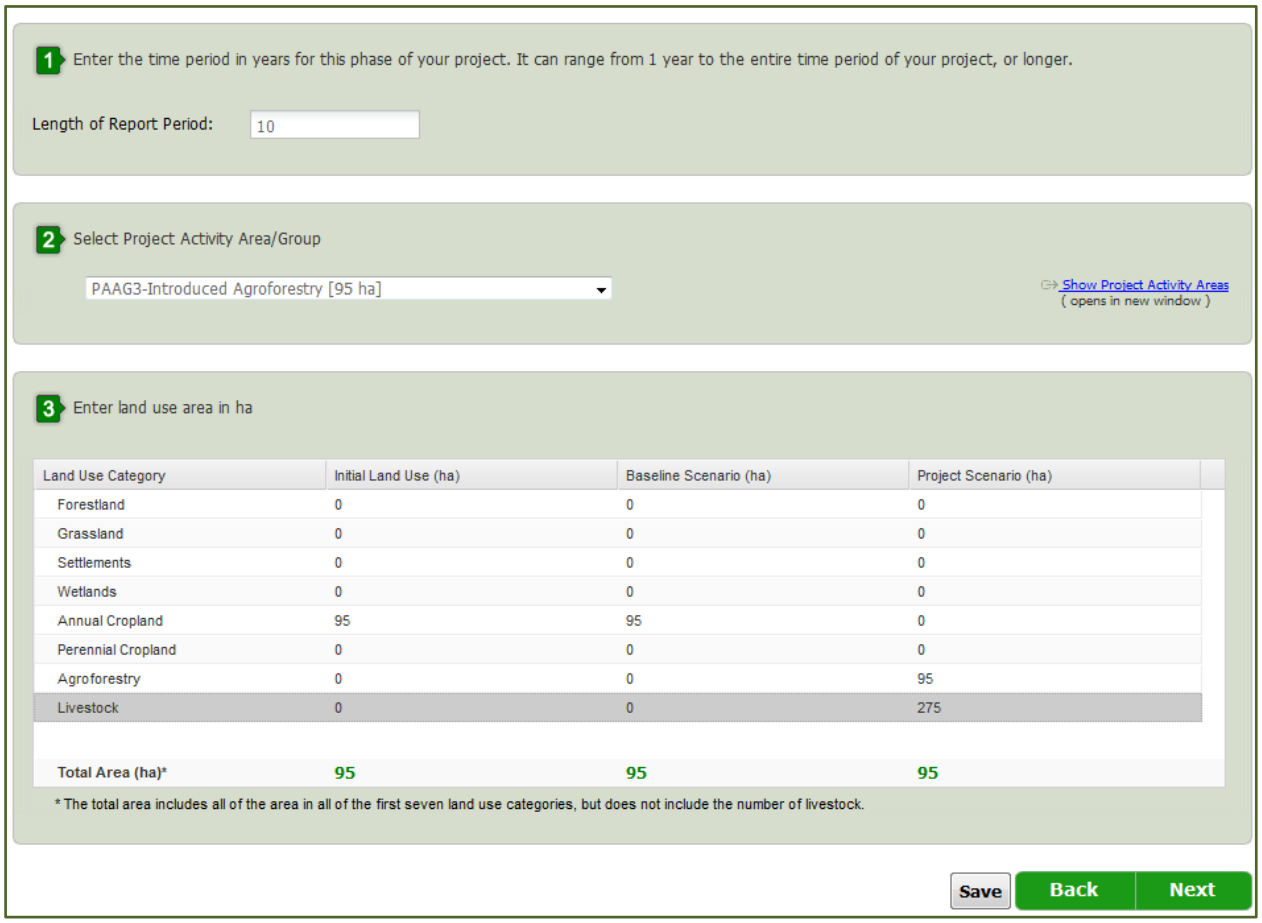
3 Enter land use area in ha

Land Use Category	Initial Land Use (ha)	Baseline Scenario (ha)	Project Scenario (ha)
Forestland	0	0	590
Grassland	590	590	0
Settlements	0	0	0
Wetlands	0	0	0
Annual Cropland	0	0	0
Perennial Cropland	0	0	0
Agroforestry	0	0	0
Livestock	0	0	0
Total Area (ha)*	**590**	**590**	**590**

* 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.

Save Back Next

5. Go back to Step 1, enter project period, and select the Project Activity Group "Introduced Agroforestry."
6. In Step 3, enter the land areas in the table as described for this project and click 'Save':
   In this Project Activity Group, 95 ha were in annual cropland at the beginning of the project. In the baseline scenario, 95 ha remain in cropland. In the project scenario, the annual cropland is converted to agroforestry and 275 head of livestock are also added (note that livestock are added as number of animals, not hectares, if you hover over the word 'livestock' a note appears to tell you this).



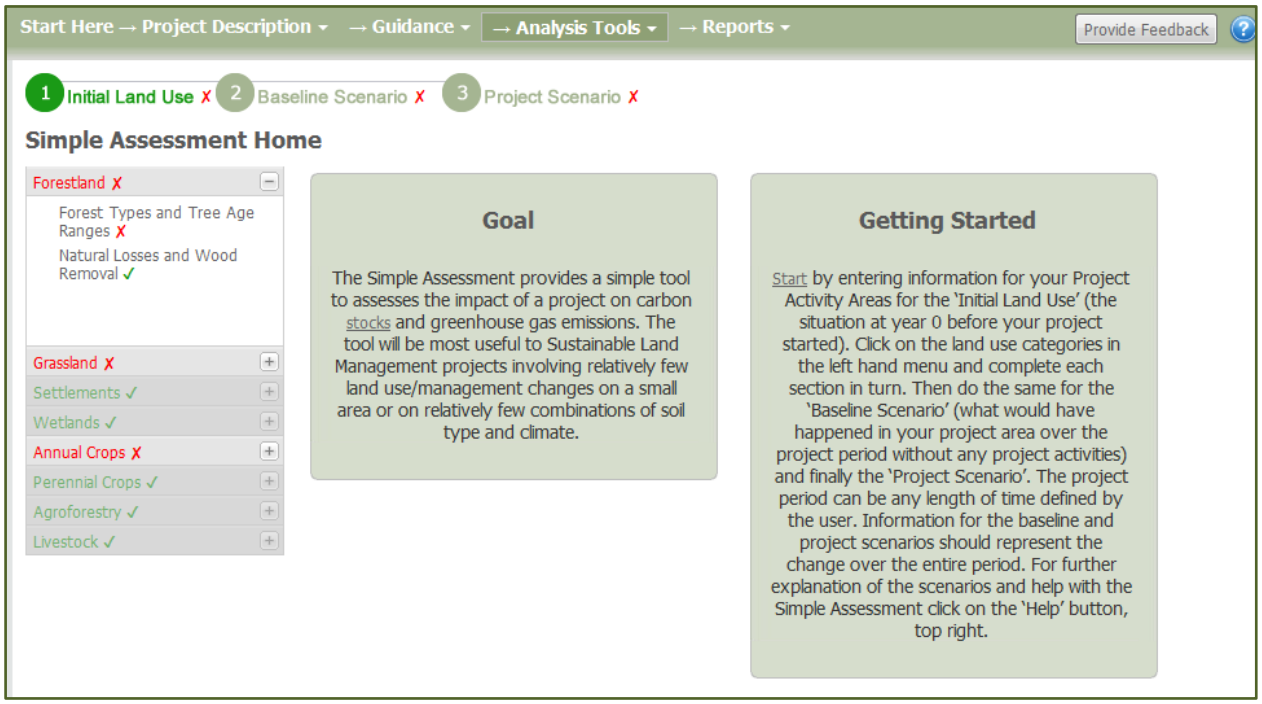
7. You have now entered land areas for all Project Activity Areas Groups, so you may proceed to the Simple Assessment.

Initial land use

Analysis Tools> Simple Assessment> Initial Land Use

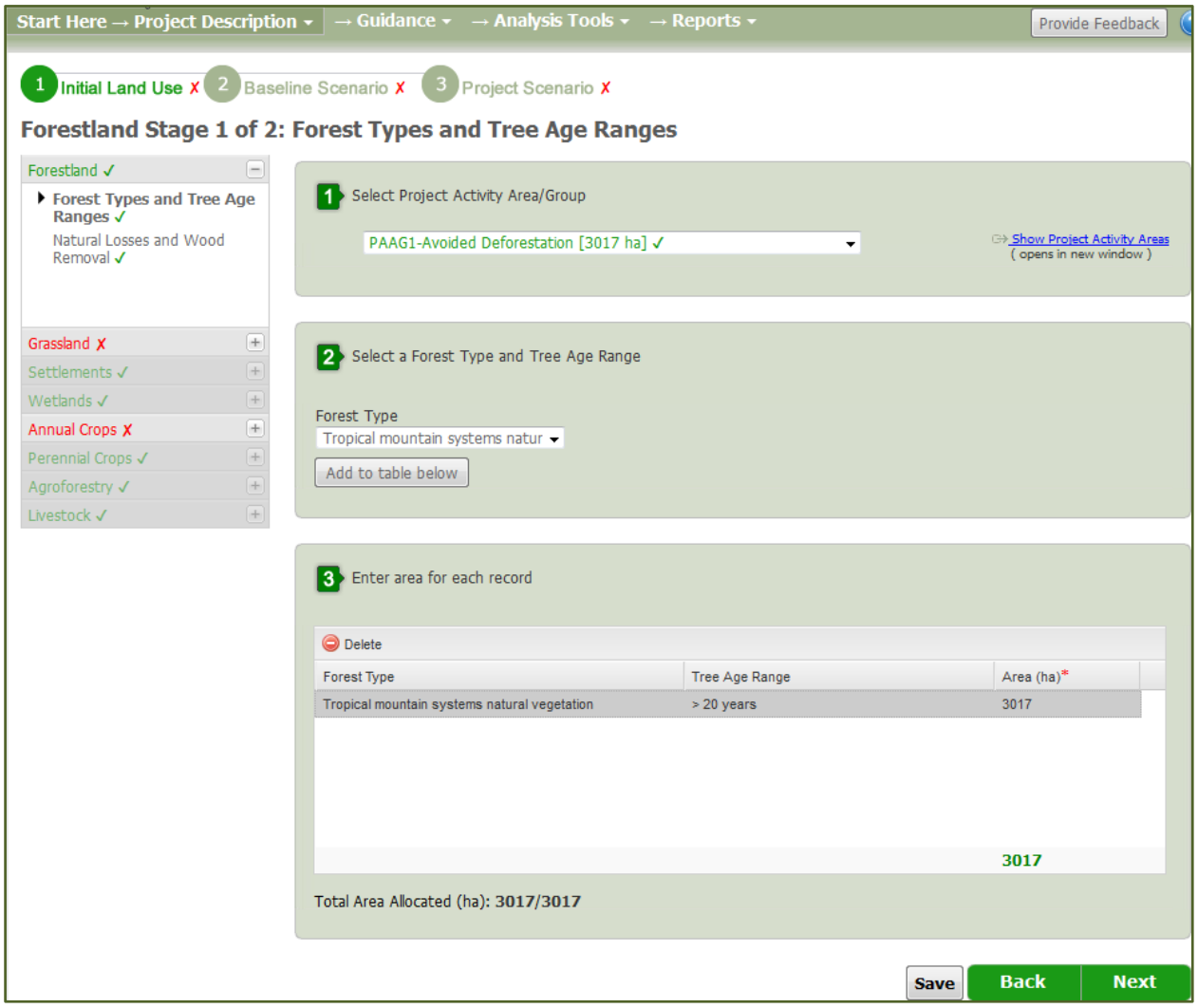
Hover over 'Analysis Tools' in the top menu, click on 'Simple Assessment Home Page' and click on initial land use'.

