Carbon Monitoring, Verification and Reporting

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NASA LCLUC Science Team Meeting

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Background: acronyms

- **MRV**
  - **Measurement, Reporting, Verification**
- **REDD/REDD+**
  - **Reducing Emissions from Deforestation and Forest Degradation**
  - **Plus (+) … carbon sequestration and social/ecological co-benefits**

  … carbon fluxes plus social and ecological co-benefits

What's driving the need for an MRV

- Forest carbon is risky business
  - Permanence and leakage
  - Robust and accurate measurements
- Need for assurances
  - Real and permanent carbon mitigation
  - Consistent, transparent and institutionalized

MRV Approaches: Ad hoc or Standardized?

- Accepted and standard MRV approach "pieces"
  - Combination of remote sensing and ground-based measurements
  - IPCC Tiered approach to forest biomass/carbon
  - Basic Measurement/Monitoring Protocol and Guidelines
    - IPCC GPG-LULUCF (2003)
    - AFOLU (2006)

MRV Approaches: Ad hoc or Standardized?

- MRV tools and technologies →no single turn-key approach
  - Remote sensing data and analysis
    - Optical data, radar data, lidar data
    - Discrete classification ← → Continuous fields classification
  - Scaling up ground-based measurements with remote sensing data

MRV Approaches: Ad hoc or Standardized?

Document, implement and report a project MRV approach and results

or …

Build an *integrated*, *flexible* and *transparent* system using Internet and geospatial tools and technologies

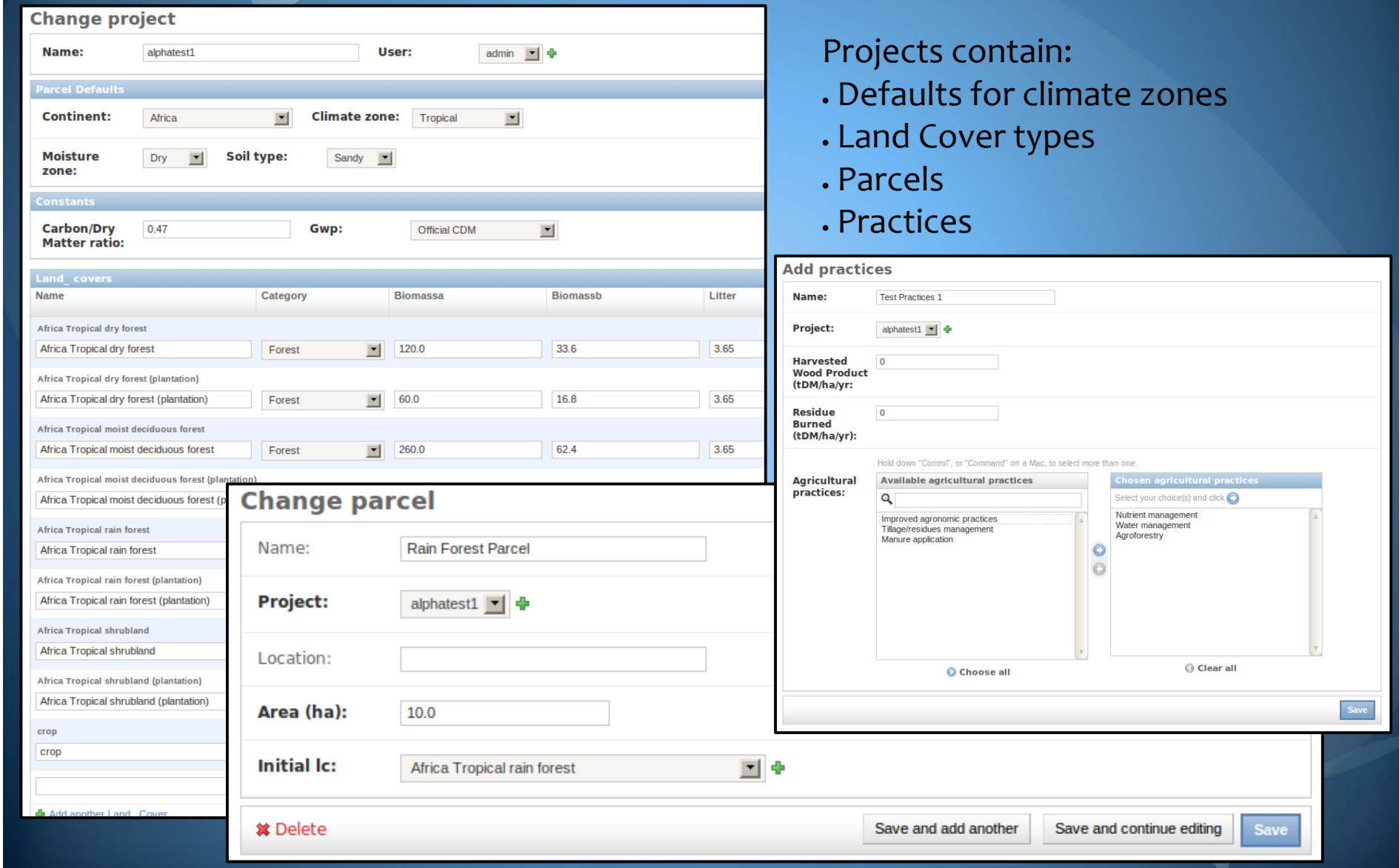
GOES MRV System

- Uses best practices and standard protocols
  - Robust and accurate (peer reviewed) remote sensing techniques
  - IPCC Tiered approach to biomass/carbon estimates
  - Multi-resolution integrated data: ground-based → very high resolution satellite data → medium resolution (large area) satellite data
- All forest carbon types
  - Intact forest and woodlands (deforestation/degradation)
  - Small-holder plantations and agroforestry (trees on farm)
- Integrated Internet-based technologies
  - Web-GIS, Database-driven, Google maps → mash-up
  - Visualization and reporting functionality
- Scalable from project level to national/regional level

Landscape indicators of carbon benefits

CBP Forest Carbon Module	Result	Core Indicators
Module 1 – Ex Ante Calculator	Estimate of future sequestration	tCO_2e to be sequestered
	Estimate of future reduced emissions	tCO_2e emissions to be reduced
Module 2 – Trees Outside Forests	Increased tree cover on non-forest land remaining as non-forest land	Changes in hectares with increasing canopy cover but still below forest threshold
	Enhanced carbon stocks on non-forest land	tCO_2e sequestered
	Cost effectiveness	tCO_2e sequestered / $ invested
Module 3 – Afforestation / Reforestation	Afforestation of non-forest land	Changes in hectares of non-forest land become forest land
	Enhanced carbon stocks on land not previously forest	tCO_2e sequestered
	Reforestation of degraded forest land	Changes in hectares of degraded forest land becoming fully stocked forest land
	Enhanced carbon stocks on degraded forest land	tCO_2e sequestered
	Cost effectiveness	tCO_2e sequestered / $ invested
Module 4 – Reducing Emissions from Deforestation and Degradation	Reduced deforestation	Changes in hectares of loss of natural forest cover
	Reduced degradation	Changes in hectares of forest degradation
	Reduced emissions from degradation and deforestation	tCO_2e emissions reduced
	Enhanced forest carbon stocks	tCO_2e sequestered
	Cost effectiveness	tCO_2e avoided / $ invested
Module 5 – Landscape Indicators of Carbon Benefits	Evaluation of land cover change	Land cover index
	Evaluation of trees outside forests	Tree crown area index
	Evaluation of carbon stock change	Carbon stock index
	Evaluation of forest fire occurrences	Fire risk index
	Evaluation of land cover change near high slopes or rivers	Watershed index
	Evaluation of Climate, Community, Biodiversity Alliance standards	Social, economic and biodiversity index

Project Admin Interface

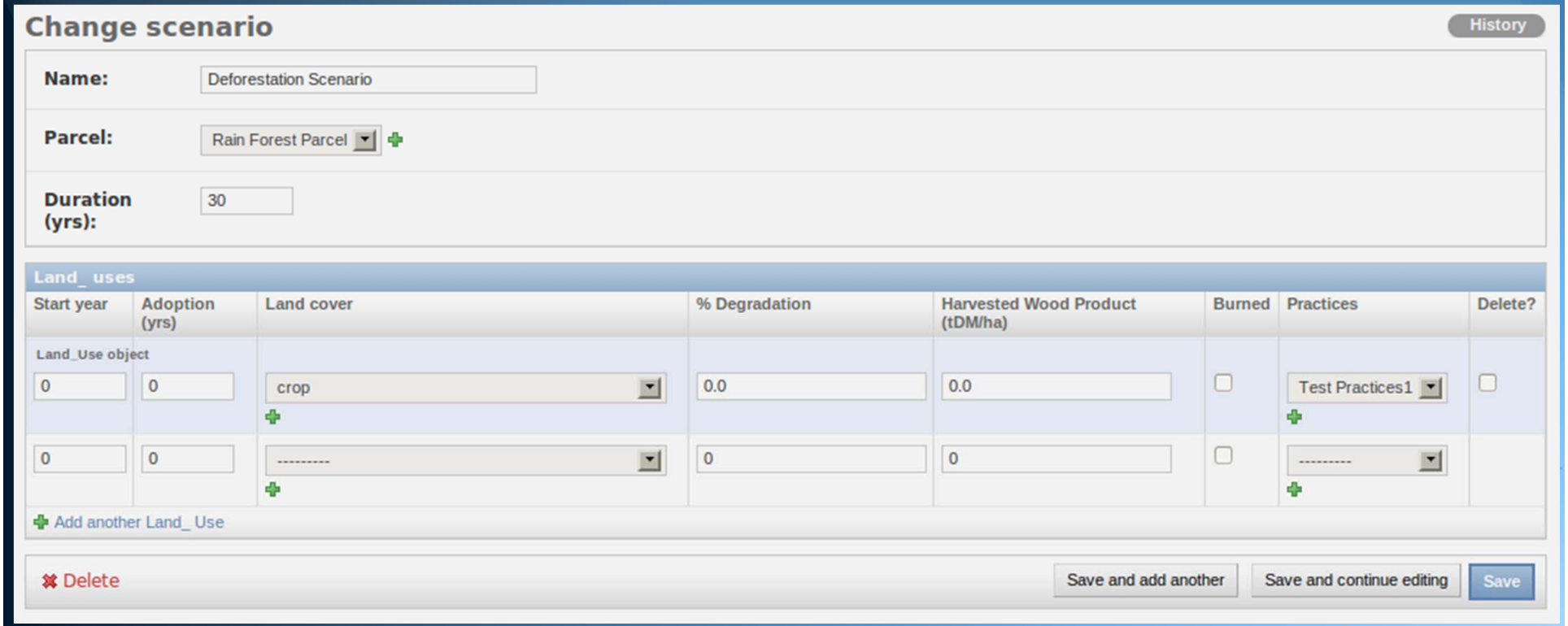


Projects contain:

- Defaults for climate zones
- Land Cover types
- Parcels
- Practices

Deforestation Scenario Example

- 30-year scenario on 'Rain Forest Parcel'
- Converted to annual crop at year 0
    - Practices performed annually for life of scenario



Deforestation Scenario Results

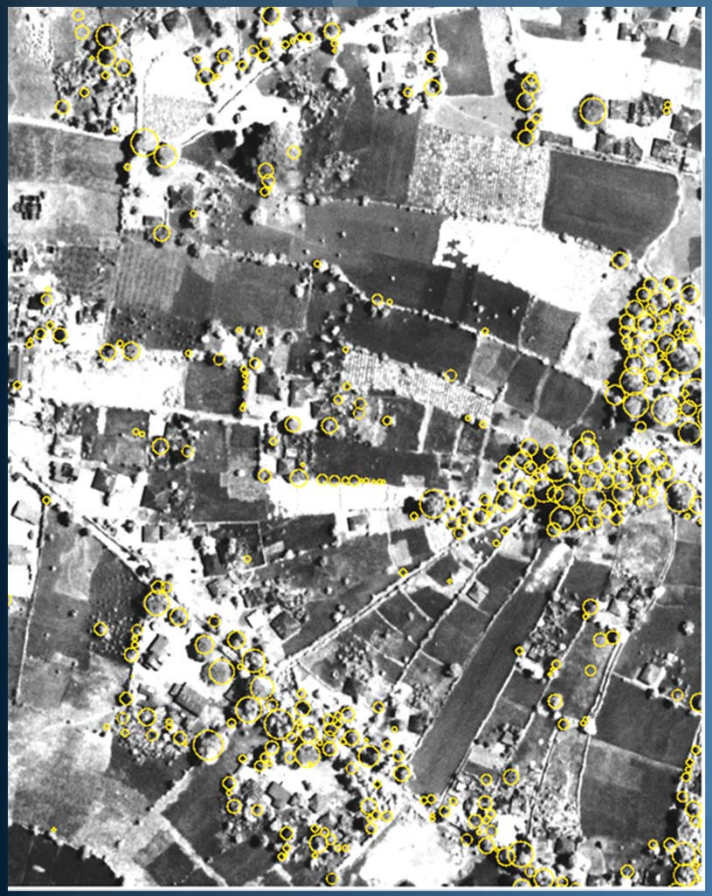
- Carbon stock pools created annually
- Carbon moved between pools, not removed/added

Select carbon pools to change Add carbon pools

Action: --------- Go 0 of 31 selected

Scenario	Year	Getbiomass	Getdeadcarbon	Getsoil	Getatmcarbon	Getatmch4	Getatmn2o	Getharvested
Deforestation Scenario	0	4247.0	36.5	310.0	0.0	0.0	0.0	0.0
Deforestation Scenario	1	400.0	0	314.5	4283.5	0.0	0.0	0.0
Deforestation Scenario	2	400.0	0	319.0	4283.5	0.0	0.0	0.0
Deforestation Scenario	3	400.0	0	323.5	4283.5	0.0	0.0	0.0
Deforestation Scenario	4	400.0	0	328.0	4283.5	0.0	0.0	0.0
Deforestation Scenario	5	400.0	0	332.5	4283.5	0.0	0.0	0.0
Deforestation Scenario	6	400.0	0	337.0	4283.5	0.0	0.0	0.0
Deforestation Scenario	7	400.0	0	341.5	4283.5	0.0	0.0	0.0
Deforestation Scenario	8	400.0	0	346.0	4283.5	0.0	0.0	0.0
Deforestation Scenario	9	400.0	0	350.5	4283.5	0.0	0.0	0.0
Deforestation Scenario	10	400.0	0	355.0	4283.5	0.0	0.0	0.0
Deforestation Scenario	11	400.0	0	359.5	4283.5	0.0	0.0	0.0
Deforestation Scenario	12	400.0	0	364.0	4283.5	0.0	0.0	0.0
Deforestation Scenario	13	400.0	0	368.5	4283.5	0.0	0.0	0.0
Deforestation Scenario	14	400.0	0	373.0	4283.5	0.0	0.0	0.0
Deforestation Scenario	15	400.0	0	377.5	4283.5	0.0	0.0	0.0
Deforestation Scenario	16	400.0	0	382.0	4283.5	0.0	0.0	0.0
Deforestation Scenario	17	400.0	0	386.5	4283.5	0.0	0.0	0.0
Deforestation Scenario	18	400.0	0	391.0	4283.5	0.0	0.0	0.0
Deforestation Scenario	19	400.0	0	395.5	4283.5	0.0	0.0	0.0
Deforestation Scenario	20	400.0	0	400.0	4283.5	0.0	0.0	0.0
Deforestation Scenario	21	400.0	0	400.0	4283.5	0.0	0.0	0.0
Deforestation Scenario	22	400.0	0	400.0	4283.5	0.0	0.0	0.0

Module 2: Trees Outside Forest



(0.6 m PAN Quickbird image of Western Kenya)

- Identify and measure individual trees in non-forest land cover including trees on farms, trees outside forest, grasslands, settlements, etc
- Requires fine resolution (<1m) satellite imagery (Quickbird, Worldview, etc)
- Requires modified allometry to relate crown attributes (crown projection area, crown diameter) to stem DBH or directly to AGB
- Map carbon in all trees within area of interest

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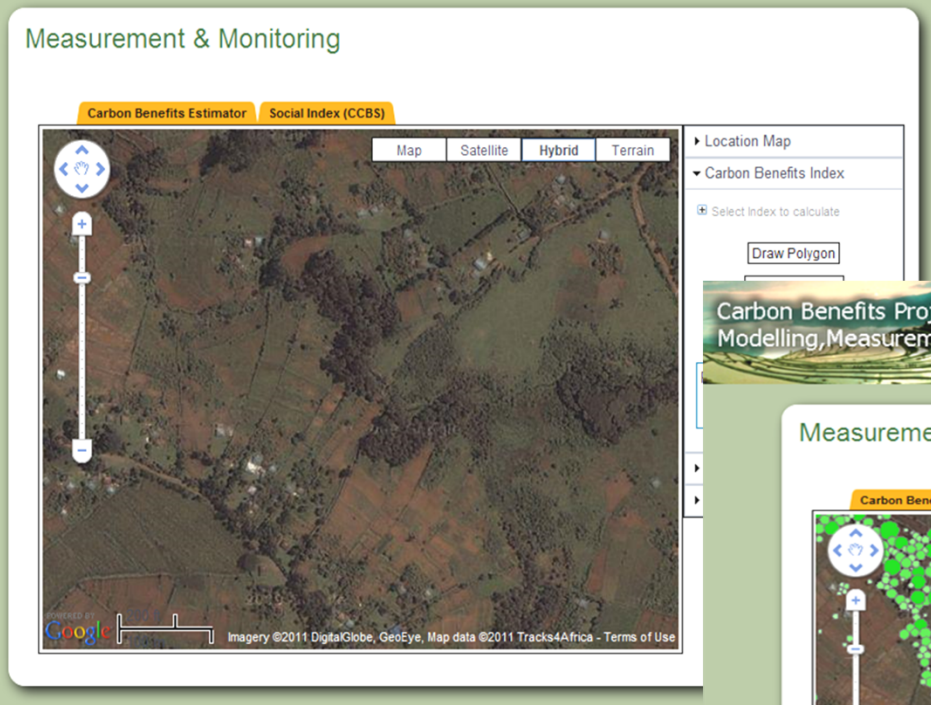
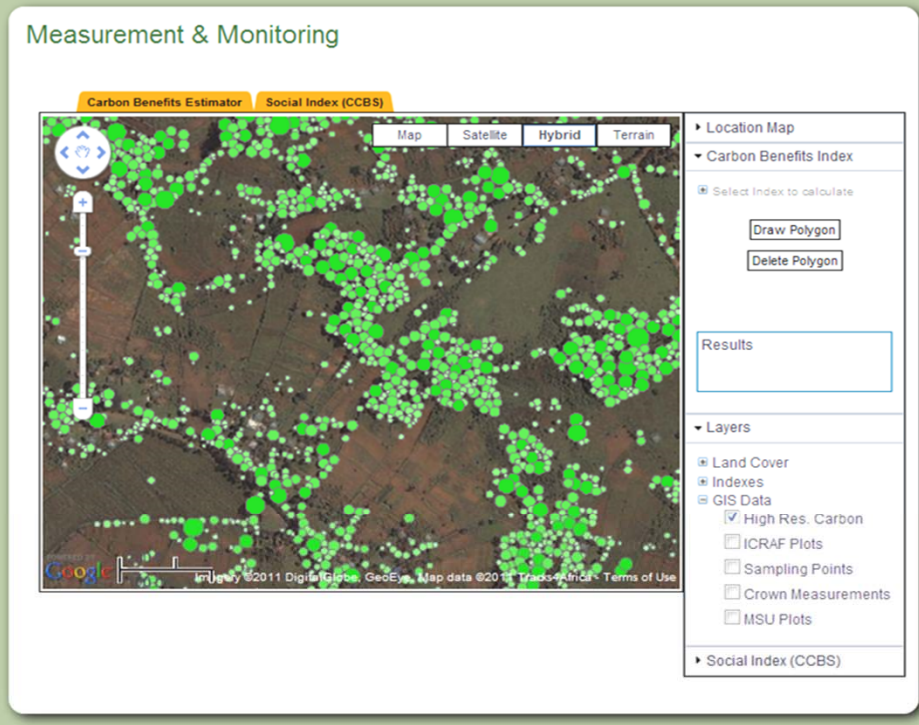
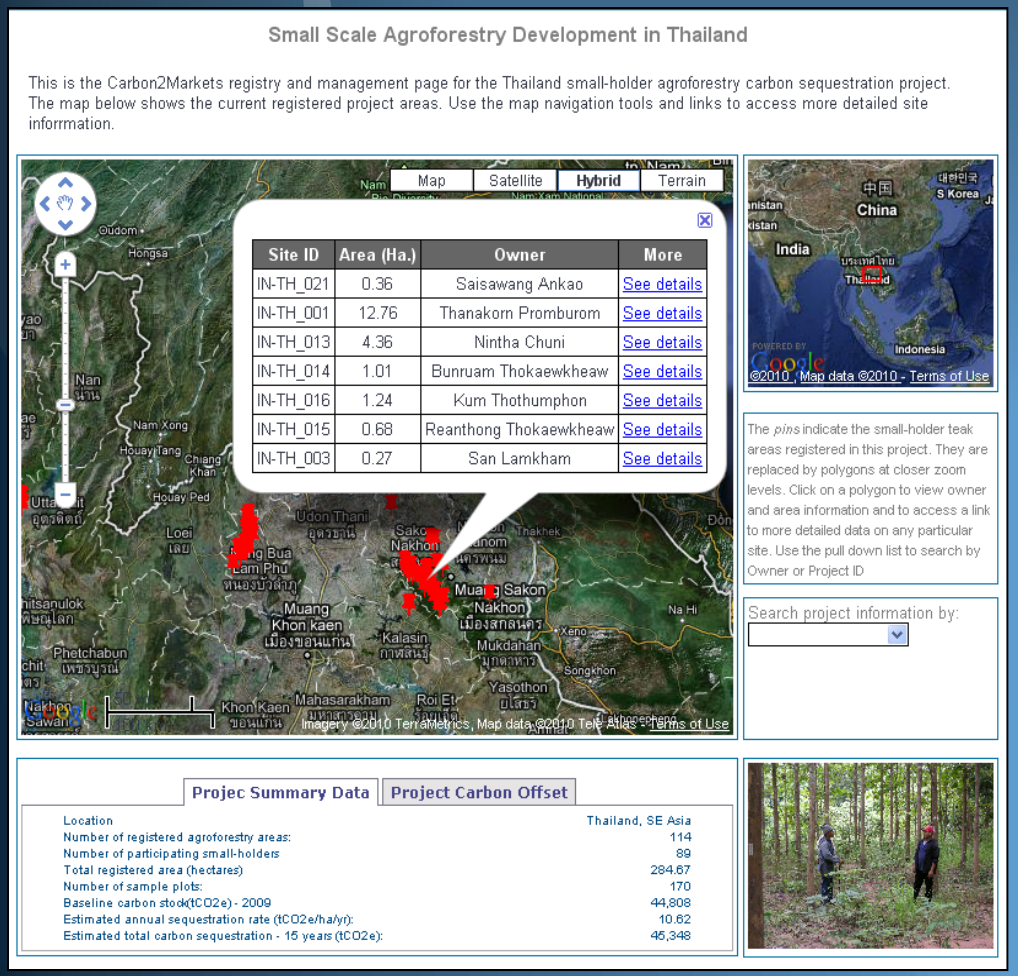
Agricultural landscape with scattered trees and small woodlots in western Kenya
~30 km NE of Kisumu





Trees identified on Quickbird imagery (0.6m)
Tree crowns measured by computer algorithm
Crown allometry to assign biomass to trees
Draw polygon over Area of Interest to sum the carbon in trees outside forest within AOI

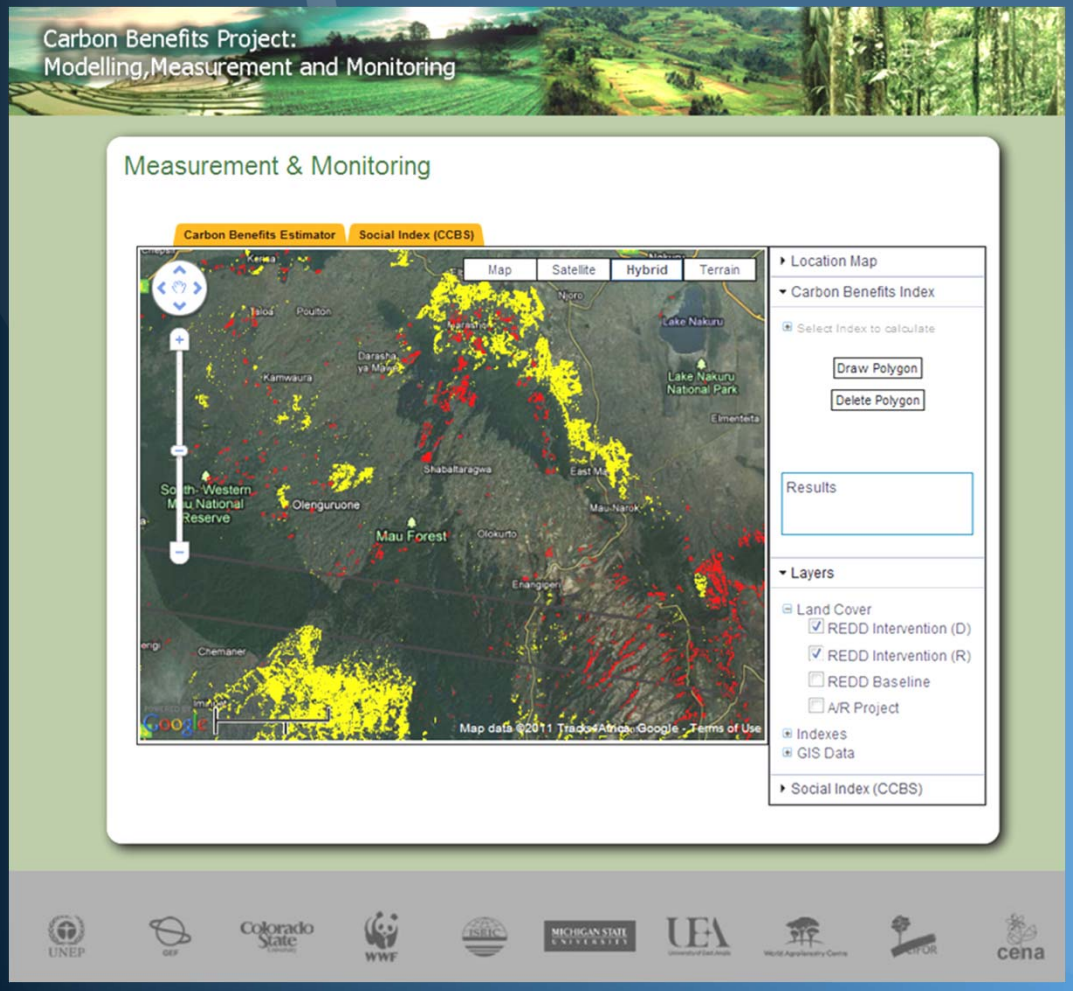
Module 3: Afforestation and Reforestation