This brings you to an explanatory screen; notice the red crosses that indicate that no specifics have been entered for this scenario.



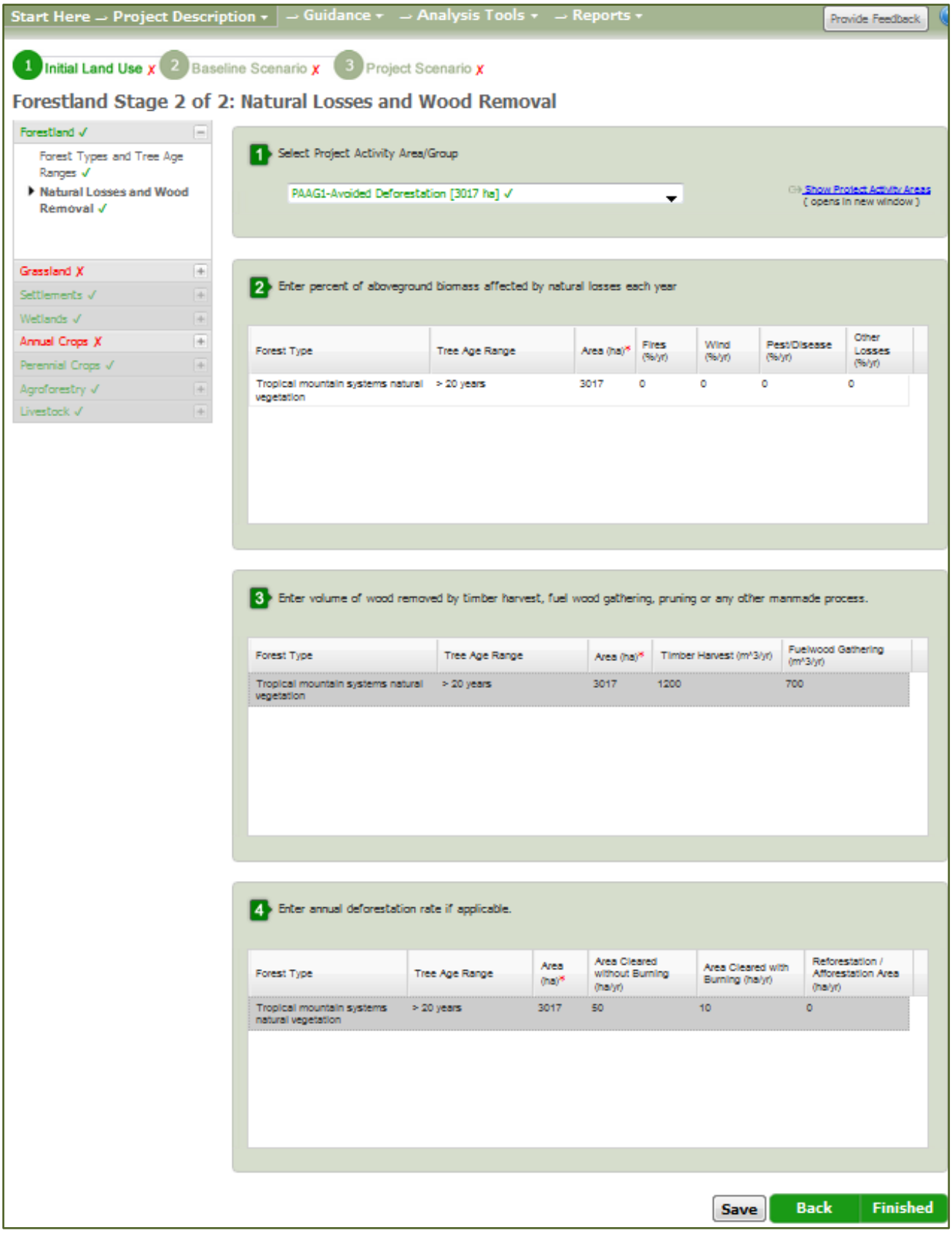
From the menu of land use categories on the left hand side choose "Forestland".

1. Select *Forest Types and Tree Age Ranges.*
2. In step 1, select Project Activity Group "Avoided Deforestation".
3. In step 2, select Forest Type "Tropical mountain systems natural vegetation" and add to the table below.
4. In step 3, select Tree Age Range "> 20 years" and type in the Area associated with this Forest Type and Tree Age Range (in this case 3017 ha).



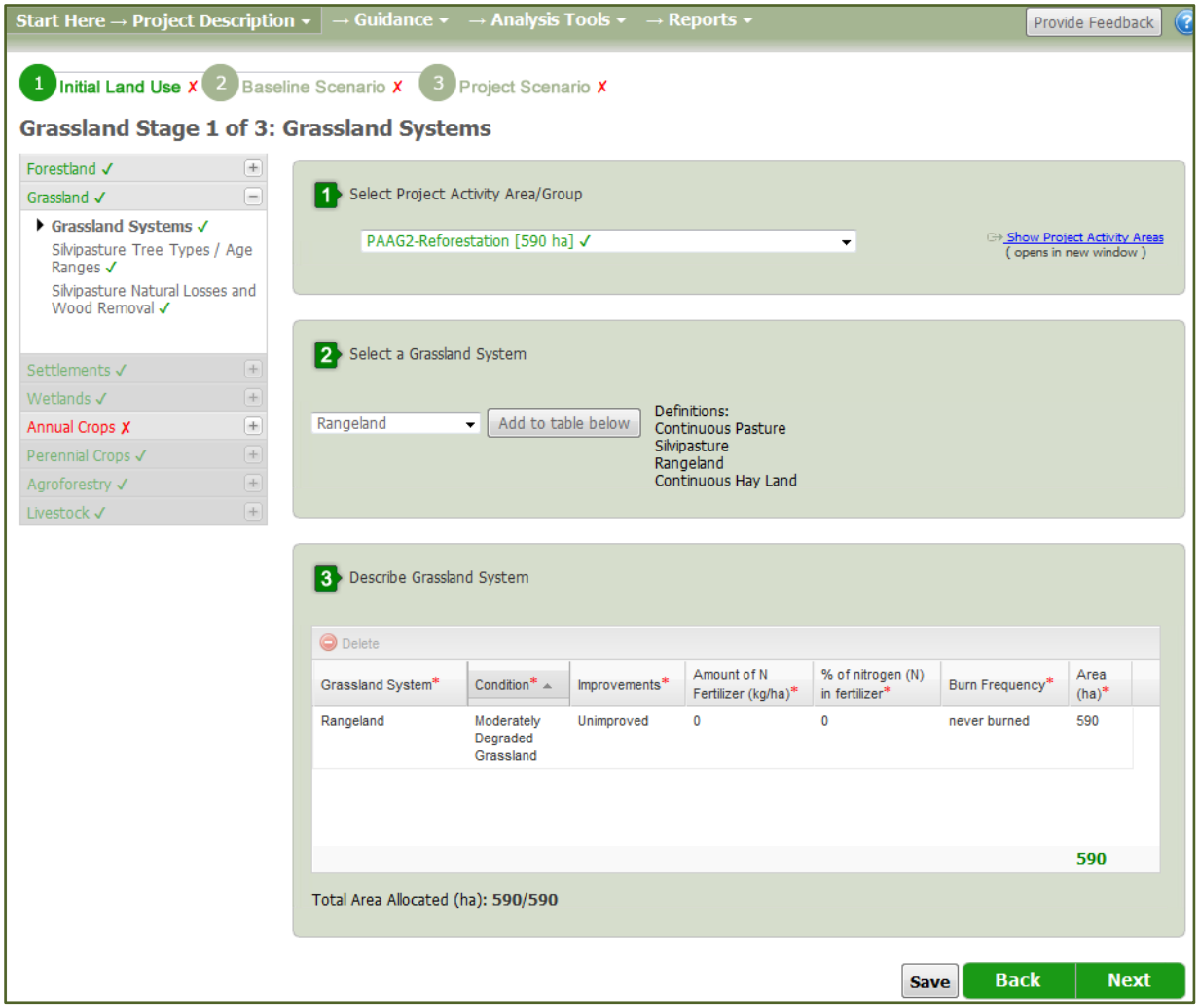
Click *Save* and then *Next* to go to the Natural Losses and Wood Removal page.

5. In step 1, select "Avoided Deforestation".
6. In step 2, enter per cent per year of aboveground biomass affected by natural losses (0 for each category)
7. In step 3, enter volumes of wood removed by timber harvest (1200 m3/yr) and fuel wood gathering (700 m3/yr).
8. In step 4, enter deforestation rate for Area Cleared without Burning (50 ha/yr) and Area Cleared with Burning (10 ha/yr).
9. Click *Save* and then *Finished*.


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
PAAG1-Avoided Deforestation [3017 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)
Tropical mountain systems natural vegetation
> 20 years
3017
0
0
0
0
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)
Tropical mountain systems natural vegetation
> 20 years
3017
1200
700
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)
Tropical mountain systems natural vegetation
> 20 years
3017
50
10
0
Save
Back
Finished

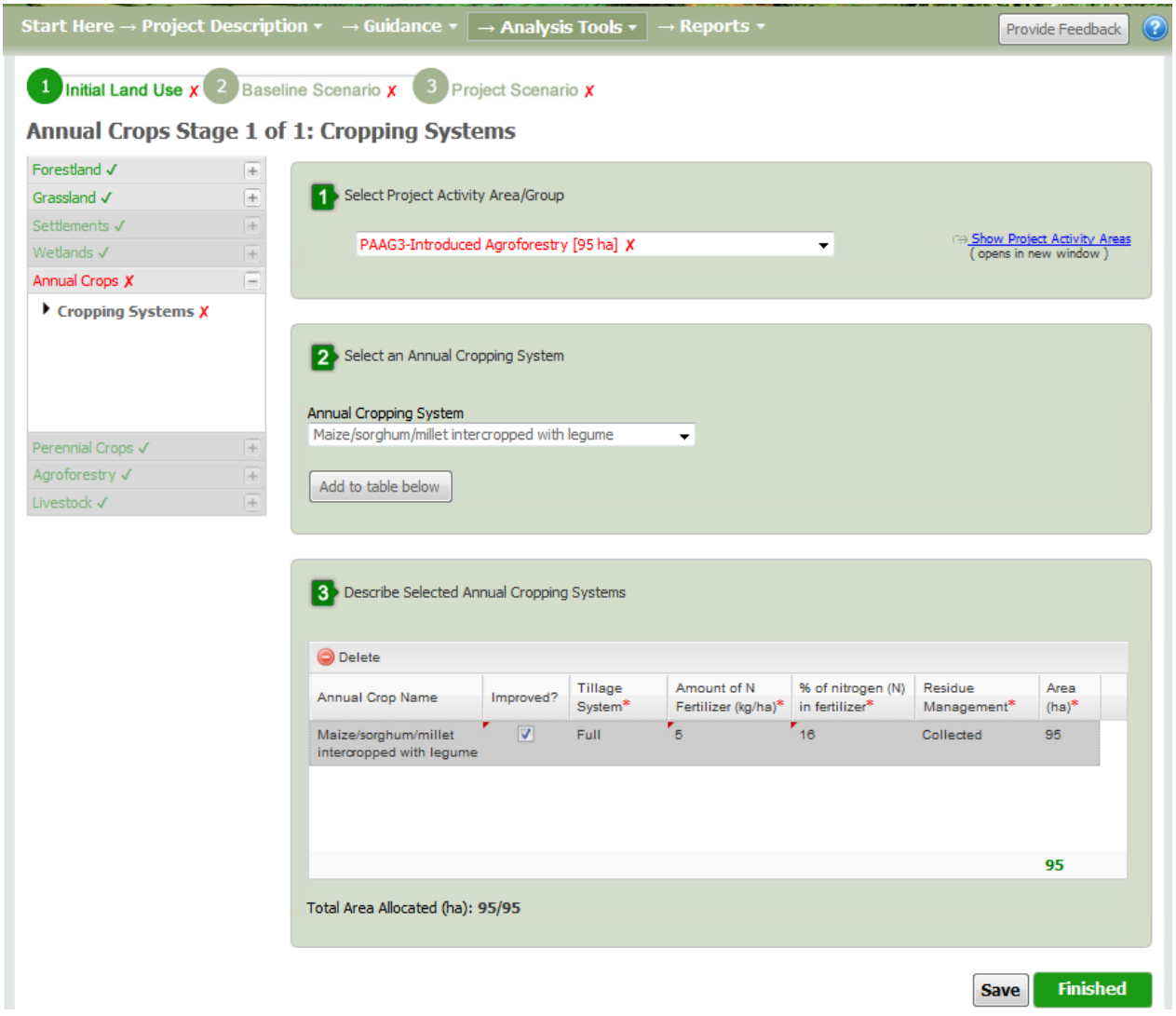
Grassland – Select grassland from the menu on the left hand side