- GIS for project boundaries
- Fine resolution (<1m) imagery for monitoring tree survival and growth
- Field sampling to determine biomass growth rates
- Online data management system to allow project participants to upload inventory data
- System uses inventory data to perform carbon calculations to show carbon sequestration in each forest stand and total project

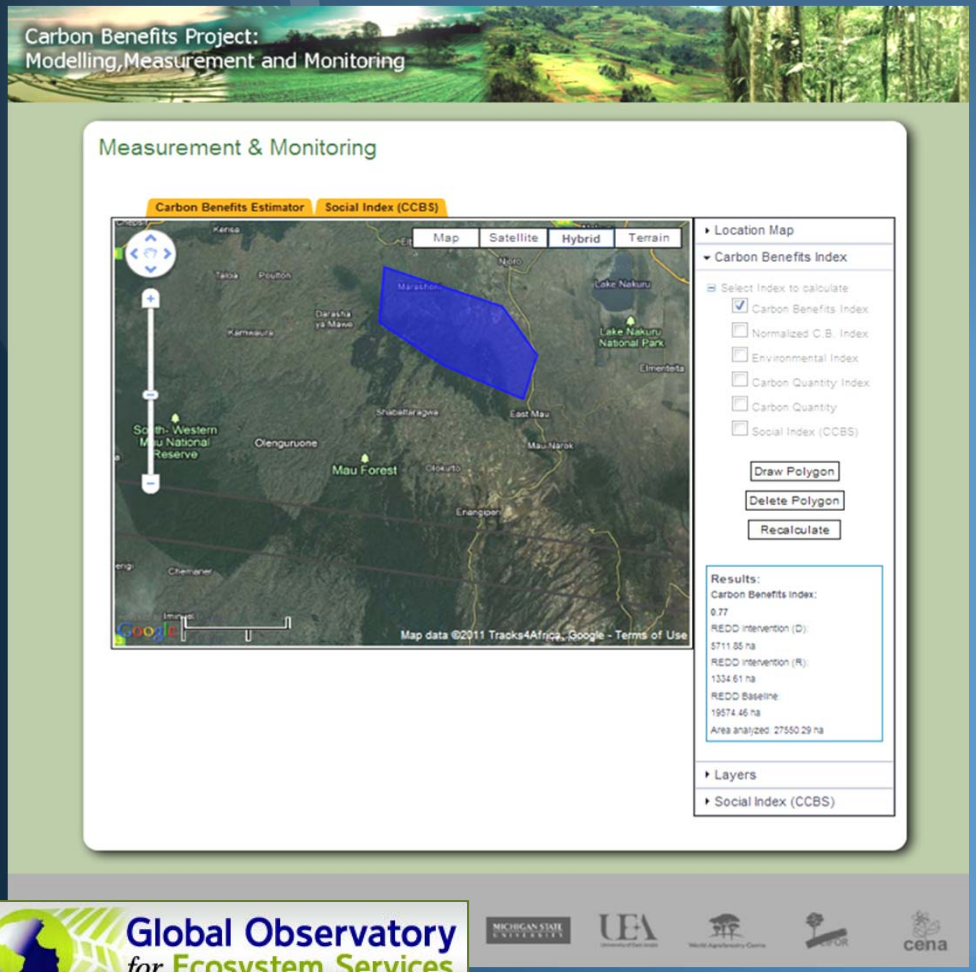
Global Observatory for Ecosystem Services

Module 4: Reducing Emissions from Deforestation and Degradation



- Identify and measure extent of forest land cover using 30 m Landsat imagery
- Determine deforestation rates using historical Landsat imagery
- Apply biomass to forest types using IPCC default values, national inventory data, or field sampling data specific to the project area
- Downscale forest biomass using fractional cover or disturbance index for degradation estimates
- Map carbon emissions in forest land cover change areas

Module 5: Indicators of Landscape Carbon Benefits



- Land Cover Change Index
  - deforestation or degradation
- Carbon Stock Index
  - deforestation with carbon density
- Fire Risk Index
  - fire occurrence in or near project area using MODIS data
- Environmental Index
  - deforestation with topography and watershed attributes
- Social and Biodiversity Index
  - Self assessment using CCBA standard metrics

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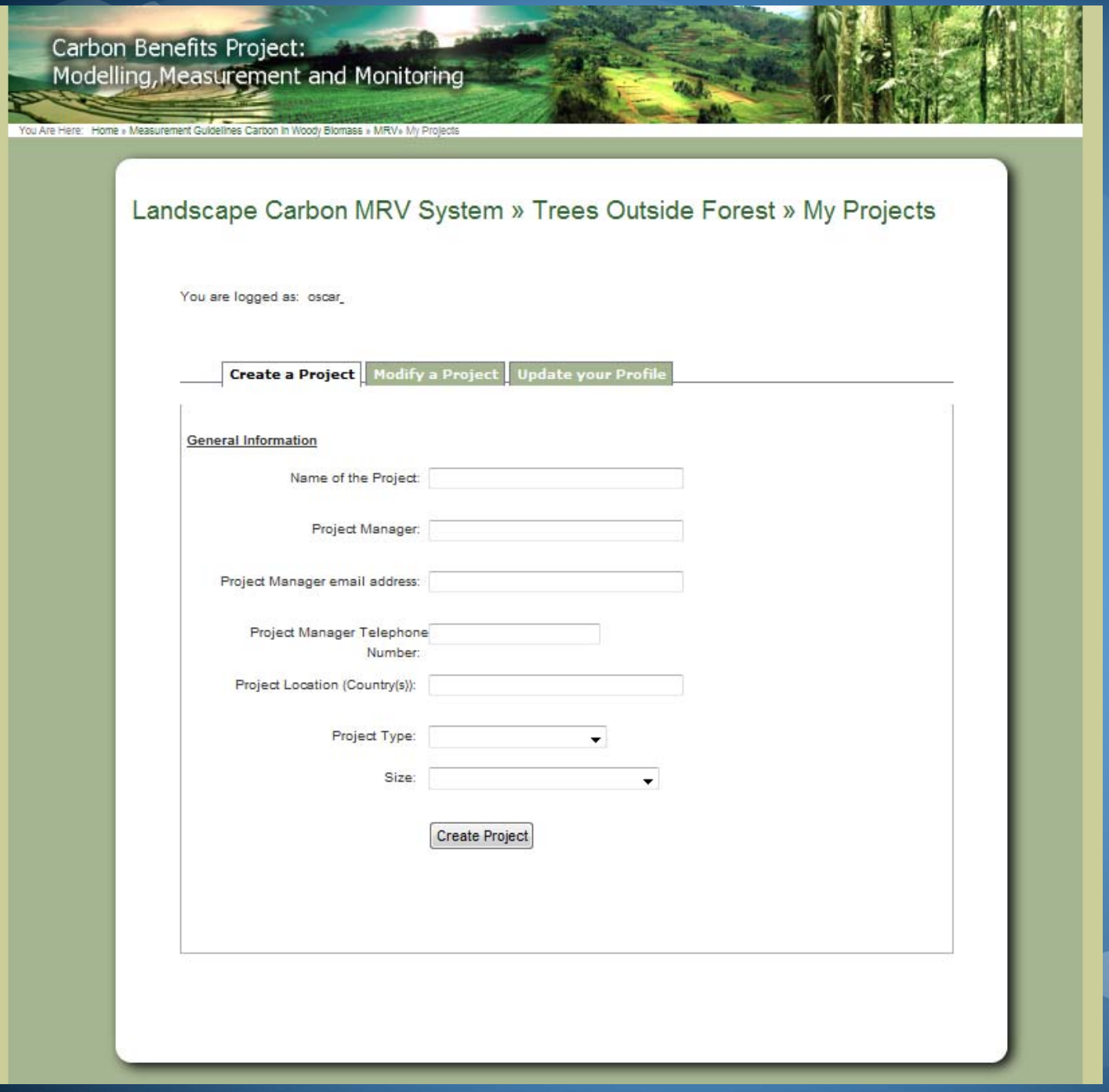
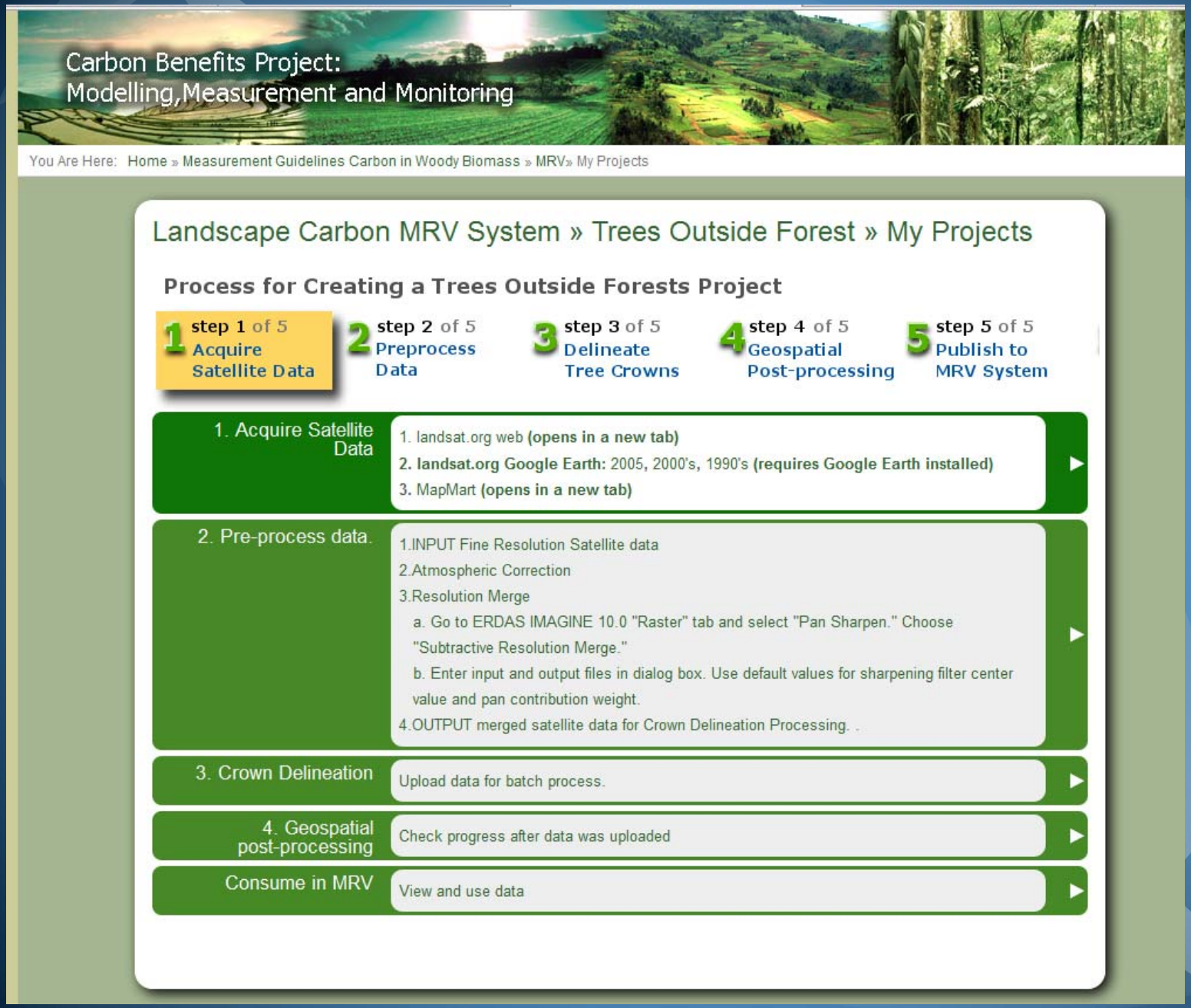


Start a Project



Work on Your Project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Carbon2Markets™ is a project of Michigan State University that focuses on combining value chains from carbon credits in the carbon financial markets and agro-forestry products for small holders in developing countries. Carbon2Markets™ provides accurate measurements of carbon sequestration from reforestation and agro-forestry land management activities using high resolution remote sensing data, web-GIS tools, and modeling. Our offset projects have repeat monitoring to ensure long-term storage of sequestered carbon. Our model of project development and monitoring enhances the ground measurements with measurements from earth observing satellites.
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A/R & Small-holder Plantations

Thailand: small-holder teak

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Publications

Carbon2Markets™ Prospectus
Greening the Globe through Carbon Sequestration
Released August 2007

Amazon Deforestation
A photo essay by Ricardo Funari
Released 2000

Other publications from Carbon2Markets™
Carbon2Markets™ has several publications available on the web through the Global Observatory for Ecosystem Services.

Downloads

Carbon2Markets™ project inventory KMZ file
To review more details on some of the more advanced Carbon2Markets™ projects download this KMZ file for your Google Earth thick client.

Carbon Offsets Project Thailand(Teak)

Access the MRV system for the small-scale agroforestry carbon offset project in Thailand.

- *283 ha small-holder tectona grandis*
- *Average size 2.9 ha*
- *114 stands in five provinces*
- *98 households*

Featured Projects

Carbon2Markets™ is currently developing and registering several projects in Africa, Southeast Asia and Latin America. Below is a brief listing of a few featured projects. These projects and others can be explored in greater depth using the map above or by downloading this KMZ file. To see an example of a detailed project management and measurement system for one site click here.

Viet Nam

Kien Lao and Cam Son Communes, Luc Ngan District, Bac Giang Province
The project area is located approximately 90 kilometers northeast of the capital city, Hanoi. The landscape Luc Ngan District is a mosaic of paddy rice in the lowlands, Litchi orchards, cassava, soybean and pineapple, and afforestation/reforestation in the upland areas. This Carbon2Markets™ project is centered on community-based agroforestry with Litchi and small-holder afforestation/reforestation (Acacia, Pine, and Eucalyptus) in collaboration with the Vietnamese Ministry of Agriculture and Rural Development.
Access the Luc Ngan Project

Thailand

Inpang Community Network - Northeast Thailand
The Inpang Community Network began in the mid 1980s with local farmers in Northeast Thailand embracing the tenants of the "Sufficiency Economy". As such, Inpang families have transformed a number of fields to diverse agro-forestry systems. The Inpang Community Network includes more than 4000 households in five provinces in Northeast Thailand. Inpang farmer's fields span a spectrum from small-holder single-species plantations to very complex multi-species, multi-aged, forest farms. Carbon2Markets is developing this project in cooperation with the Inpang Community Network and Mahasarakham University.
Access here

Lao PDR

Luang Prabang Province
Luang Prabang province is dominated by mountainous and hilly terrain. Since early 1990s many small-holders have planted Teak plantations on degraded hillsides. Carbon2Markets is developing this project in cooperation with the Luang Prabang Provincial Agriculture and Forestry Office and the Faculty of Forestry, National University of Laos.

Sangthong District, Vientiane Province
The model training forest is located approximately 60 kilometers northwest of Vientiane, the capital city. The model training forest includes multi-species plantations and assisted natural regeneration sites. Carbon2Markets is developing this project in collaboration with the Faculty of Forestry, National University of Laos, and four villages in the 4,800 ha training and demonstration

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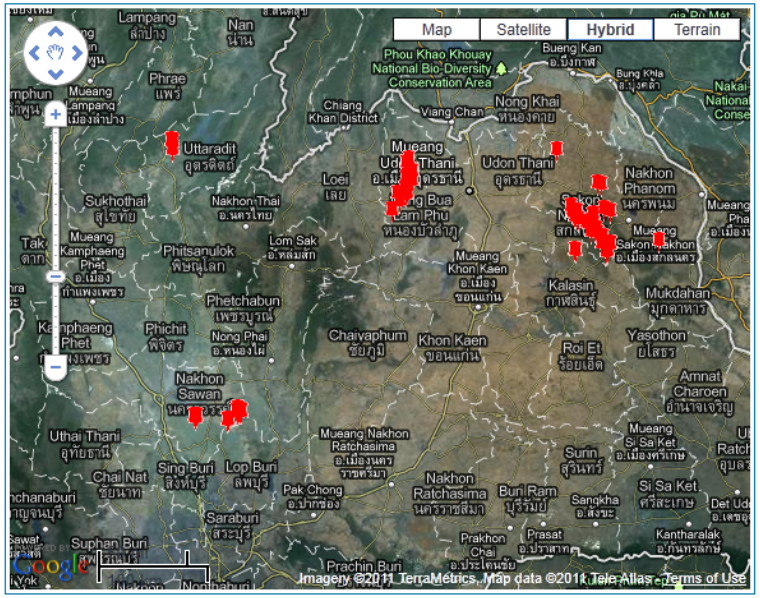
Small Scale Agroforestry Development in Thailand

This is the Carbon2Markets registry and management page for the Thailand small-holder agroforestry carbon sequestration project. The map below shows the current registered project areas. Use the map navigation tools and links to access more detailed site information.



The *pins* indicate the small-holder teak areas registered in this project. They are replaced by polygons at closer zoom levels. Click on a polygon to view owner and area information and to access a link to more detailed data on any particular site. Use the pull down list to search by Owner or Project ID

Search project information by:

Projec Summary Data | **Project Carbon Offset**

Location	Thailand, SE Asia
Number of registered agroforestry areas:	114
Number of participating small-holders	94
Total registered area (hectares)	289.79
Number of sample plots:	177
Baseline carbon stock(tCO2e) - 2009	44,808
Estimated annual sequestration rate (tCO2e/ha/yr):	10.62
Estimated total carbon sequestration - 15 years (tCO2e):	46,164

Generate a report with the most updated information on the project.

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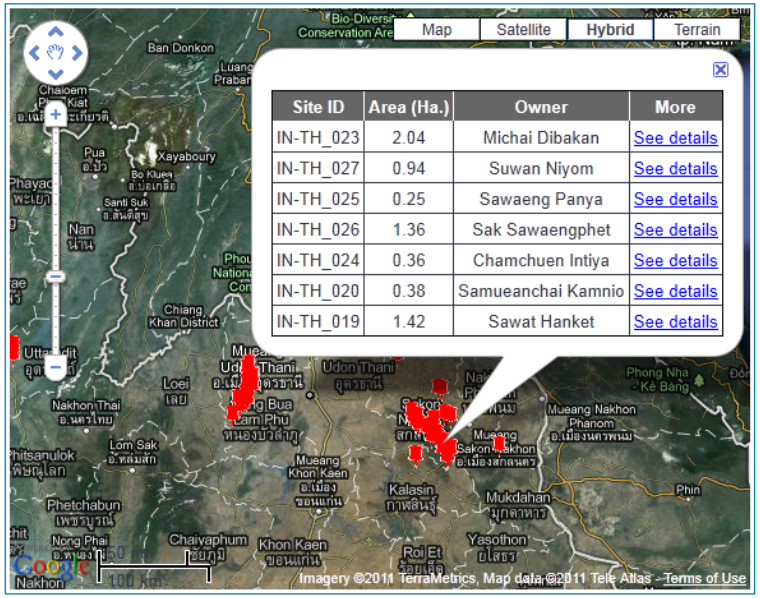

Site ID	Area (Ha.)	Owner	More
IN-TH_023	2.04	Michai Dibakan	See details
IN-TH_027	0.94	Suwan Niyom	See details
IN-TH_025	0.25	Sawaeng Panya	See details
IN-TH_026	1.36	Sak Sawaengphet	See details
IN-TH_024	0.36	Chamchuen Intiya	See details
IN-TH_020	0.38	Samueanchai Kamnio	See details
IN-TH_019	1.42	Sawat Hanket	See details

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How to:
Navigate with the map controls (zoom in/out, pan) or select map type at the top right.
Click once on the Sample Plot balloon to access plot level information and tree data.
Detail information about this agroforestry site is listed in the tabs below the map.
Legend Symbols
Corner Point of Sample Plot
Agroforestry Site
Site Information
Plot Details
Baseline Carbon Stock
Carbon Sequestration
Project ID
Agroforestry Site ID IN-TH_016
Area (hectares) 1.24
Land Use in 1990 Cassava
Tree Species Tectona grandis
Year Planted (AC) 1994
200
150
100
50
0
Y2 Y6 Y10 Y14
Ex-Ante Carbon Sequestration
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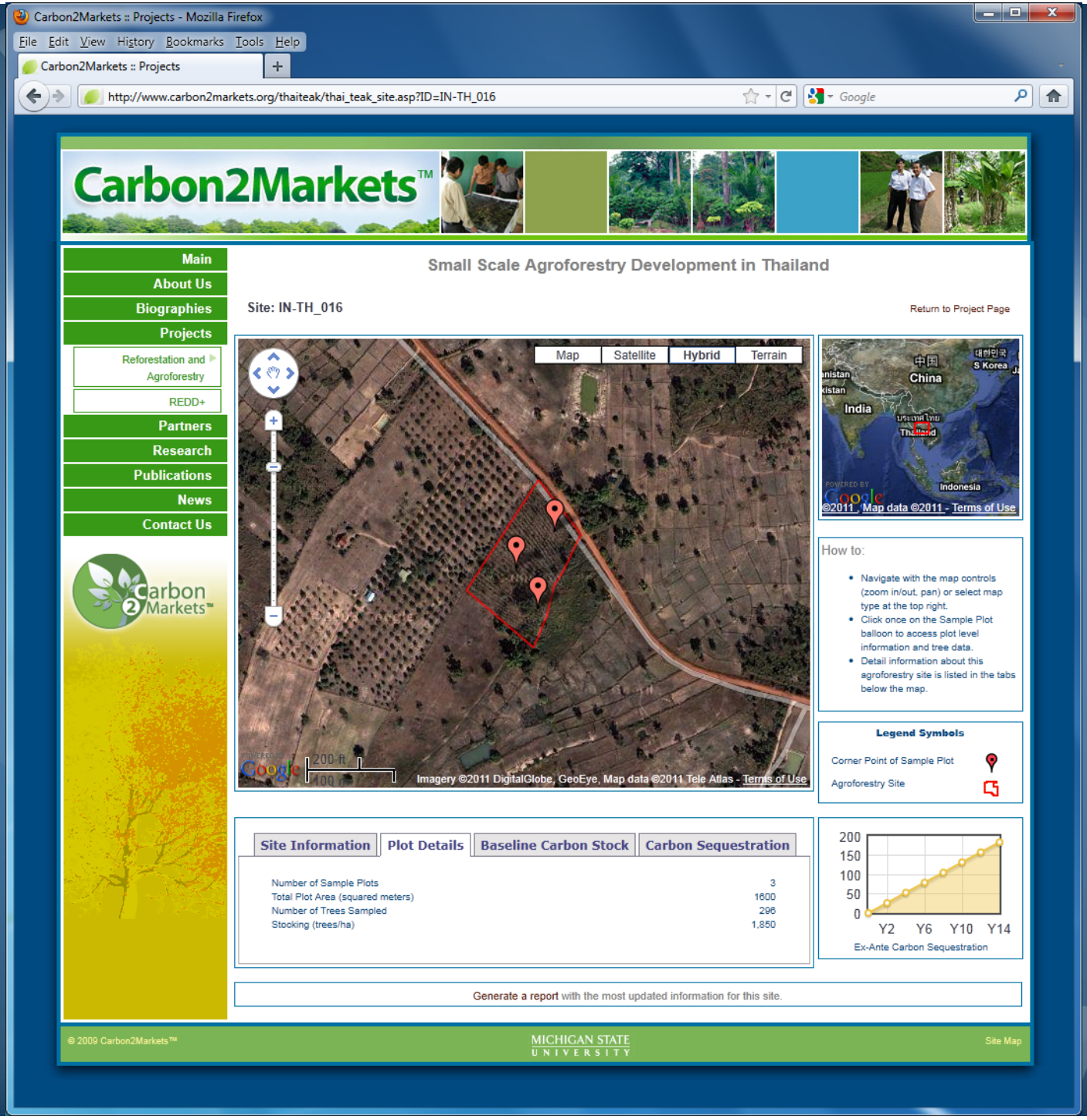
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Corner Point of Sample Plot
Agroforestry Site
Site Information
Plot Details
Baseline Carbon Stock
Carbon Sequestration
Number of Sample Plots 3
Total Plot Area (squared meters) 1600
Number of Trees Sampled 296
Stocking (trees/ha) 1,850
200
150
100
50
0
Y2 Y6 Y10 Y14
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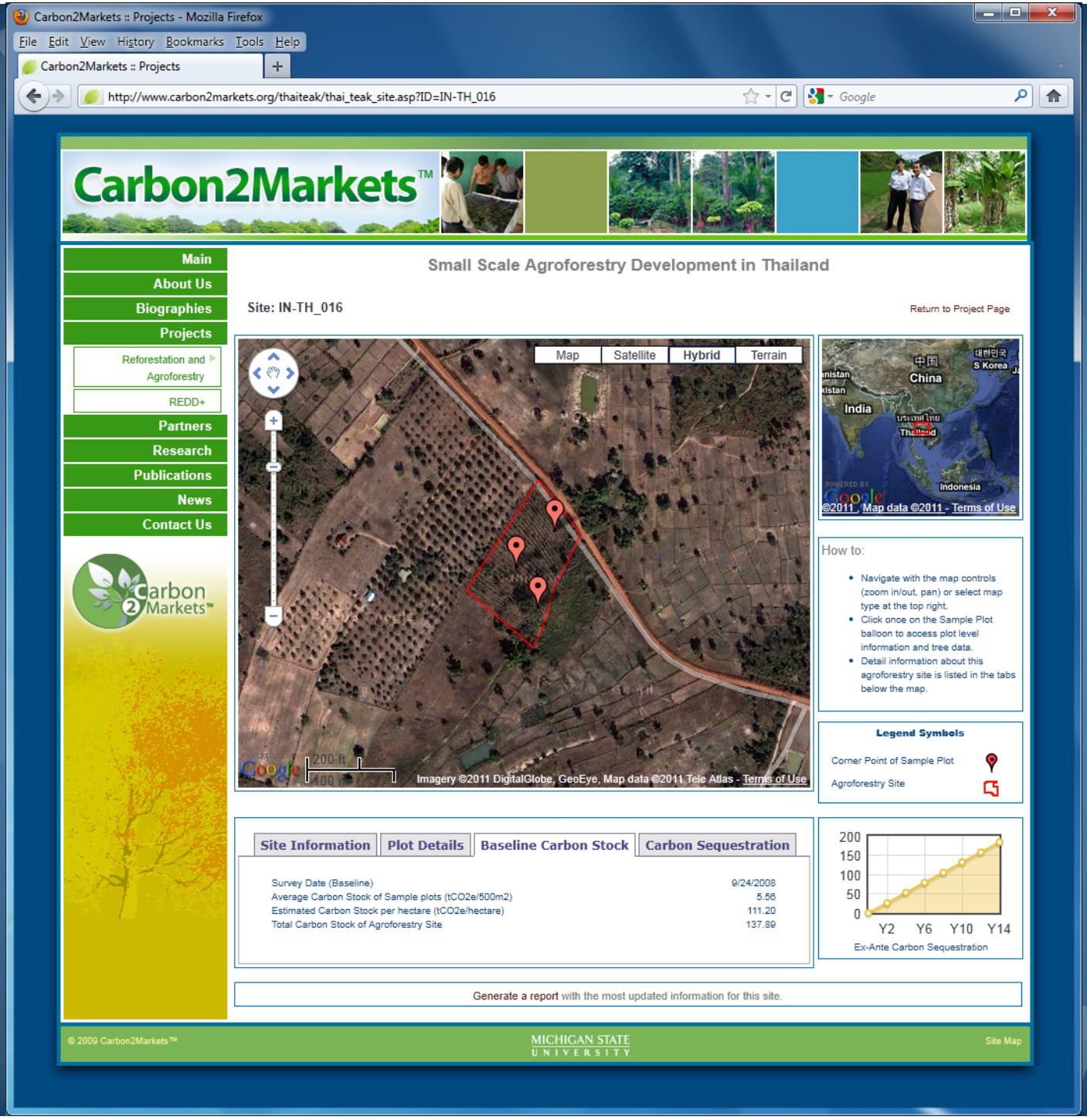
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Agroforestry Site
Site Information
Plot Details
Baseline Carbon Stock
Carbon Sequestration
Survey Date (Baseline) 9/24/2008
Average Carbon Stock of Sample plots (tCO2e/500m2) 5.56
Estimated Carbon Stock per hectare (tCO2e/hectare) 111.20
Total Carbon Stock of Agroforestry Site 137.89
200
150
100
50
0
Y2 Y6 Y10 Y14
Ex-Ante Carbon Sequestration
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Click once on the Sample Plot balloon to access plot level information and tree data.
Detail information about this agroforestry site is listed in the tabs below the map.
Legend Symbols
Corner Point of Sample Plot
Agroforestry Site
Site Information
Plot Details
Baseline Carbon Stock
Carbon Sequestration
Baseline Year 2009
Baseline Carbon Stock (tCO2e) 137.89
Sequestration Rate (tCO2e/ha/year) 10.62
Year 5 - 2014 (tCO2e) 65.84
Year 10 - 2019 (tCO2e) 131.69
Year 15 - 2024 (tCO2e) 197.53
200
150
100
50
0
Y2 Y6 Y10 Y14
Ex-Ante Carbon Sequestration
Generate a report with the most updated information for this site.
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http://www.carbon2markets.org/thaiteak/thai_teak_plot.asp?plot=IN-TH_016_03&site_ID=IN-TH_016