1. Select *Grassland Systems*
2. In Step 1, select Project Activity Area "Reforestation"
3. In Step 2, select "Rangeland" and *Add to table below*
4. In Step 3, describe the grassland system as follows
   a. Condition: Moderately Degraded Grassland
   b. Improvements: Unimproved
   c. Amount of N Fertilizer (kg / ha): 0
   d. Per cent (%) of nitrogen in fertilizer: 0
   e. Burn frequency: never burned
   f. Area (ha): 590
5. Click *Save* and then *Next.*



As no silvipasture systems were considered in this Project Activity Area, you do not need to complete the sections on Silvipasture.

4. In Step 3, describe the selected annual cropping system (Maize/sorghum/millet intercropped with legume) as follows:
   a. Improved: Check (hover over the word improved for a definition)
   b. Tillage System: Full
   c. Amount of N Fertilizer (kg/ha): 5
   d. % of nitrogen in fertilizer: 16
   e. Residue management: Collected
   f. Area (ha): 95
5. Click *Save* and then *Finished*



You have now described the initial land use in all of the areas where the project is working.

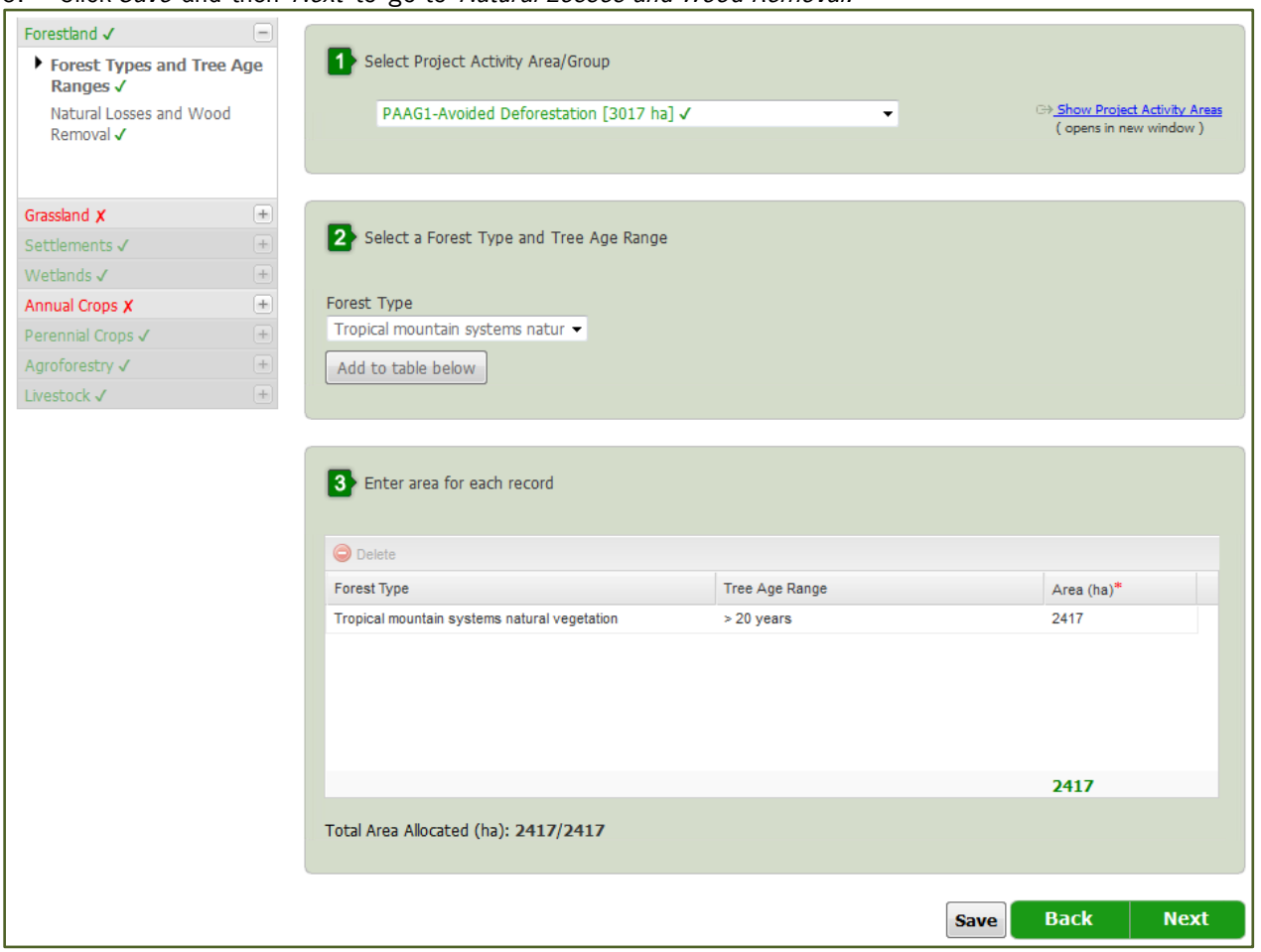
Baseline scenario

Click on:

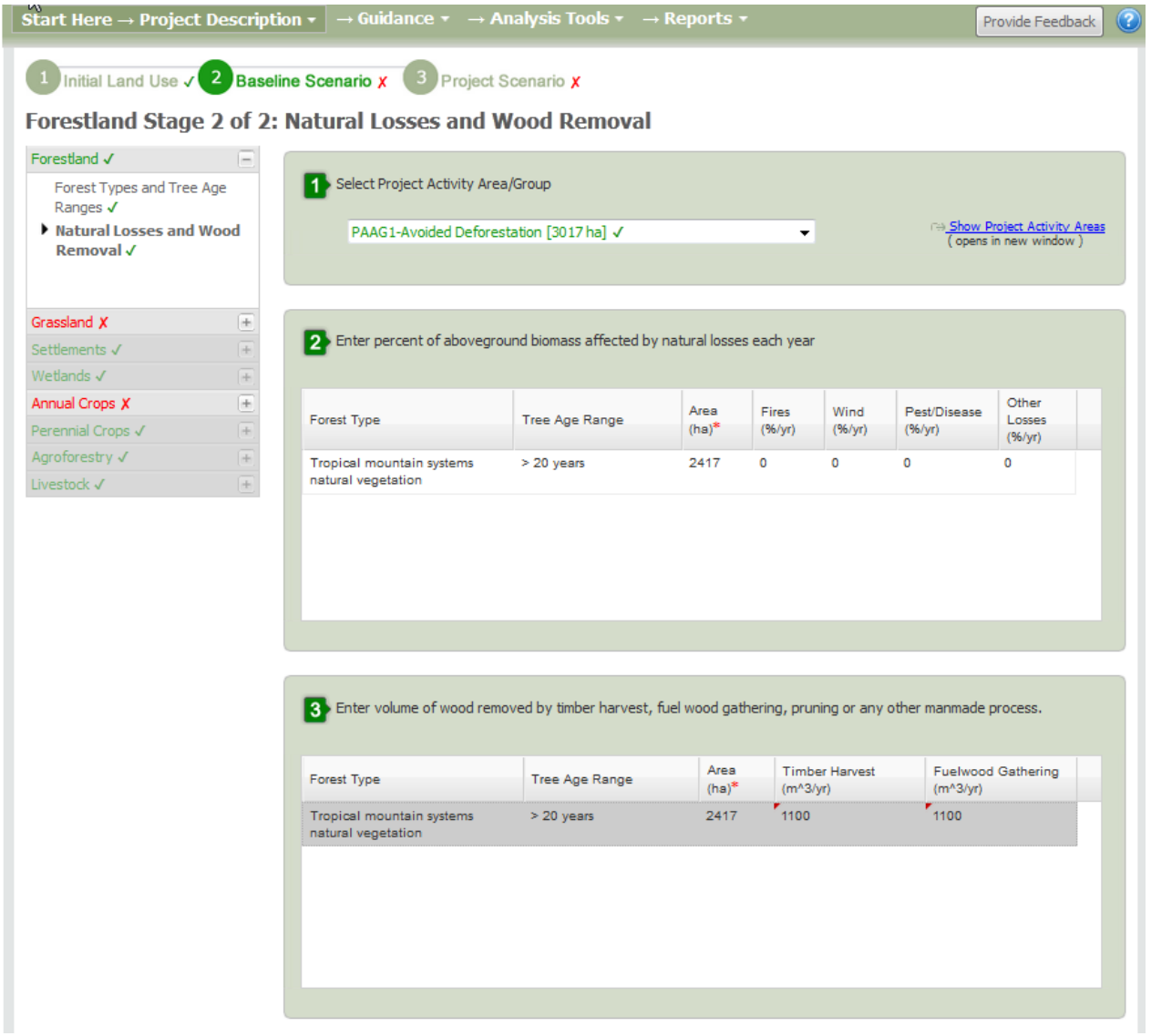
Analysis Tools >Simple Assessment> Baseline Scenario

Forestland

1. Select Forest Types and Tree Age Ranges
2. In Step 1, select the Project Activity area "Avoided Deforestation"
3. In Step 2, select the Forest Type and Tree Age Range "Tropical mountain systems natural vegetation" and *Add to table below*
4. In Step 3, select the Tree Age Range (> 20 years) and enter the Area (2417 ha)
5. Click *Save* and then *Next* to go to *Natural Losses and Wood Removal.*



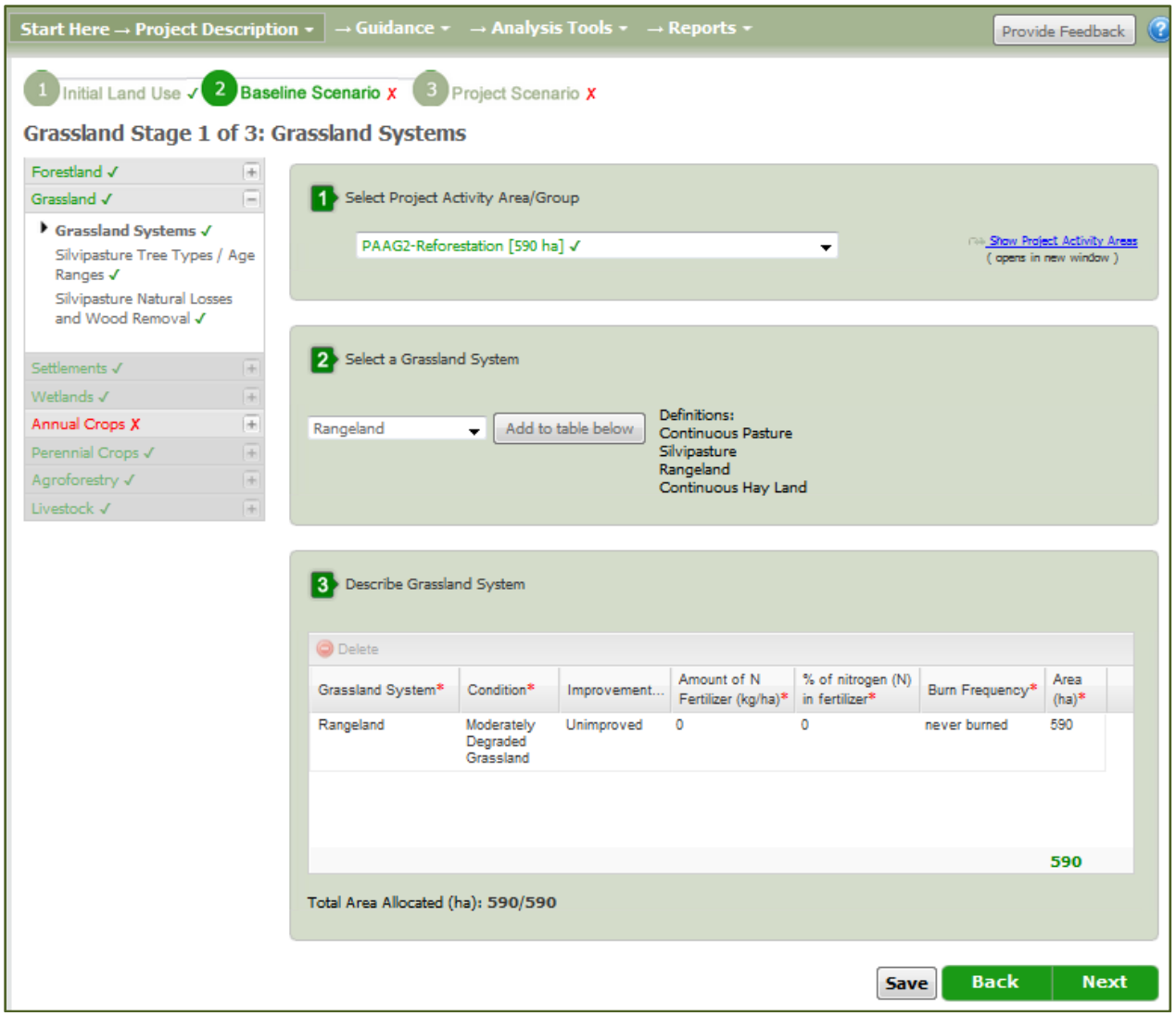
6. In Step 1, select "Avoided Deforestation"
7. In Step 2, enter per cent per year of aboveground biomass affected by natural losses (0 for each category)
8. In Step 3, enter volumes of wood removed by timber harvest (1100 m3/yr) and fuel wood gathering (1100 m3/yr)
9. In Step 4, enter deforestation rate for Area Cleared without Burning (0 ha/yr) and Area Cleared with Burning (55 ha/yr)
10. Click *Save* and then *Finished*



Grassland

1. Select Grassland Systems
2. In Step *1,* select Project Activity Area "Reforestation"
3. In Step *2,* select "Rangeland" and *add to table below*
4. In Step *3,* describe the grassland system as follows
   a. Condition: Moderately Degraded Grassland
   b. Improvements: Unimproved
   c. Amount of N Fertilizer (kg / ha): 0
   d. % of nitrogen in fertilizer: 0
   e. Burn Frequency: never burned
   f. Area (ha): 590

Click *Save* and then *Next.*



Because no silvipasture systems were selected in this Project Activity Group Area, the sections on Silvipasture do not need to be entered.

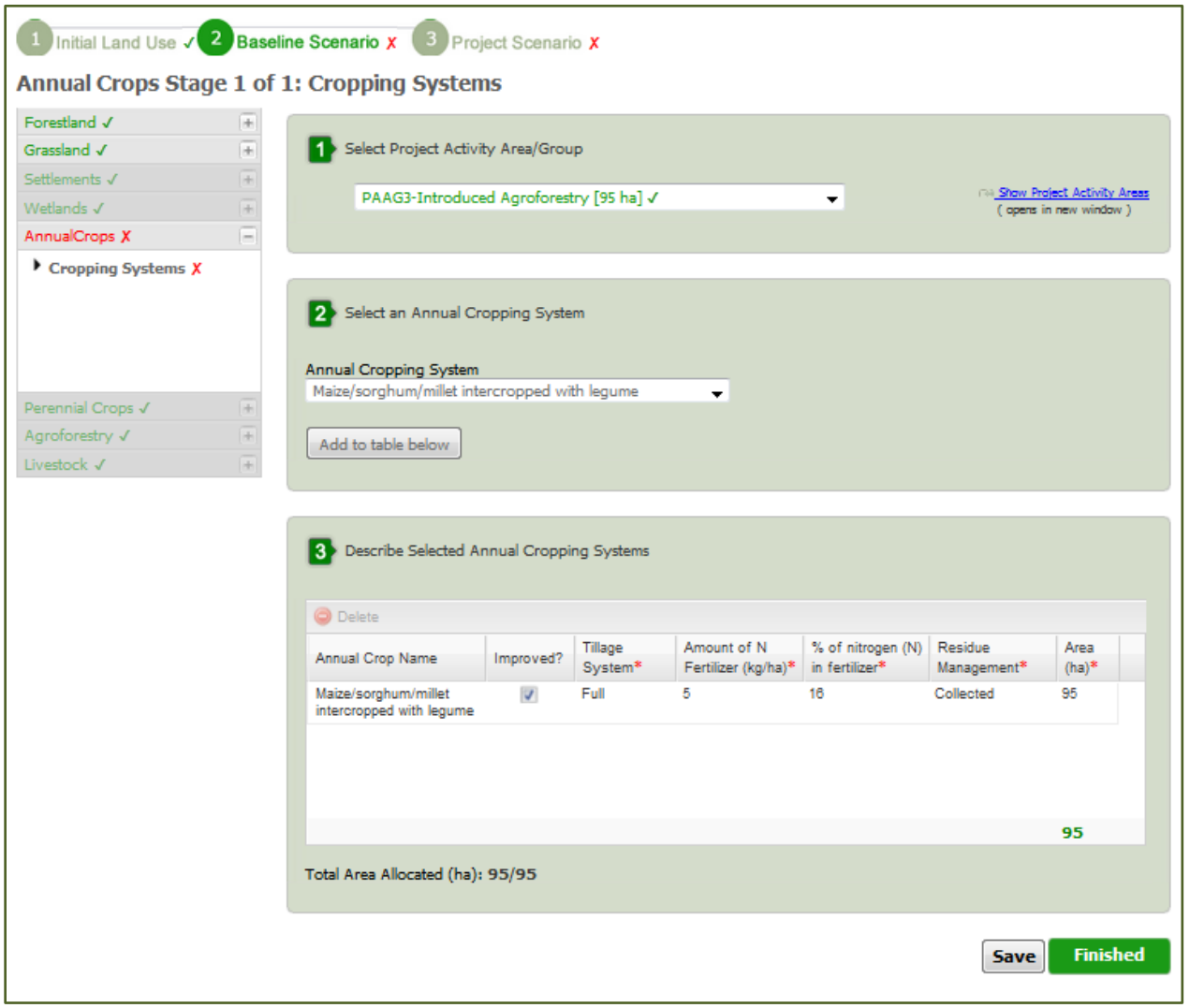
Next go to Annual Crops.

Annual Crops

As indicated earlier, *Project Activity Data can be entered in any sequence*. Here, you will start with "Introduced Agroforestry".

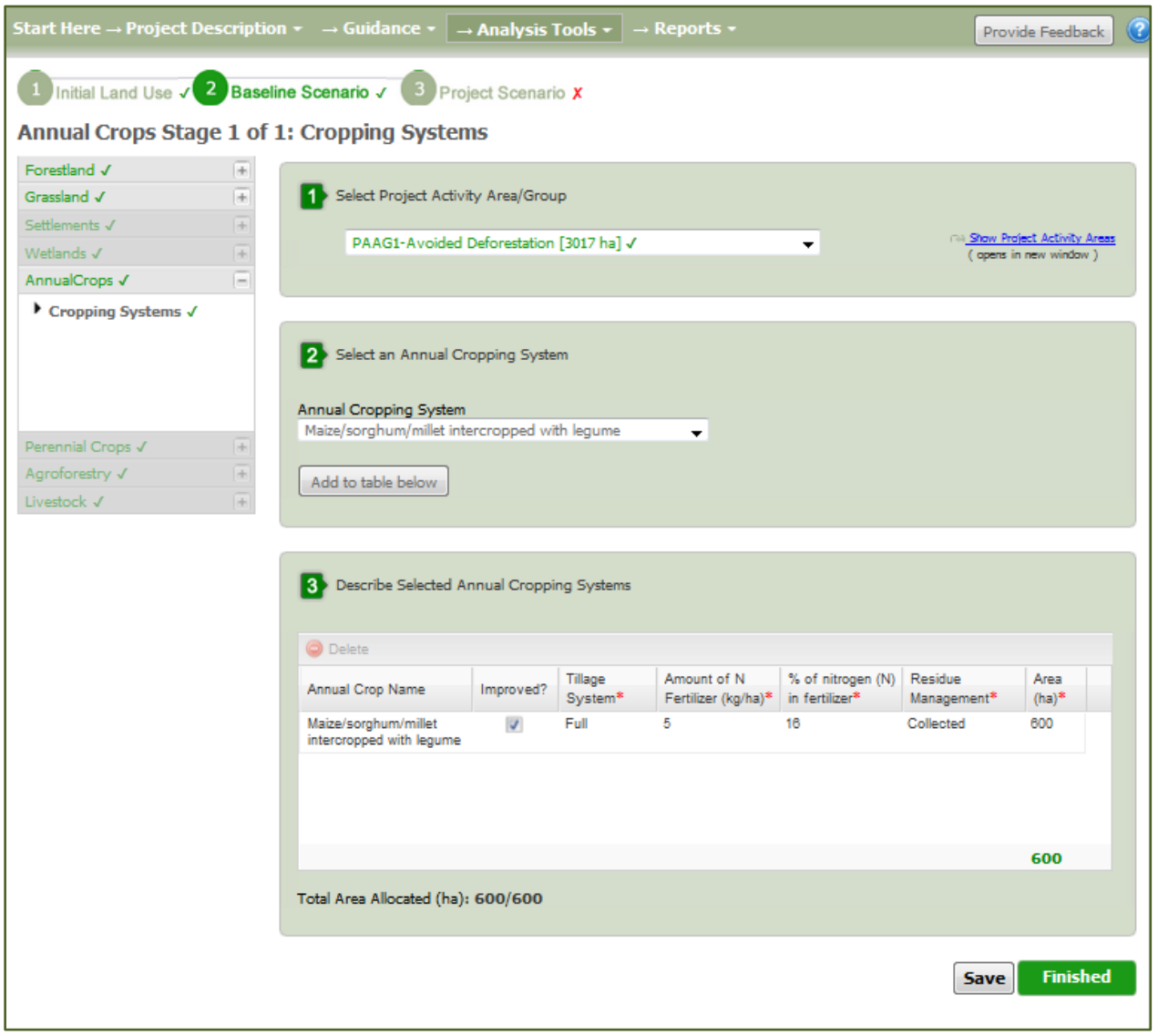
1. In Step 1, select Project Activity Area "Introduced Agroforestry"