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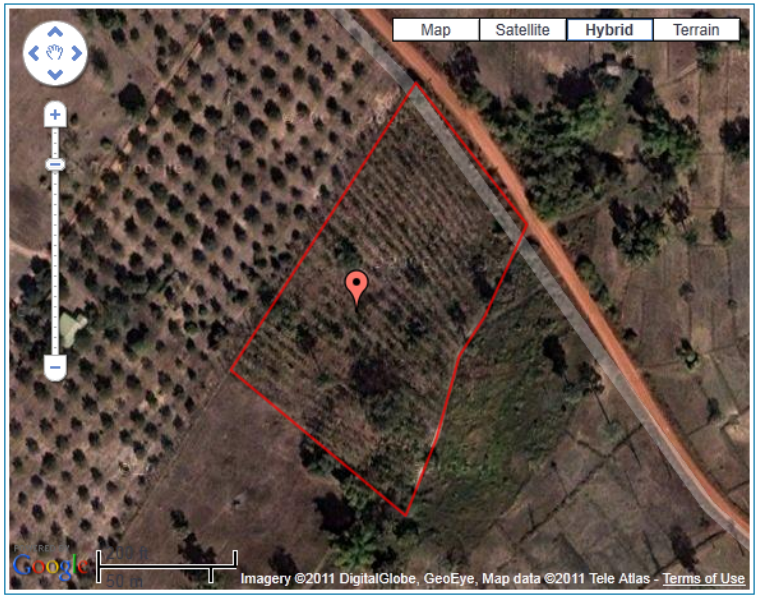
Small Scale Agroforestry Development in Thailand

Site: IN-TH_016 / Plot: IN-TH_016_03

Return to: Project Page > Site IN-TH_016



How to:

- Navigate with the map controls (zoom in/out, pan) or select map type at the top right.
- Click once on the Sample Plot balloon to access plot level information and tree data.
- Detail information about this agroforestry site is listed below the map.

Legend Symbols

Corner Point of Sample Plot

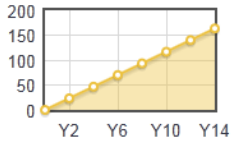
Agroforestry Site

Plot ID: IN-TH_016_03

Project ID	
Agroforestry Site ID	IN-TH_016
Plot Dimensions (meters.)	22x25
Plot Area (m2)	550
Corner point Coordinate (Latitude in DD)	17.0694
Corner point Coordinate (Longitud in DD)	103.8693
Total Trees	71
Baseline Carbon in Plot (tCO2)	2.04

Ex ante year by year (tCO2)

See graph in the right panel →



Full size graph here

Generate a report with the most updated information for this plot.

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http://www.carbon2markets.org/thaiteak/thai_teak_plot_tree_level.asp?plot=IN-TH_016_03&site_ID=IN-TH_016

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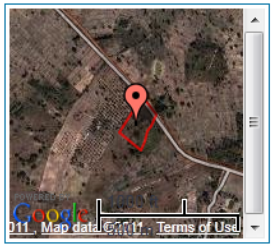
Small Scale Agroforestry Development in Thailand

Site: IN-TH_016 / Plot: IN-TH_016_03

Return to: Project Page > Site IN-TH_016

	Tree ID	Height (m)	Circumference (cm.)	DBH (cm)	AG Bio (t)	AG C (t)	BG C (t)	AG CO2e (t)	BG CO2e (t)	TOT CO2e (t)
1	IN1-16-3-1	8	32.50	10.35	0.0182	0.0091	0.03343	0.0050	0.0185	0.05190
2	IN1-16-3-2	8	29.60	9.43	0.0151	0.0076	0.02777	0.0042	0.0153	0.04302
3	IN1-16-3-3	4	11.50	3.66	0.0012	0.0006	0.00214	0.0004	0.0014	0.00357
4	IN1-16-3-4	4	20.00	6.37	0.0035	0.0017	0.00641	0.0010	0.0037	0.01014
5	IN1-16-3-5	5	27.50	8.76	0.0082	0.0041	0.01505	0.0024	0.0088	0.02390
6	IN1-16-3-6	7	31.60	10.06	0.0151	0.0076	0.02769	0.0042	0.0152	0.04291
7	IN1-16-3-7	6	13.80	4.39	0.0025	0.0013	0.00459	0.0008	0.0028	0.00738
8	IN1-16-3-8	8	32.70	10.41	0.0185	0.0092	0.03384	0.0051	0.0186	0.05248
9	IN1-16-3-9	8	33.20	10.57	0.0190	0.0095	0.03488	0.0052	0.0190	0.05393
10	IN1-16-3-10	5	10.20	3.25	0.0011	0.0006	0.00211	0.0004	0.0014	0.00351
11	IN1-16-3-11	5	13.50	4.30	0.0020	0.0010	0.00367	0.0006	0.0023	0.00596
12	IN1-16-3-12	8	39.50	12.58	0.0269	0.0134	0.04925	0.0070	0.0255	0.07480
13	IN1-16-3-13	9	41.50	13.22	0.0333	0.0167	0.06108	0.0084	0.0309	0.09194
14	IN1-16-3-14	6	18.00	5.73	0.0042	0.0021	0.00778	0.0012	0.0044	0.01219
15	IN1-16-3-15	2	9.00	2.87	0.0004	0.0002	0.00066	0.0001	0.0005	0.00118
16	IN1-16-3-16	8	23.00	7.32	0.0092	0.0046	0.01683	0.0026	0.0096	0.02647
17	IN1-16-3-17	5	18.50	5.89	0.0037	0.0019	0.00685	0.0011	0.0040	0.01081
18	IN1-16-3-18	5	13.00	4.14	0.0019	0.0009	0.00341	0.0006	0.0021	0.00555
19	IN1-16-3-19	6	33.30	10.61	0.0144	0.0072	0.02637	0.0040	0.0147	0.04104
20	IN1-16-3-20	6	20.90	6.66	0.0057	0.0029	0.01046	0.0016	0.0057	0.01618
21	IN1-16-3-21	7	23.50	7.48	0.0084	0.0042	0.01538	0.0025	0.0090	0.02438
22	IN1-16-3-22	6	18.00	5.73	0.0042	0.0021	0.00778	0.0012	0.0044	0.01219
23	IN1-16-3-23	4	9.50	3.03	0.0008	0.0004	0.00147	0.0003	0.0010	0.00249
24	IN1-16-3-24	8	35.30	11.24	0.0215	0.0107	0.03940	0.0057	0.0208	0.06024
25	IN1-16-3-25	8	40.80	12.99	0.0287	0.0143	0.05253	0.0073	0.0268	0.07933
26	IN1-16-3-26	7	22.80	7.26	0.0079	0.0040	0.01449	0.0023	0.0086	0.02308
27	IN1-16-3-27	8	41.00	13.06	0.0289	0.0145	0.05304	0.0074	0.0270	0.08004
28	IN1-16-3-28	4	8.50	2.71	0.0006	0.0003	0.00118	0.0002	0.0008	0.00202
29	IN1-16-3-29	4	16.30	5.19	0.0023	0.0012	0.00427	0.0007	0.0026	0.00689
30	IN1-16-3-30	5	16.80	5.35	0.0031	0.0015	0.00566	0.0009	0.0033	0.00901
31	IN1-16-3-31	5	12.50	3.98	0.0017	0.0009	0.00315	0.0005	0.0020	0.00516
32	IN1-16-3-32	4	13.00	4.14	0.0015	0.0007	0.00273	0.0005	0.0018	0.00450
33	IN1-16-3-33	9	43.60	13.89	0.0367	0.0184	0.06737	0.0093	0.0340	0.10140
34	IN1-16-3-34	6	16.00	5.10	0.0034	0.0017	0.00616	0.0010	0.0036	0.00976
35	IN1-16-3-35	7	20.00	6.37	0.0061	0.0030	0.01117	0.0017	0.0061	0.01722
36	IN1-16-3-36	7	21.50	6.85	0.0070	0.0035	0.01289	0.0021	0.0079	0.02077
37	IN1-16-3-37	8	29.00	9.24	0.0145	0.0073	0.02666	0.0040	0.0148	0.04146
38	IN1-16-3-38	8	42.00	13.38	0.0304	0.0152	0.05564	0.0079	0.0288	0.08447
39	IN1-16-3-39	6	27.00	8.60	0.0095	0.0047	0.01739	0.0027	0.0099	0.02728
40	IN1-16-3-40	7	23.50	7.48	0.0084	0.0042	0.01538	0.0025	0.0090	0.02438
41	IN1-16-3-41	6	19.70	6.27	0.0051	0.0025	0.00930	0.0014	0.0052	0.01446
42	IN1-16-3-42	5	16.50	5.25	0.0030	0.0015	0.00546	0.0009	0.0032	0.00870
43	IN1-16-3-43	5	17.50	5.57	0.0033	0.0017	0.00614	0.0010	0.0036	0.00973
44	IN1-16-3-44	4	10.00	3.18	0.0009	0.0004	0.00162	0.0003	0.0011	0.00275
45	IN1-16-3-45	8	28.00	8.92	0.0136	0.0068	0.02487	0.0038	0.0140	0.03891
46	IN1-16-3-46	6	16.50	5.25	0.0036	0.0018	0.00655	0.0010	0.0038	0.01034
47	IN1-16-3-47	8	29.40	9.36	0.0149	0.0075	0.02740	0.0041	0.0151	0.04250
48	IN1-16-3-48	7	18.30	5.83	0.0051	0.0026	0.00937	0.0014	0.0052	0.01456