2. In Step 2, select the annual cropping system "Maize/sorghum/millet intercropped with legume" and then *Add to table below*
3. In Step 3, describe the selected annual cropping system as follows:
   a. Improved: Check
   b. Tillage System: Full
   c. Amount of N Fertilizer (kg/ha): 5
   d. %of nitrogen in fertilizer: 16
   e. Residue management: Collected
   f. Area (ha): 95
4. Click *Save*



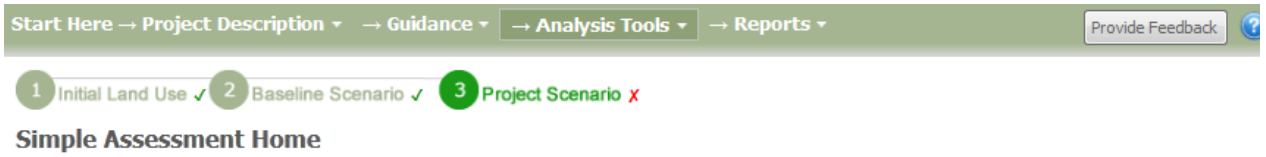
5. Go back to step 1, select Project Activity Area "Avoided Deforestation"
6. In Step 2, select the annual cropping system "Maize/sorghum/millet intercropped with legume" and then Add to table below
7. In Step 3, describe the selected annual cropping system as follows:

a. Improved: Check
b. Tillage System: Full
c. Amount of N Fertilizer (kg/ha): 5
d. % of nitrogen in fertilizer: 16
e. Residue management: Collected
f. Area (ha): 600
8. Click *Save* and then *Finished*



Congratulations, you have now described the Baseline Scenario in all of the areas where the project is working!

Project scenario

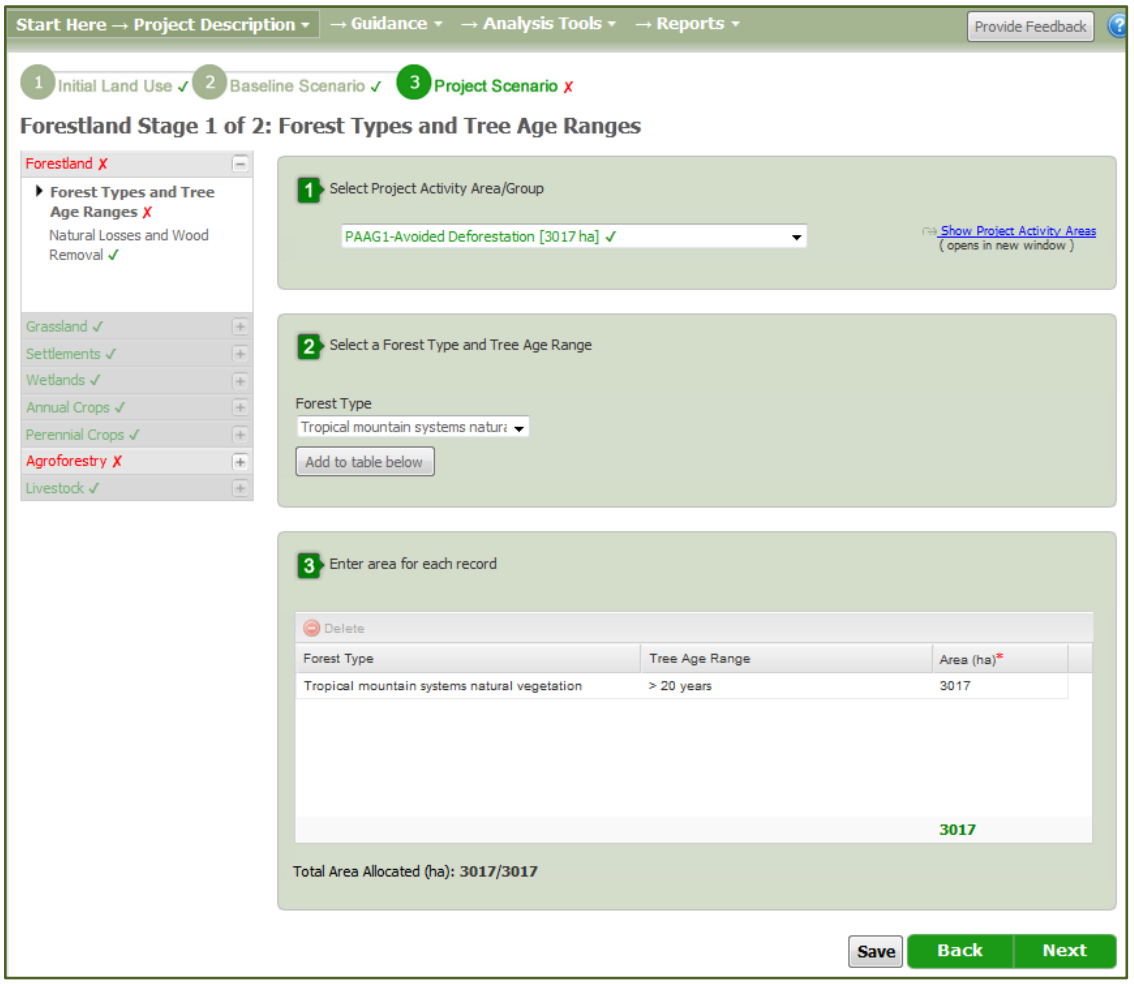


Analysis Tools> Simple Assessment> Project Scenario

Forestland

1. Select *Forest Types and Tree Age Ranges*
2. In step 1, select *Project* Area Activity Group "Avoided Deforestation"
3. In step 2, select *Forest Type* "Tropical mountain systems natural vegetation" and add to table below. In step 3, select *Tree Age Range* > 20 years" and type in the Area associated with this Forest Type and Tree Age Range (3017 ha).

Click *Save* and then *Next* to go to *Natural Losses and Wood Removal.*



5. In step 1, select Project Activity Group "Avoided Deforestation" if not already selected.
6. In step 2, enter per cent per year of aboveground biomass affected by natural losses (0 for each category)
7. In step 3, enter volumes of wood removed by timber harvest (1000 m3/yr) and fuel wood gathering (900 m3/yr).
8. In step 4 (you may have to scroll down to see this), enter deforestation rate for Area Cleared without Burning (50 ha/yr) and Area Cleared with Burning (0 ha/yr).
9. Click *Save* and then *Finished* (no screen shown here).
10. Go back to *Forest Types and Tree Age Ranges* and in step 1, select *Project Activity Group* "Reforestation"
11. In step 2, select each of the following Forest Types and Add to table below: Tropical Mountain Systems Plantation – other.
12. In step 3, select Tree Age Range " <=20 years" for all forest types and assign total area.
13. Click *Save*

Enter *Next* and go to *Natural Losses* and *Wood Removal*.

14. In step 2, enter per cent per year of aboveground biomass affected by natural losses (0 for each category)
15. In step 3, enter volumes of wood removed for all forest types by timber harvest (0 for all types) and fuel wood gathering (0 for all types).
16. In step 4, enter "deforestation rate" for Area Cleared without Burning (0 ha/yr) and Area Cleared with Burning (0 ha/yr).
17. Click *Save* and then *Finished.*

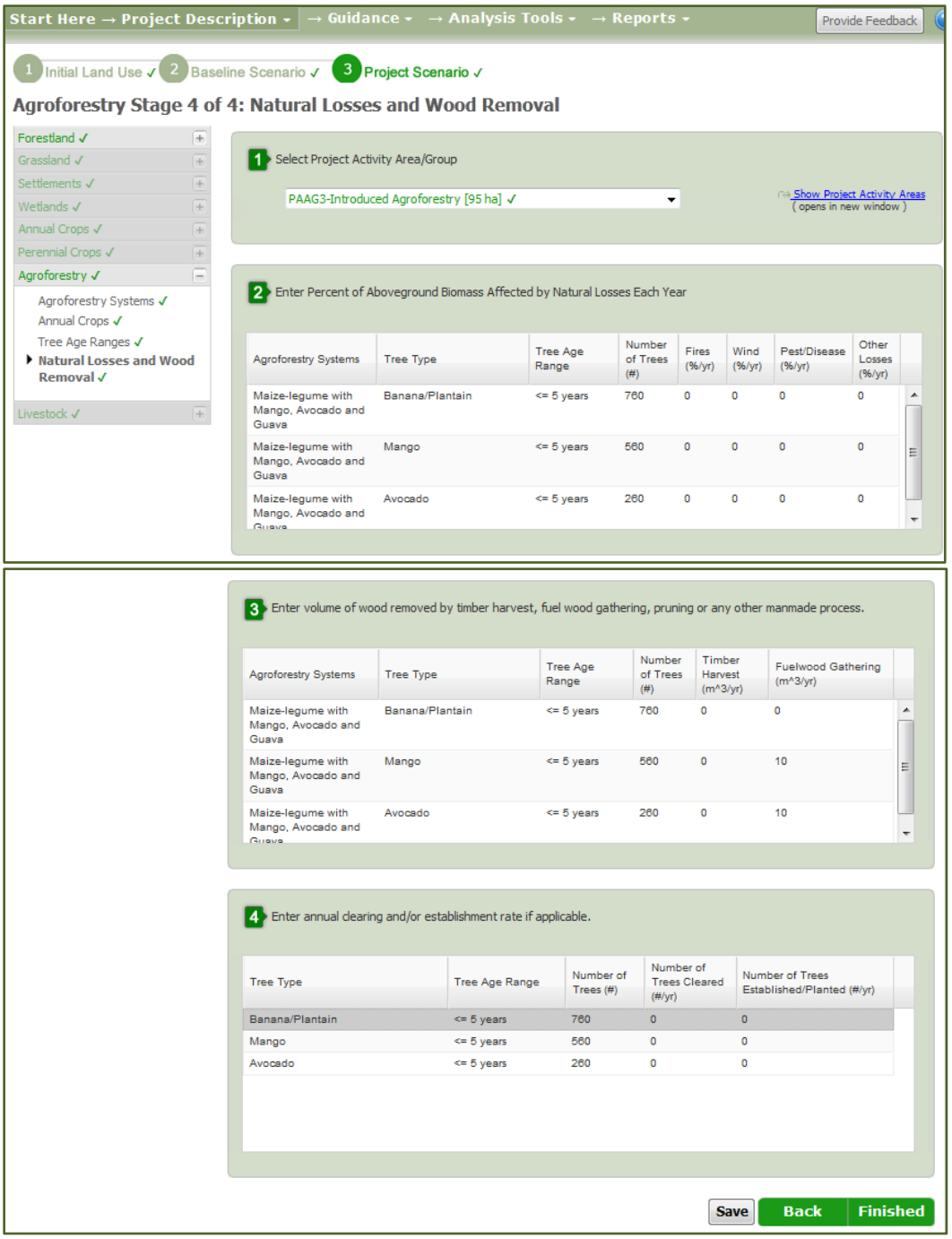
System Agroforestry

1. Select *Agroforestry Systems*
2. In step 1, select Project Activity Area "Introduced Agroforestry"
3. In step 2, name the agroforestry system "Maize-legume with Mango, Avocado and Banana/Plantain" (you will have to type this in) and assign the area (95 ha).
4. Click Save and then Next to go to Annual Crops *(screen not shown)*

5. In step 1, select Project Activity Area "Introduced Agroforestry"
6. In step 2, select the agroforestry system you created on the previous page
7. In step 3, select the cropping system that best represents the crops in your agroforestry system: "Maize/sorghum/millet intercropped with legume"
8. In Step 4, describe the selected annual cropping system as follows:
   a. Improved: Check
   b. Tillage System: Reduced
   c. Amount of N Fertilizer (kg/ha): 50
   d. % of nitrogen in fertilizer: 16
   e. Residue management: Grazed
9. Click *Save* and then *Next* to go to *Tree Age Ranges.*

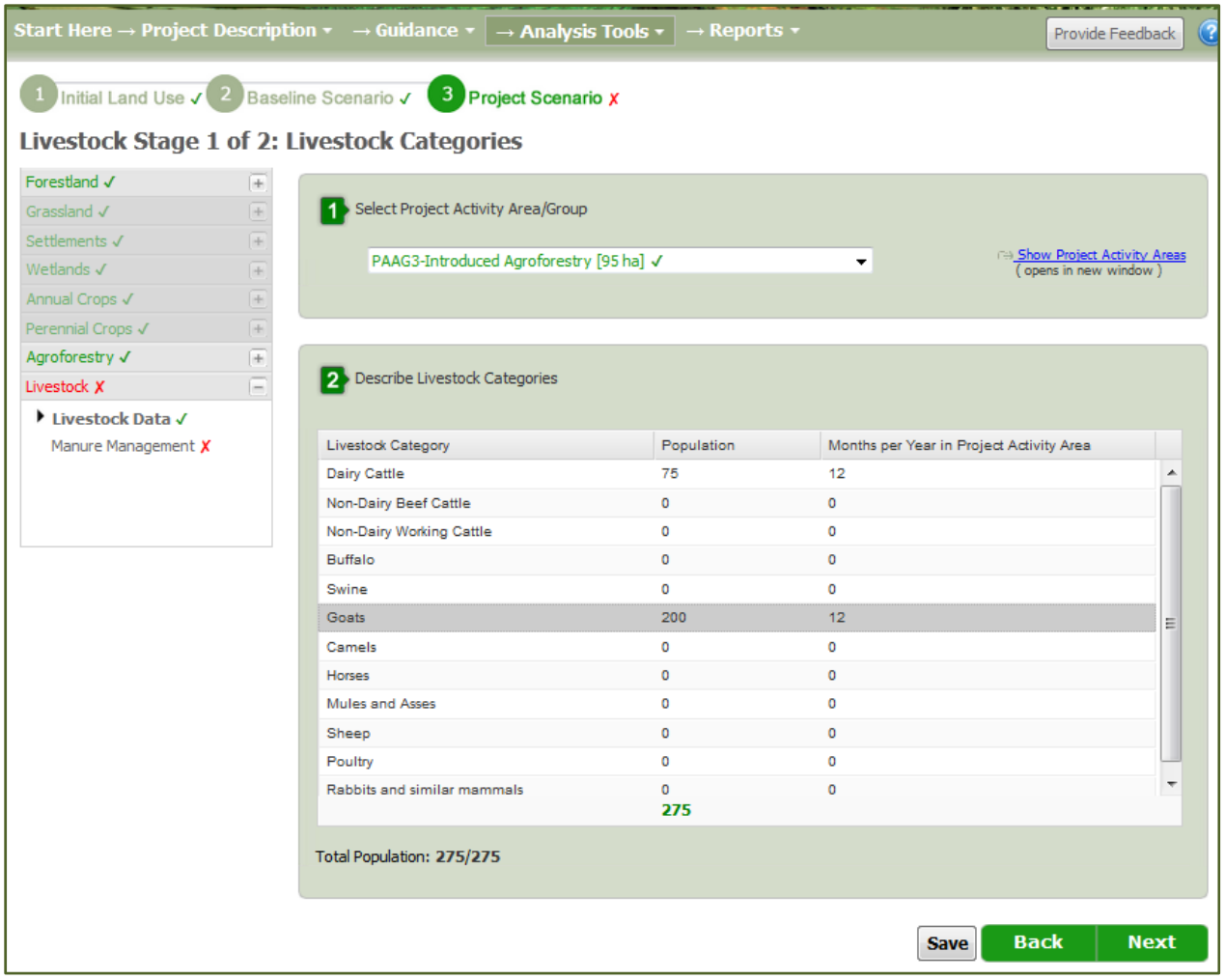
10. In step 2, select the agroforestry system
11. In step 3, select the following tree types represented in the agroforestry system and Add to table below: Mango, Avocado, and Banana/Plantain
12. In step 3, select *Tree Age Range* "<= 5 years" for all three "tree" types and assign number of trees for each tree type: Mango (560), Avocado (260), Banana/Plantain (760)
13. Click *Save* and then *Next* to go to *Natural Losses and Wood Removal.*

14. In step 2, enter per cent per year of aboveground biomass affected by natural losses (0 for each category for all tree types)
15. In step 3, enter volumes of wood removed for all forest types by timber harvest (0 m3 yr-1 for all types) and fuel wood gathering: Mango (10 m3 yr-1), Avocado (10 m3 yr-1), Banana/Plantain (0 m3 yr-1)
16. In step 4, enter the annual clearing and/or establishment rate if applicable (0 for each category here)
16. Click Save and then *Finished.*

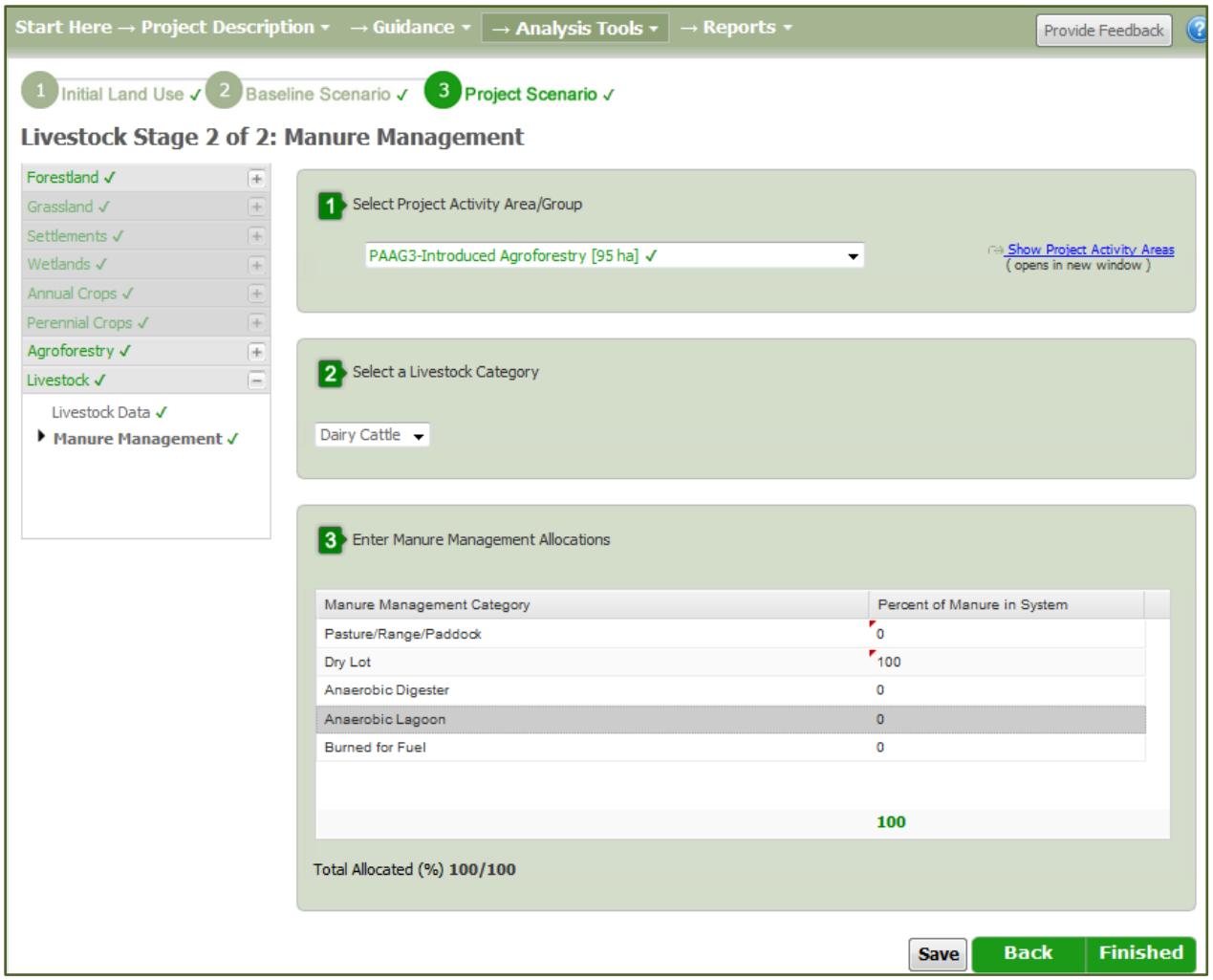

Start Here → Project Description
→ Guidance
→ Analysis Tools
→ Reports
Provide Feedback
1 Initial Land Use ✓
2 Baseline Scenario ✓
3 Project Scenario ✓
Agroforestry Stage 4 of 4: Natural Losses and Wood Removal
Forestland ✓
Grassland ✓
Settlements ✓
Wetlands ✓
Annual Crops ✓
Perennial Crops ✓
Agroforestry ✓
Agroforestry Systems ✓
Annual Crops ✓
Tree Age Ranges ✓
Natural Losses and Wood Removal ✓
Livestock ✓
1 Select Project Activity Area/Group
PAAG3-Introduced Agroforestry [95 ha] ✓
Show Project Activity Areas
(opens in new window)
2 Enter Percent of Aboveground Biomass Affected by Natural Losses Each Year
Agroforestry Systems
Tree Type
Tree Age Range
Number of Trees (#)
Fires (%/yr)
Wind (%/yr)
Pest/Disease (%/yr)
Other Losses (%/yr)
Maize-legume with Mango, Avocado and Guava
Banana/Plantain
<= 5 years
760
0
0
0
0
Maize-legume with Mango, Avocado and Guava
Mango
<= 5 years
560
0
0
0
0
Maize-legume with Mango, Avocado and Guava
Avocado
<= 5 years
260
0
0
0
0
3 Enter volume of wood removed by timber harvest, fuel wood gathering, pruning or any other manmade process.
Agroforestry Systems
Tree Type
Tree Age Range
Number of Trees (#)
Timber Harvest (m^3/yr)
Fuelwood Gathering (m^3/yr)
Maize-legume with Mango, Avocado and Guava
Banana/Plantain
<= 5 years
760
0
0
Maize-legume with Mango, Avocado and Guava
Mango
<= 5 years
560
0
10
Maize-legume with Mango, Avocado and Guava
Avocado
<= 5 years
260
0
10
4 Enter annual clearing and/or establishment rate if applicable.
Tree Type
Tree Age Range
Number of Trees (#)
Number of Trees Cleared (#/yr)
Number of Trees Established/Planted (#/yr)
Banana/Plantain
<= 5 years
760
0
0
Mango
<= 5 years
560
0
0
Avocado
<= 5 years
260
0
0
Save
Back
Finished