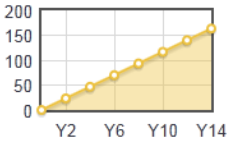


Legend Symbols

Corner Point of Sample Plot

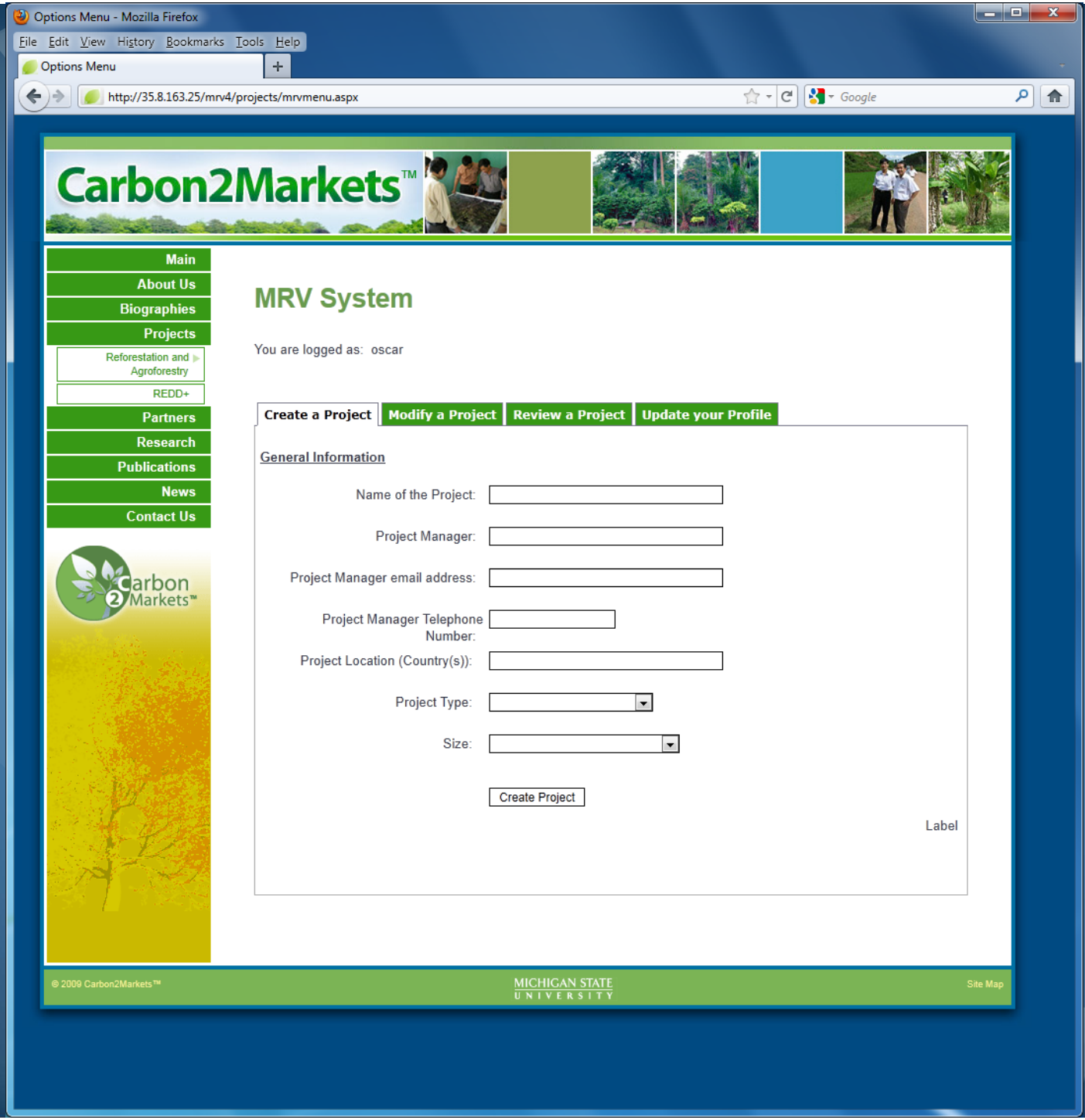
Agroforestry Site

Project Site ID	**IN-TH_016**
Plot Size (mts.)	**22x25**
Plot Area (m2)	**550**
Latitude	**17.0694**
Longitud	**103.8693**
Total Trees	**71**
Plot Baseline (tCO2)	**2.04**
Standarized Baseline	**1.85**



Ex-Ante Carbon Sequestration

Detailed graph here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Project Manager:
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Project Manager Telephone Number:
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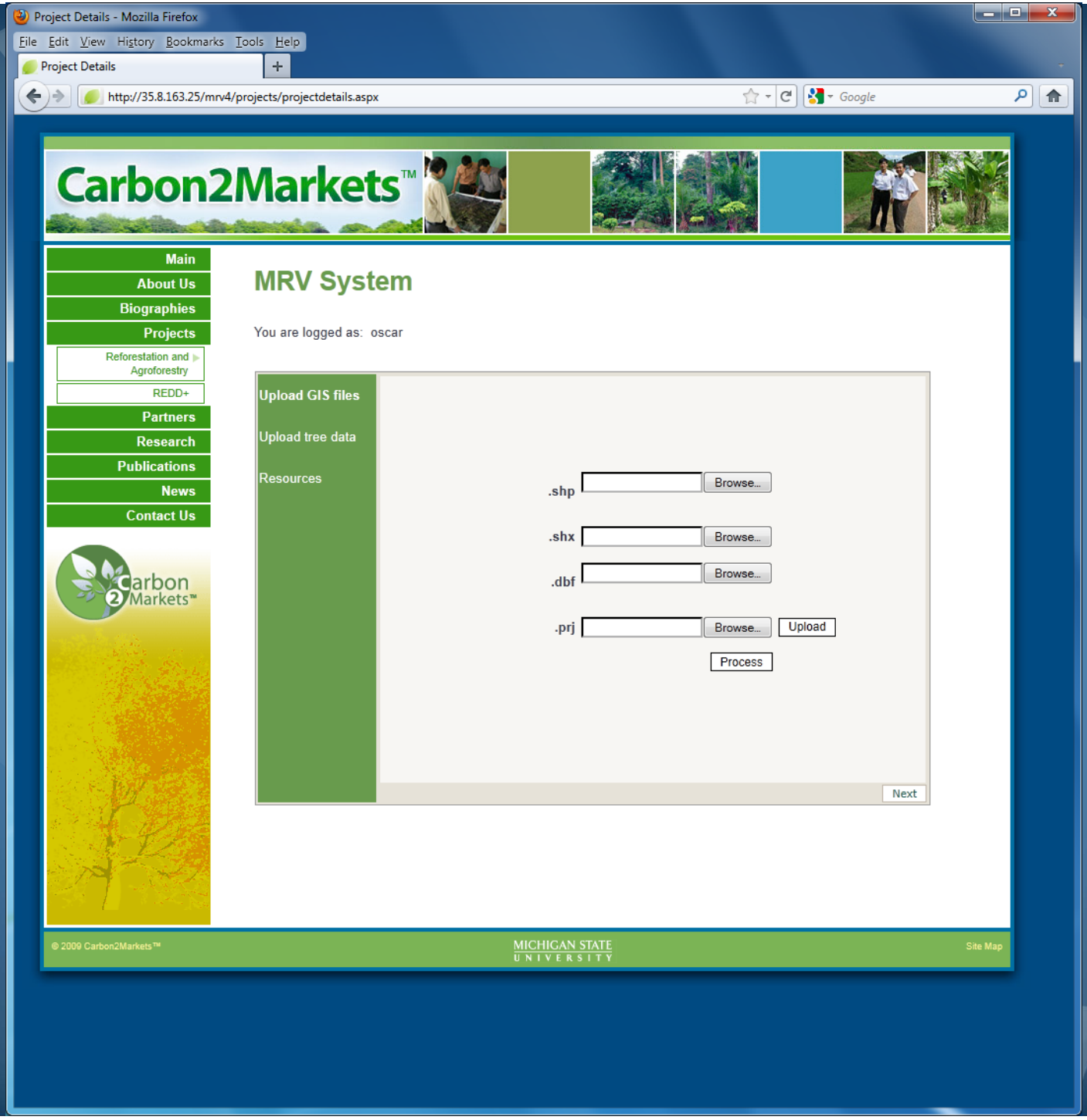
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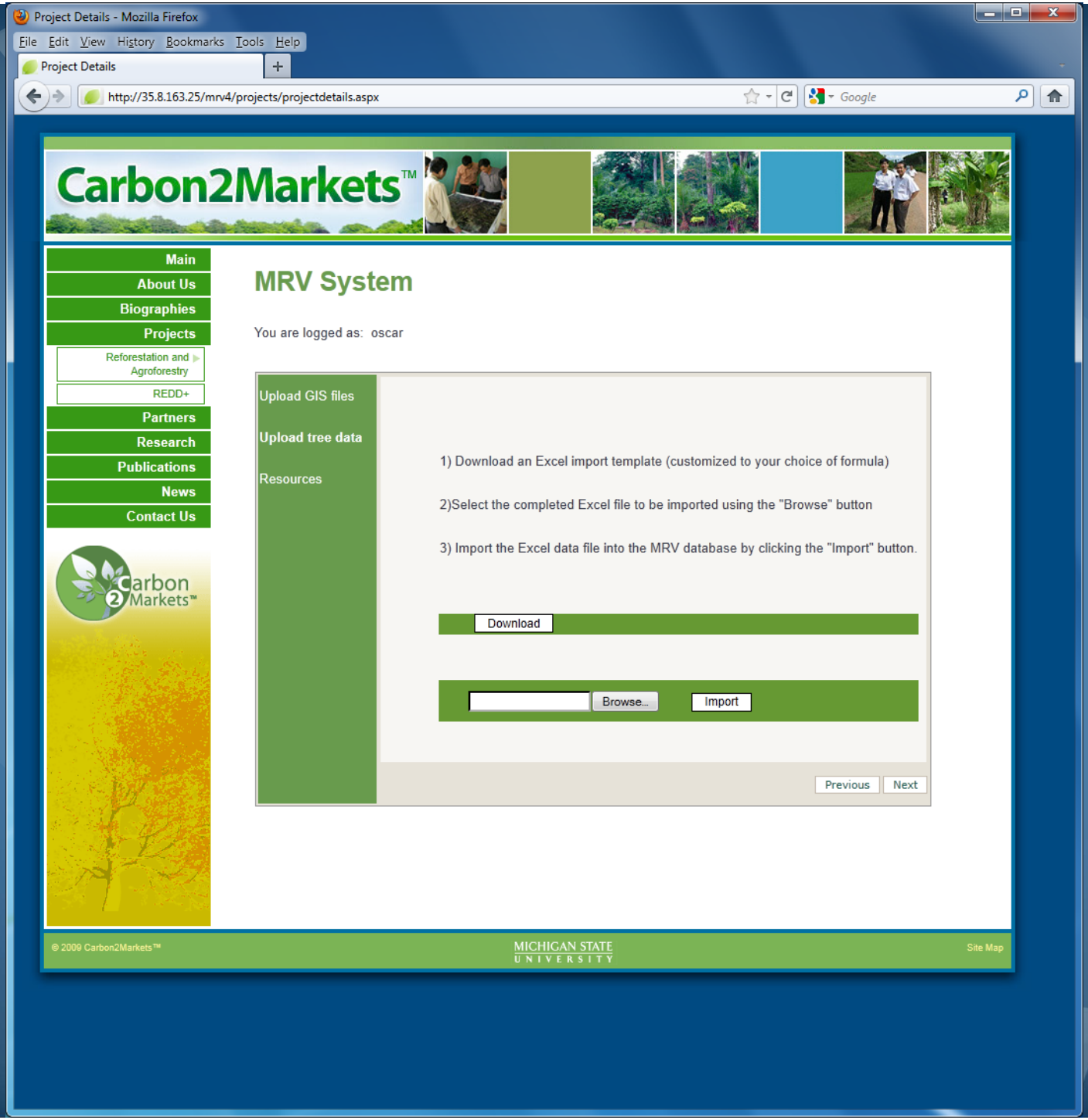
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MRV System
You are logged as: oscar
Upload GIS files
Upload tree data
Resources
1) Download an Excel import template (customized to your choice of formula)
2)Select the completed Excel file to be imported using the "Browse" button
3) Import the Excel data file into the MRV database by clicking the "Import" button.
Download
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Import
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Next
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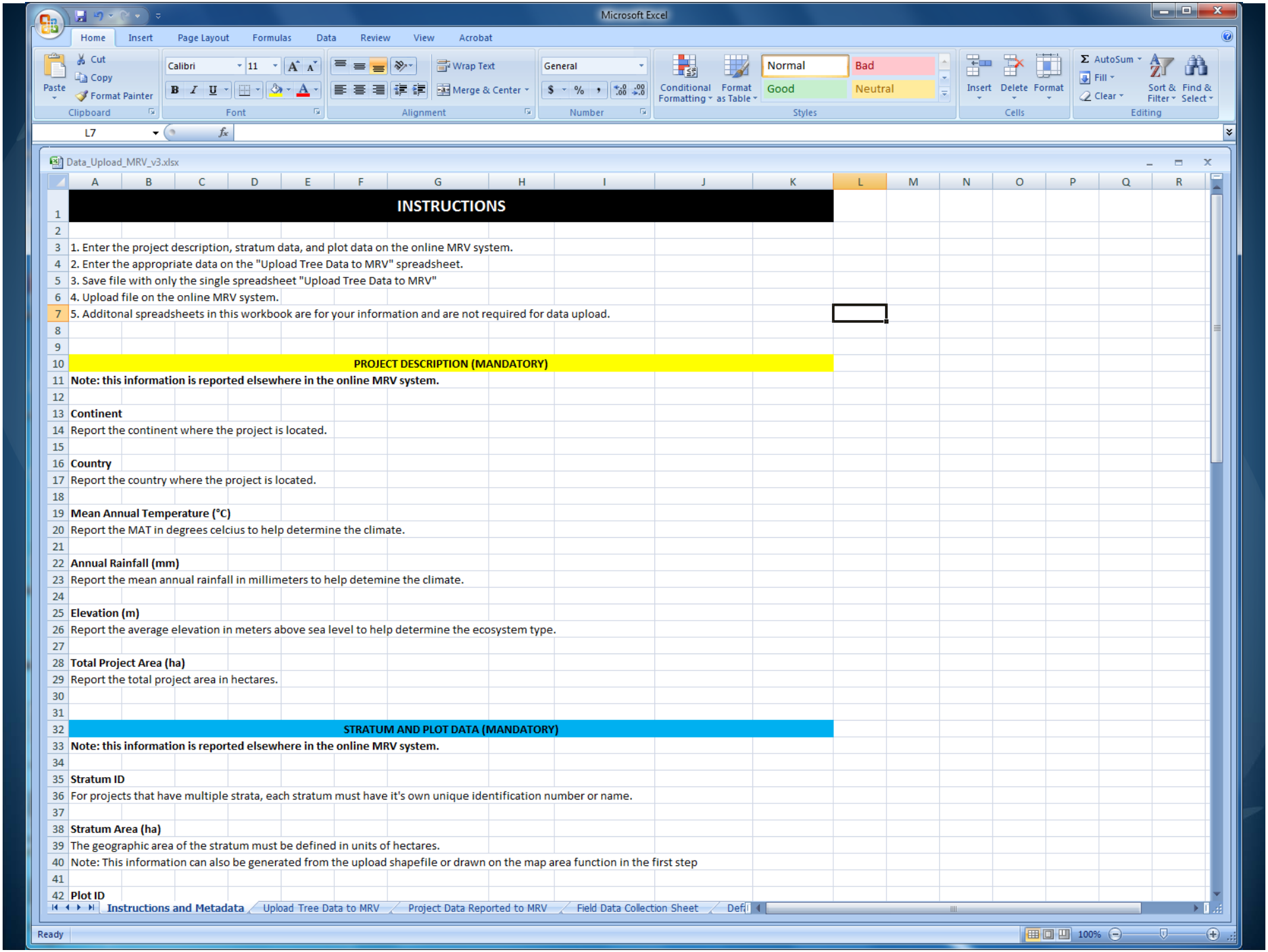
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Good
Neutral
Styles
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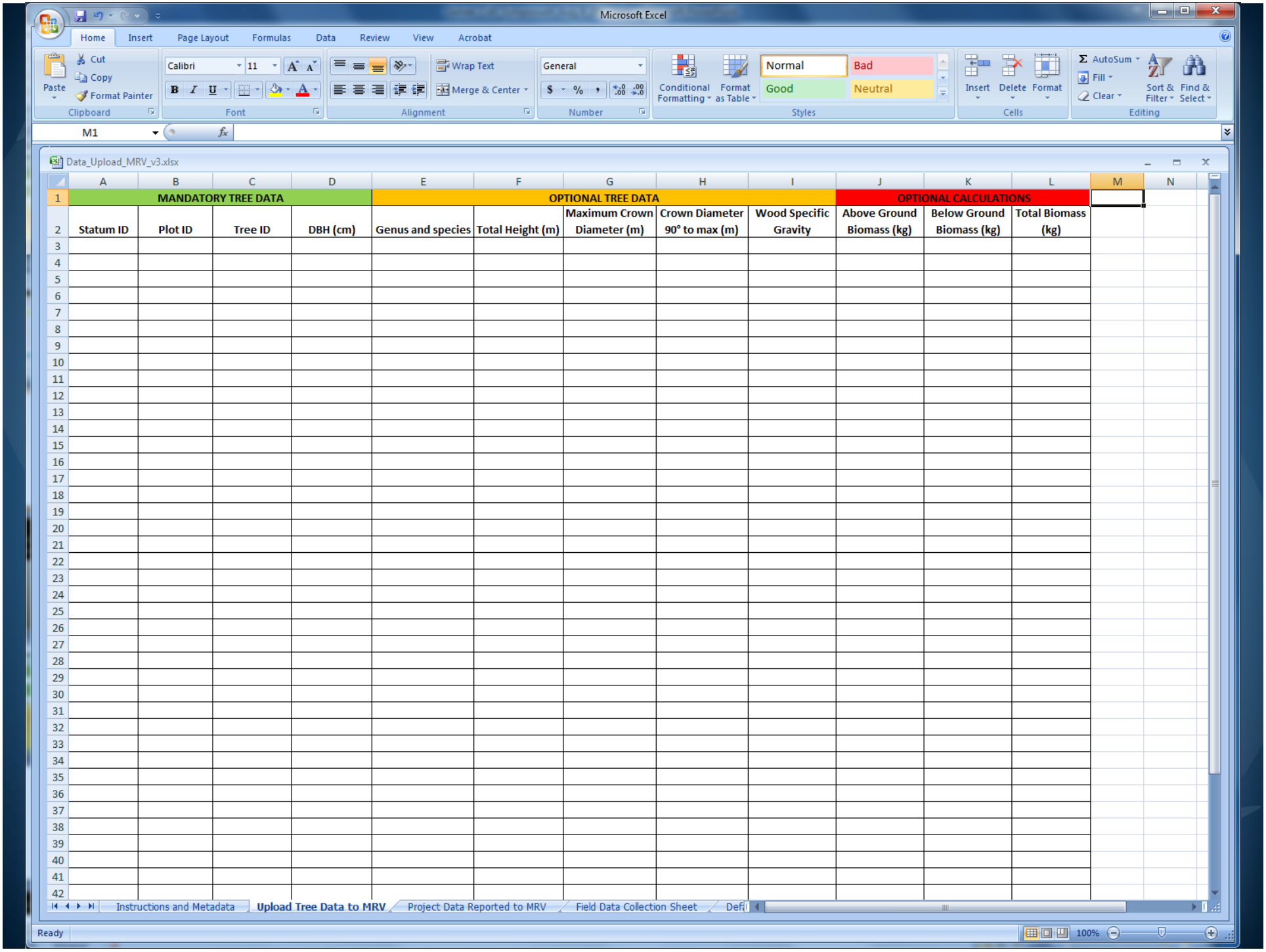
L7
Data_Upload_MRV_v3.xlsx
INSTRUCTIONS
1. Enter the project description, stratum data, and plot data on the online MRV system.
2. Enter the appropriate data on the "Upload Tree Data to MRV" spreadsheet.
3. Save file with only the single spreadsheet "Upload Tree Data to MRV"
4. Upload file on the online MRV system.
5. Additonal spreadsheets in this workbook are for your information and are not required for data upload.
PROJECT DESCRIPTION (MANDATORY)
Note: this information is reported elsewhere in the online MRV system.
Continent
Report the continent where the project is located.
Country
Report the country where the project is located.
Mean Annual Temperature (°C)
Report the MAT in degrees celcius to help determine the climate.
Annual Rainfall (mm)
Report the mean annual rainfall in millimeters to help detemine the climate.
Elevation (m)
Report the average elevation in meters above sea level to help determine the ecosystem type.
Total Project Area (ha)
Report the total project area in hectares.
STRATUM AND PLOT DATA (MANDATORY)
Note: this information is reported elsewhere in the online MRV system.
Stratum ID
For projects that have multiple strata, each stratum must have it's own unique identification number or name.
Stratum Area (ha)
The geographic area of the stratum must be defined in units of hectares.
Note: This information can also be generated from the upload shapefile or drawn on the map area function in the first step
Plot ID
Instructions and Metadata
Upload Tree Data to MRV
Project Data Reported to MRV
Field Data Collection Sheet
Ready
100%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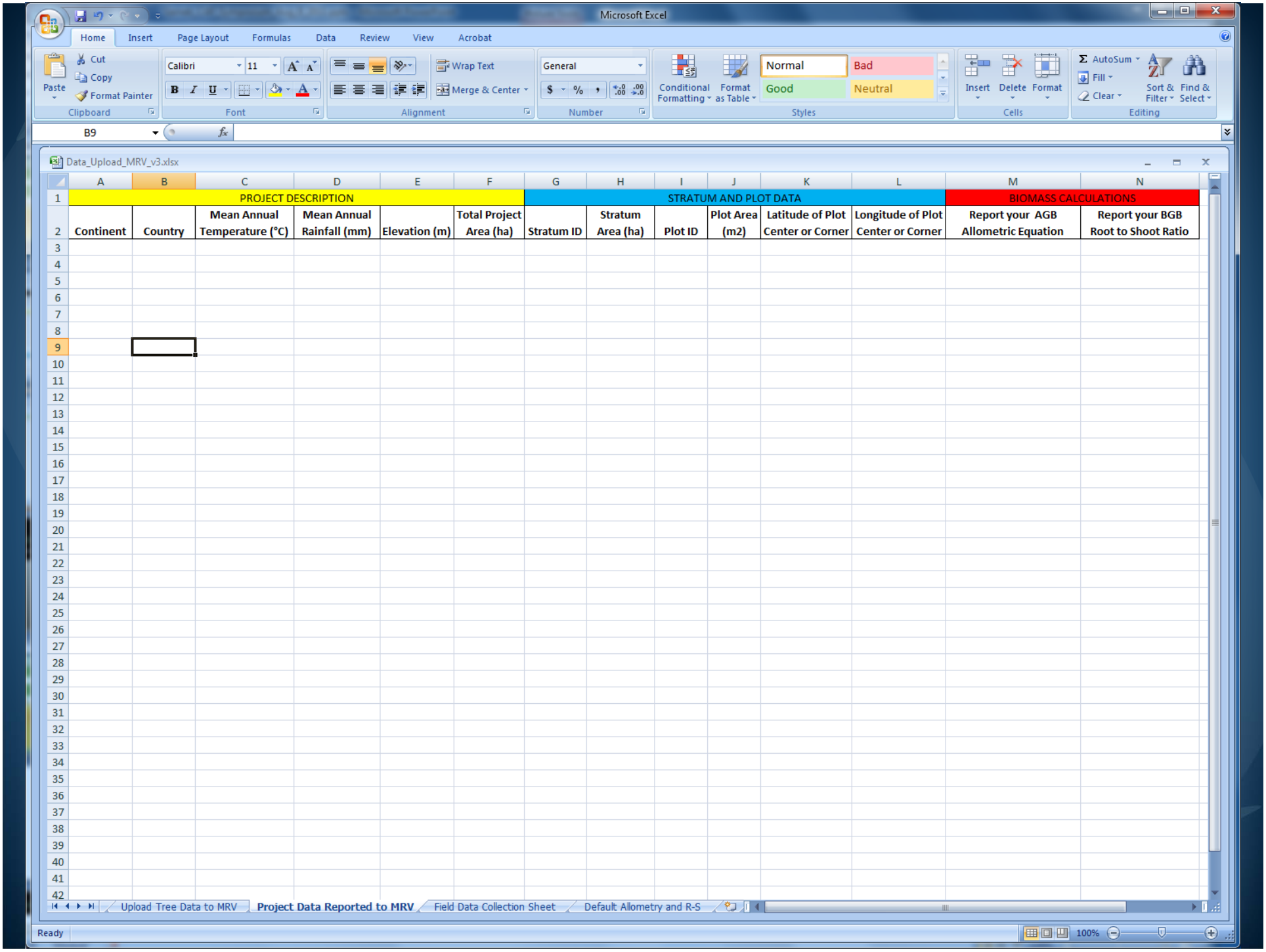
MANDATORY TREE DATA
OPTIONAL TREE DATA
OPTIONAL CALCULATIONS
Statum ID
Plot ID
Tree ID
DBH (cm)
Genus and species
Total Height (m)
Maximum Crown Diameter (m)
Crown Diameter 90° to max (m)
Wood Specific Gravity
Above Ground Biomass (kg)
Below Ground Biomass (kg)
Total Biomass (kg)
Instructions and Metadata
Upload Tree Data to MRV
Project Data Reported to MRV
Field Data Collection Sheet
Ready
100%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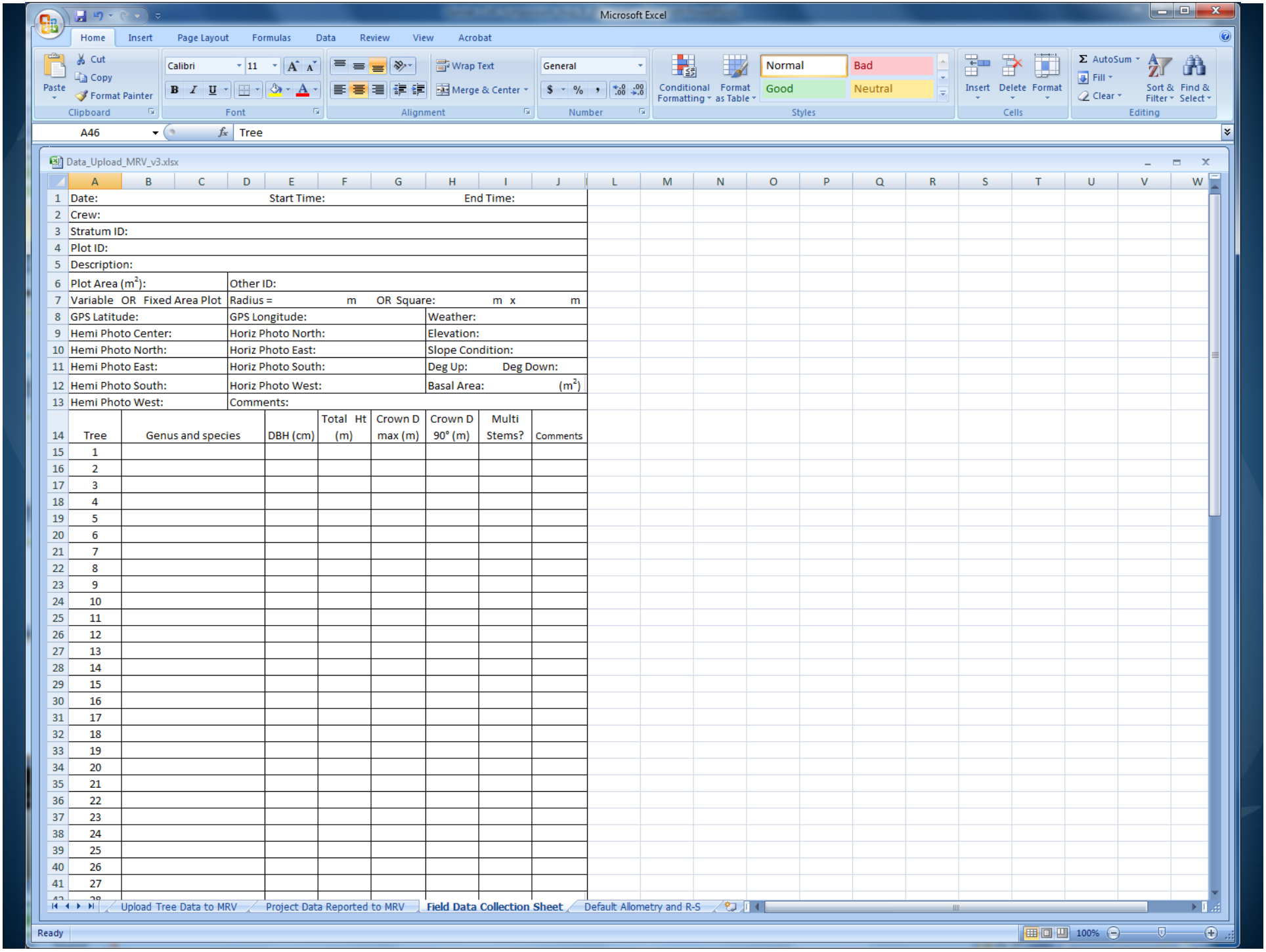
B9
Data_Upload_MRV_v3.xlsx
PROJECT DESCRIPTION
STRATUM AND PLOT DATA
BIOMASS CALCULATIONS
Continent
Country
Mean Annual Temperature (°C)
Mean Annual Rainfall (mm)
Elevation (m)
Total Project Area (ha)
Stratum ID
Stratum Area (ha)
Plot ID
Plot Area (m2)
Latitude of Plot Center or Corner
Longitude of Plot Center or Corner
Report your AGB Allometric Equation
Report your BGB Root to Shoot Ratio
Upload Tree Data to MRV
Project Data Reported to MRV
Field Data Collection Sheet
Default Allometry and R-S
Ready
100%