Livestock

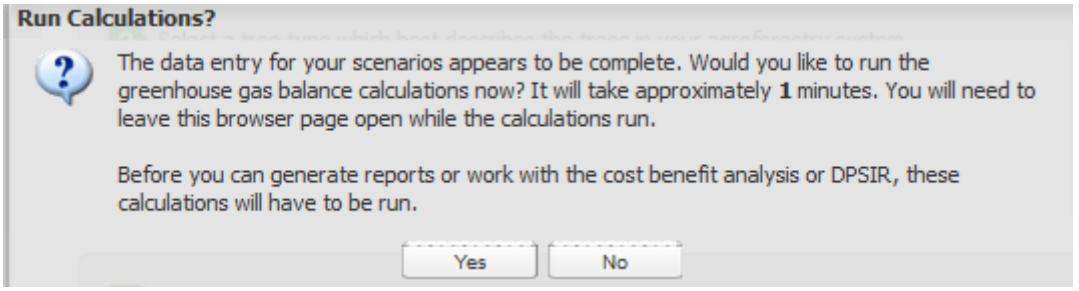
1. Select *Livestock Data*
2. In step 1, select Project Activity Area "Introduced Agroforestry"
3. In step 2, enter the population and months per year livestock are in the Project Activity Area: Dairy Cattle (75 head, 12 months per year), Goats (200 head, 12 months per year)
4. Click *Save* and then *Next* to go to *Manure Management*



5. In step 2, Manure Management, select livestock category "Goats"
6. In step 3, enter per cent in each manure management system: 100% in Pasture/Range/Paddock
7. Click Save
8. Go back to step 2 and select livestock category "Dairy Cattle"
9. In step 3, enter per cent in each manure management system: 100% in Dry Lot
10. Click Save and then *Finished.*



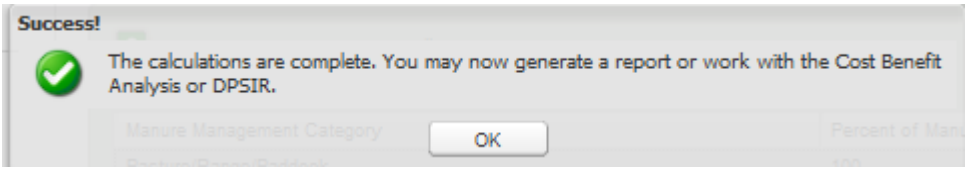
All fields should now have been filled for your project. This shown by green ticks for 1 - Initial Land Use, 2 – Base line Scenario, and 3- Project Scenario. Typically, you will get the following screen:



Create report

You can now run the calculations for the Simple Assessment and create a range of reports for the project area.

After some minutes the following screen will appear:



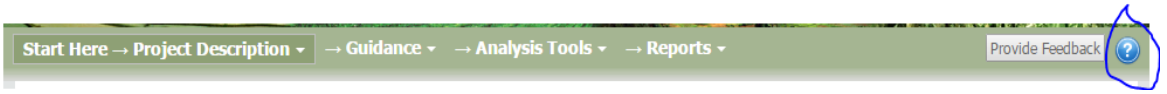
For this exercise, we will skip the DPSIR and cost-benefit-analysis; see CBP page for additional information.

Type OK, and then 'Finished' which will bring you to the main CBP screen.

Go to Reports and create a summary report (PDF) for your project.

Open (save first!) the summary report and look at the results for the hypothetical Kakagema case as derived from an IPCC Tier 1 type inventory using the Simple Assessment.

Below are some excerpts including information on soil carbon changes. A detailed description of the reports may be found through the help page.



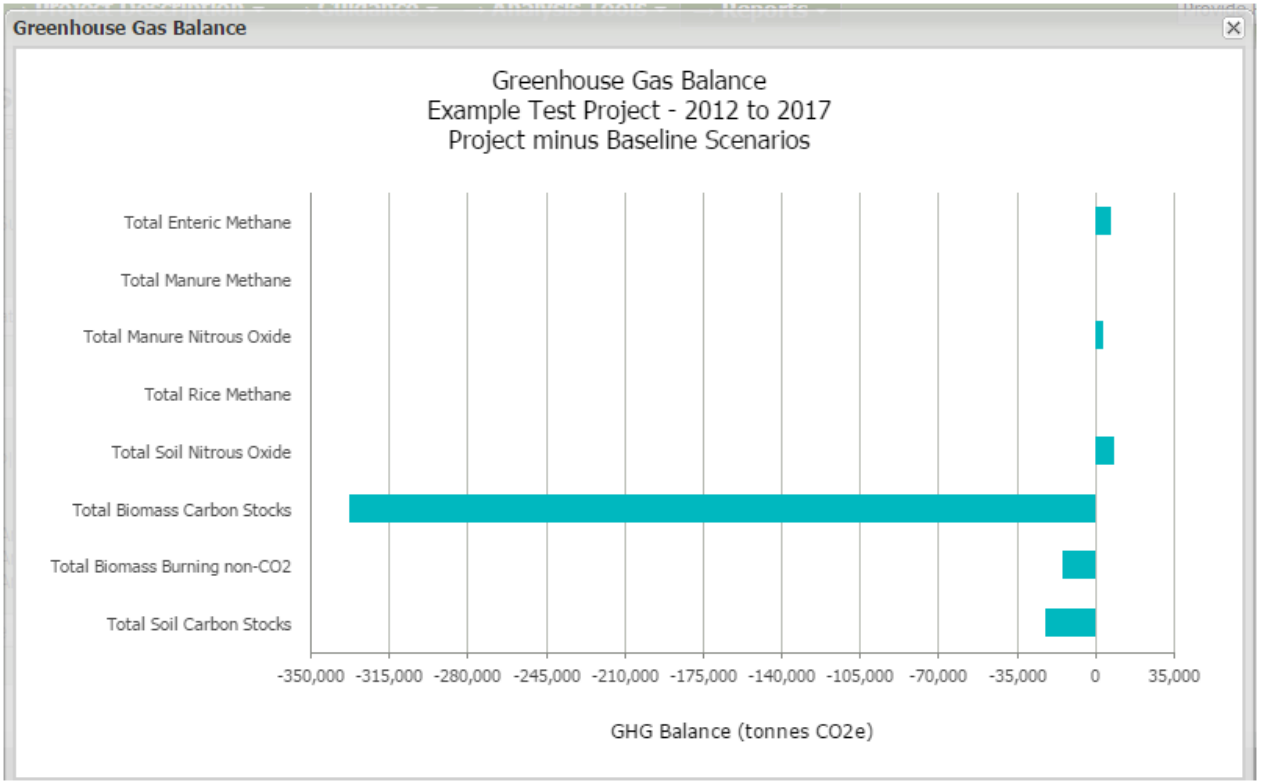
Look at the Appendix for supplemental information.

Generate a graph for the greenhouse balance of your project, defined as "Project scenario" minus "Baseline scenario" (Note smaller blue zones for Total enteric methane (7400); Total manure nitrous oxide (3372) and Total soil nitrous oxide (8360), expressed as tonnes CO_{2e} (see next page).

Table 3.1 Simple Summary Report following UNFCCC Common Reporting Guidelines.

Greenhouse Gas Source and Sink Categories	Baseline Scenario (2017 - 2027) Emissions and Removals				Project Scenario (2017 - 2027) Emissions and Removals				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	tCO_2e / ha / yr
Agriculture											
A. Enteric Methane		0				7400			7400	2	0.2
B. Manure Management		0	0			218	3372		3590	0.97	0.1
C. Rice Cultivation		0				0			0	0	0
D. Agricultural Soils	0	0	5		0	0	8365		8360	2.3	0.23
E. Prescribed Burning of Savannas		0	0	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	-11790				-166448				-154659	-42	-4.2
B. Forest and Grassland Conversion	177747	10751	3769	0	0	0	0	0	-192267	-52	-5.2
C. Abandonment of Managed Lands	0				0				0	0	0
D. CO2 Emissions and Removals from Soil	17255				-4835				-22090	-6	-0.6
E. Other	0	0	0	0	0	0	0	0	0	0	0
Total	183212	10751	3774	0	-171284	7618	11737	0	-349666	-94	-9.4

Notes:
GWP are 100-year time horizon based on estimates from the IPCC Second Assessment Report.
Signs for uptake are (-) and for emissions (+).
Other GHGs include NOx, CO, VOC, SO2.
Values not identified as 'stocks' are emissions.
A. Forest and other Woody Biomass includes biomass growth and losses from timber harvest and fuelwood gathering.
B. Forest and Grassland Conversion includes emissions from deforestation and shifting cultivation.



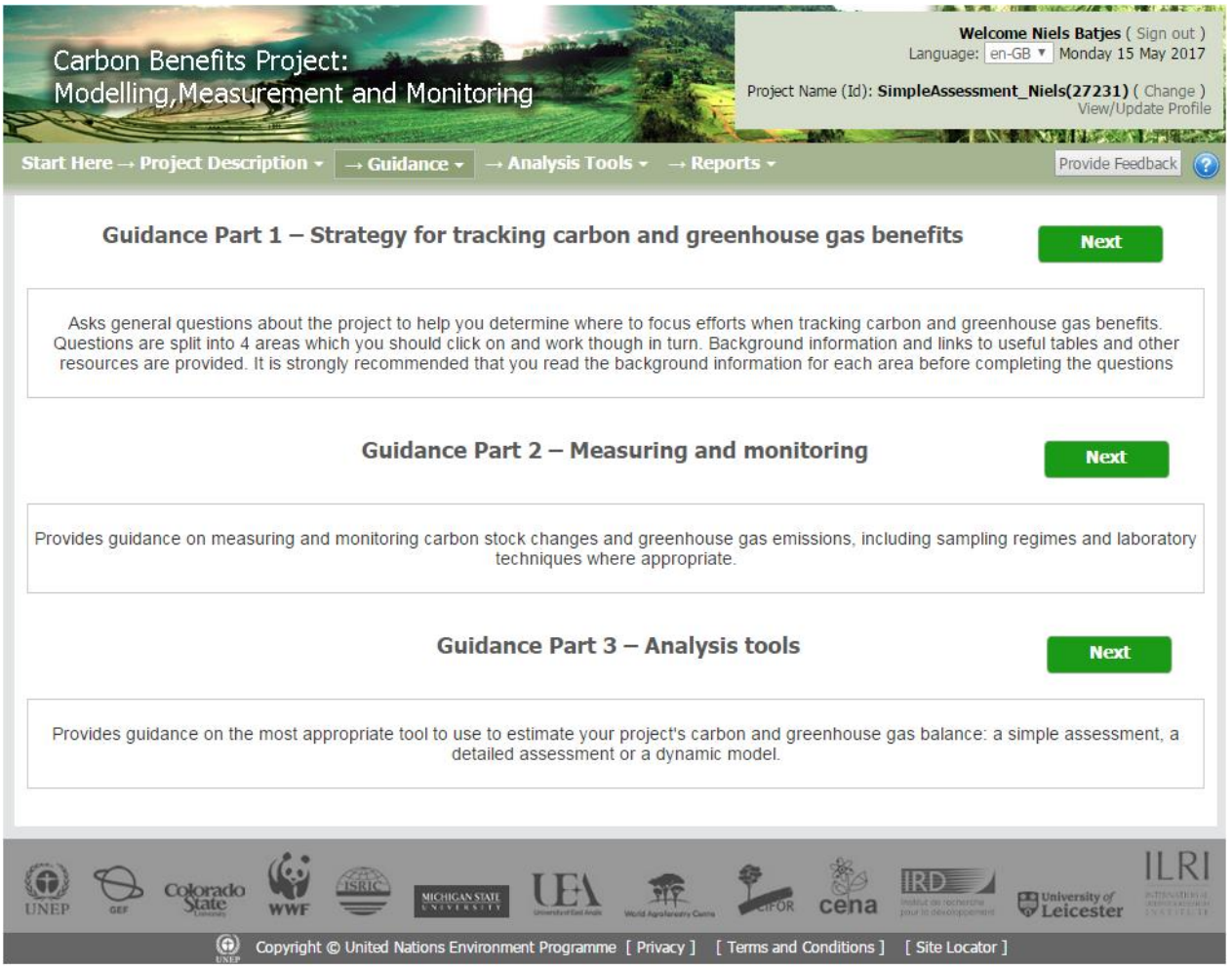
Next steps

You have now completed the exercise with the Simple Assessment.

At a later stage, you may now do various things. For example, you may proceed to the Detailed Assessment using a Tutorial developed by the CBP team; the tutorial may be downloaded from the CPB site (via the Help button, Tutorials).

Alternatively, you may wish to run a Simple Assessment for a project area of your choice for which you will have to provide (create) the necessary activity data and delineate the project areas using the inbuilt on-line drawing tools.

You may also explore the on-line CBP system at your leisure. For example, you may wish to have a closer look at Part 2 of the Guidance module which will link you to a number of useful guidelines.



Please provide feedback

You are now familiar with the principles of the Simple Assessment and some other functionalities of the CBP tool. The CBP team at CSU looks would like to receive your feedback, which you can provide by clicking on the "provide feedback" button in the upper right corner of each page: https://www.surveymonkey.com/r/783FRJM?sm=vOr6AUXZr0Qrc4OUwD6fTA%3d%3d

Acknowledgements

The GSOCMap training was organised in the framework of the Global Soil Partnership by ISRIC – World Soil Information (http://www.fao.org/global-soil-partnership/resources/events/detail/en/c/878852/).

The Carbon Benefits Project (CBP) was implemented by UNEP's Division of Global Environment Facility Coordination (DGEF) and executed by UNEP's Division of Early Warning and Assessment (DEWA) in association with two scientific consortiums; one led by Colorado State University (CSU) and the other by WWF and involved a range of partners.

This exercise is based on materials developed by the CBP team, in particular Eleanor Milne, Mark Easter and Keith Paustian, for the review workshop for the GEF of the tools developed by the Carbon Benefits project (Voi, Kenya, Sept. 2012).

References

Banwart SA, Noelmeyer E and Milne E (editors) 2015. Soil carbon: Science, Management and policy for multiple benefits. CABI, Wallingford (UK), 420 p.

Batjes NH 1996. Total carbon and nitrogen in the soils of the world. *European Journal of Soil Science* 47, 151-163. http://dx.doi.org/10.1111/j.1365-2389.1996.tb01386.x

Batjes NH 2004. Soil carbon stocks and projected changes according to land use and management: a case study for Kenya. *Soil Use and Management* 20, 350-356. http://dx.doi.org/10.1111/j.1475-2743.2004.tb00380.x

Batjes NH 2011. Soil organic carbon stocks under native vegetation - revised estimates for use with the simple assessment option of the Carbon Benefits Project system. *Agriculture, Ecosystems & Environment* 142, 365-373. http://dx.doi.org/10.1016/j.agee.2011.06.007

CBP-CSU 2009-2012. The Carbon Benefits Project. GEF, UNEP, Colorado University (Project website: http://carbonbenefitsproject-compa.colostate.edu/)

FAO 2017. *Outcome document of the global symposium on soil organic carbon (21-23 March 2017)*, Food and Agriculture Organization of the United Nations, with GSP (Global Soil Partnership), IPCC (Intergovernmental Panel on Climate Change), ITPS (Intergovernmental Technical Panel on Soils), UNCCD (United Nations Convention to Combat Desertification), UNCCD-SPI (Science-Policy Interface of the UNCCD), and WMO (World Meteorological Organization), Rome, 22 p. http://www.fao.org/3/b-i7268e.pdf

IPCC 2006. *IPCC Guidelines for National Greenhouse Gas Inventories Volume 4: Agriculture, Forestry and other Land Use*. IPCC National Greenhouse Gas Inventories Programme, Hayama (JP)http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.htm

Levèvre C, Fatma R, Viridiana A and Wiese L 2017. *Soil organic carbon the hidden potential*, FAO, Rome, 78 p. http://www.fao.org/3/a-i6937e.pdf

Milne E, Neufeldt H, Smalligan M, Rosenstock T, Bernoux M, Bird N, Casarim F, Denef K, Easter M, Malin D, Ogle S, Ostwald M, Paustian K, Pearson T and Steglich E 2012. *Methods for the quantification of emissions at the landscape level for developing countries in smallholder contexts*, CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), Copenhagen (DK), 59 p. http://www.focali.se/filer/CCAFS9_2012%20-3.pdf

Milne E, Banwart SA, Noellemeyer E, Abson DJ, Ballabio C, Bampa F, Bationo A, Batjes NH, Bernoux M, Bhattacharyya T, Black H, Buschiazzo DE, Cai Z, Cerri CE, Cheng K, Compagnone C, Conant R, Coutinho HLC, de Brogniez D, Balieiro FdC, Duffy C, Feller C, Fidalgo ECC, da Silva CF, Funk R, Gaudig G, Gicheru PT, Goldhaber M, Gottschalk P, Goulet F, Goverse T, Grathwohl P, Joosten H, Kamoni PT, Kihara J, Krawczynski R, La Scala Jr N, Lemanceau P, Li L, Li Z, Lugato E, Maron P-A, Martius C, Melillo J, Montanarella L, Nikolaidis N, Nziguheba G, Pan G, Pascual U, Paustian K, Piñeiro G, Powlson D, Quiroga A, Richter D, Sigwalt A, Six J, Smith J, Smith P, Stocking M, Tanneberger F, Termansen M, van Noordwijk M, van Wesemael B, Vargas R, Victoria RL, Waswa B, Werner D, Wichmann S, Wichtmann W, Zhang X, Zhao Y, Zheng J and Zheng J 2015. Soil carbon, multiple benefits. *Environmental Development* 13, 33-38. http://www.sciencedirect.com/science/article/pii/S2211464514000864

Ravindranath NH and Ostwald M 2008. *Carbon inventory methods - Handbook for greenhouse gas inventory, carbon mitigation and roundwood production projects*. Advances in Global Change Research, Volume 29. Springer, Heidelberg, 304 p. http://link.springer.com/book/10.1007/978-1-4020-6547-7/page/1

Sombroek WG, Braun HMH and van der Pouw BJA 1982. *Exploratory Soil Map and Agro-Climatic Zone Map of Kenya, 1980 (scale 1:1,000,000)*. Exploratory Soil Survey Report No. E1, Kenya Soil Survey, National Agricultural Laboratories, Ministry of Agriculture, Nairobi, 56 p

UNEP 2012. The benefits of soil carbon - managing soils for multiple, economic, societal and environmental benefits, *UNEP Yearbook - Emerging issues in our global environment 2012*. United Nations Environmental Programme, Nairobi, pp 19-33. http:\\www.unep.org/yearbook/2012.

Appendix – What do the projections tell us?

As the project manager, you should assess what the Simple Assessment projections are telling in terms of projected changes in soil carbon stocks for the Kakamega project area.

You may consider the following questions:

Q: As project manager, will you be able to sequester soil carbon and reduce GHG emissions with the proposed project (i.e., based on the broad assumptions entered in the modelling tool)?

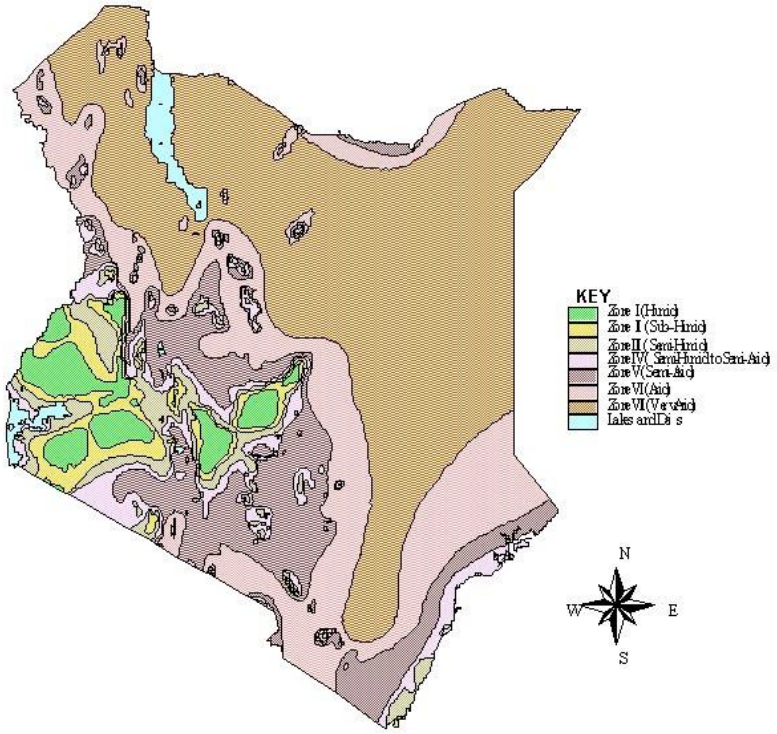
Q: Reflect about the uncertainty of the projections, model and global datasets used?

Q: How much SOC-C can be sequestered per ha to 30 cm depth according to the tool? Is this a plausible figure in your opinion? [Tip: See additional information at end of this document, Appendix]

Q: Can the proposed crops actually grow in the area taking into account the biophysical conditions? How could you assess this?

Supplemental material

1) Agro-climatic zones of Kenya (Sombroek *et al.* 1982).



2) Indicative rates of soil organic carbon sequestration (Batjes 2004).

Table 2. Indicative rates of carbon sequestration (t ha^{-1} yr^{-1}) by agro-climatic zone upon introduction of improved management within croplands in Kenya.

ACZ[a]	C sequest. rate[b]
I–II	0.30–0.50
III–IV	0.15–0.30
V–VI	0.05–0.15
VII	0–0.05

[a]Key to agro-climatic zones is given in Table 1. [b]Indicative rates based on data from Bruce *et al.* (1999b), Sampson and Scholes (2000) and Lal (2002).

3) Mean organic carbon content for Acrisols

Table 2 Mean organic carbon contents for four depth intervals by FAO–UNESCO soil units/kg m^{-2}

	0–30 cm			0–50 cm			0–100 cm			0–200 cm		
Soil unit	Mean	CV	*n*	Mean	CV	*n*	Mean	CV	*n*	Mean	CV	*n*
Acrisols	5.1	83	309	6.7	84	302	9.4	82	269	10.4	113	56
Ferric	3.7	65	122	4.8	59	120	6.7	49	104	6.8	49	23
Gleyic	6.2	97	19	7.9	96	18	9.0	60	16	11.5	—	1
Humic	10.6	54	71	14.1	57	70	20.3	57	63	29.3	64	15
Orthic	3.7	52	63	5.0	46	60	7.1	43	55	7.3	40	12
Plinthic	5.1	64	34	6.8	63	34	9.2	59	31	6.5	82	5

Source: (Batjes 1996)

4) Molecular weights

C= 12 g/mol, O = 16 g/mol

1 g C = 3.664 g CO_2