1	Date:			Start Time:			End Time:		
2	Crew:								
3	Stratum ID:								
4	Plot ID:								
5	Description:								
6	Plot Area (m^2):		Other ID:						
7	Variable OR Fixed Area Plot		Radius =	m	OR Square:		m x	m	
8	GPS Latitude:		GPS Longitude:			Weather:			
9	Hemi Photo Center:		Horiz Photo North:			Elevation:			
10	Hemi Photo North:		Horiz Photo East:			Slope Condition:			
11	Hemi Photo East:		Horiz Photo South:			Deg Up:	Deg Down:		
12	Hemi Photo South:		Horiz Photo West:			Basal Area:	(m^2)		
13	Hemi Photo West:		Comments:						
14	Tree	Genus and species	DBH (cm)	Total Ht (m)	Crown D max (m)	Crown D 90° (m)	Multi Stems?	Comments	
15	1								
16	2								
17	3								
18	4								
19	5								
20	6								
21	7								
22	8								
23	9								
24	10								
25	11								
26	12								
27	13								
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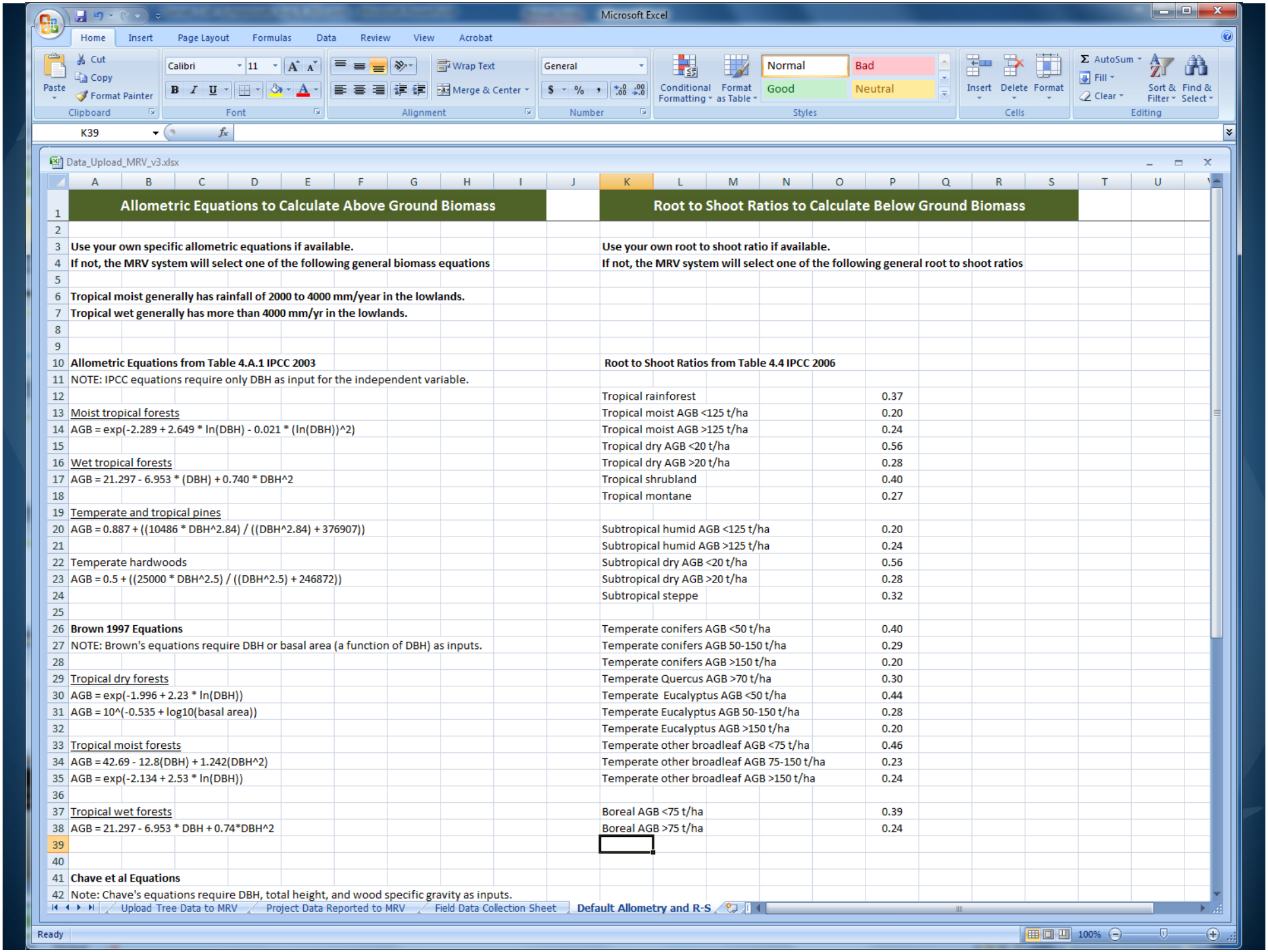

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	**Allometric Equations to Calculate Above Ground Biomass**										**Root to Shoot Ratios to Calculate Below Ground Biomass**										
2																					
3	**Use your own specific allometric equations if available.**										**Use your own root to shoot ratio if available.**										
4	**If not, the MRV system will select one of the following general biomass equations**										**If not, the MRV system will select one of the following general root to shoot ratios**										
5																					
6	**Tropical moist generally has rainfall of 2000 to 4000 mm/year in the lowlands.**																				
7	**Tropical wet generally has more than 4000 mm/yr in the lowlands.**																				
8																					
9																					
10	**Allometric Equations from Table 4.A.1 IPCC 2003**										**Root to Shoot Ratios from Table 4.4 IPCC 2006**										
11	NOTE: IPCC equations require only DBH as input for the independent variable.																				
12											Tropical rainforest					0.37					
13	Moist tropical forests										Tropical moist AGB <125 t/ha					0.20					
14	AGB = exp(-2.289 + 2.649 * ln(DBH) - 0.021 * (ln(DBH))^2)										Tropical moist AGB >125 t/ha					0.24					
15											Tropical dry AGB <20 t/ha					0.56					
16	Wet tropical forests										Tropical dry AGB >20 t/ha					0.28					
17	AGB = 21.297 - 6.953 * (DBH) + 0.740 * DBH^2										Tropical shrubland					0.40					
18											Tropical montane					0.27					
19	Temperate and tropical pines																				
20	AGB = 0.887 + ((10486 * DBH^2.84) / ((DBH^2.84) + 376907))										Subtropical humid AGB <125 t/ha					0.20					
21											Subtropical humid AGB >125 t/ha					0.24					
22	Temperate hardwoods										Subtropical dry AGB <20 t/ha					0.56					
23	AGB = 0.5 + ((25000 * DBH^2.5) / ((DBH^2.5) + 246872))										Subtropical dry AGB >20 t/ha					0.28					
24											Subtropical steppe					0.32					
25																					
26	**Brown 1997 Equations**										Temperate conifers AGB <50 t/ha					0.40					
27	NOTE: Brown's equations require DBH or basal area (a function of DBH) as inputs.										Temperate conifers AGB 50-150 t/ha					0.29					
28											Temperate conifers AGB >150 t/ha					0.20					
29	Tropical dry forests										Temperate Quercus AGB >70 t/ha					0.30					
30	AGB = exp(-1.996 + 2.23 * ln(DBH))										Temperate Eucalyptus AGB <50 t/ha					0.44					
31	AGB = 10^(-0.535 + log10(basal area))										Temperate Eucalyptus AGB 50-150 t/ha					0.28					
32											Temperate Eucalyptus AGB >150 t/ha					0.20					
33	Tropical moist forests										Temperate other broadleaf AGB <75 t/ha					0.46					
34	AGB = 42.69 - 12.8(DBH) + 1.242(DBH^2)										Temperate other broadleaf AGB 75-150 t/ha					0.23					
35	AGB = exp(-2.134 + 2.53 * ln(DBH))										Temperate other broadleaf AGB >150 t/ha					0.24					
36																					
37	Tropical wet forests										Boreal AGB <75 t/ha					0.39					
38	AGB = 21.297 - 6.953 * DBH + 0.74*DBH^2										Boreal AGB >75 t/ha					0.24					
39																					
40																					
41	**Chave et al Equations**																				
42	Note: Chave's equations require DBH, total height, and wood specific gravity as inputs.																				

REDD

Peru case study

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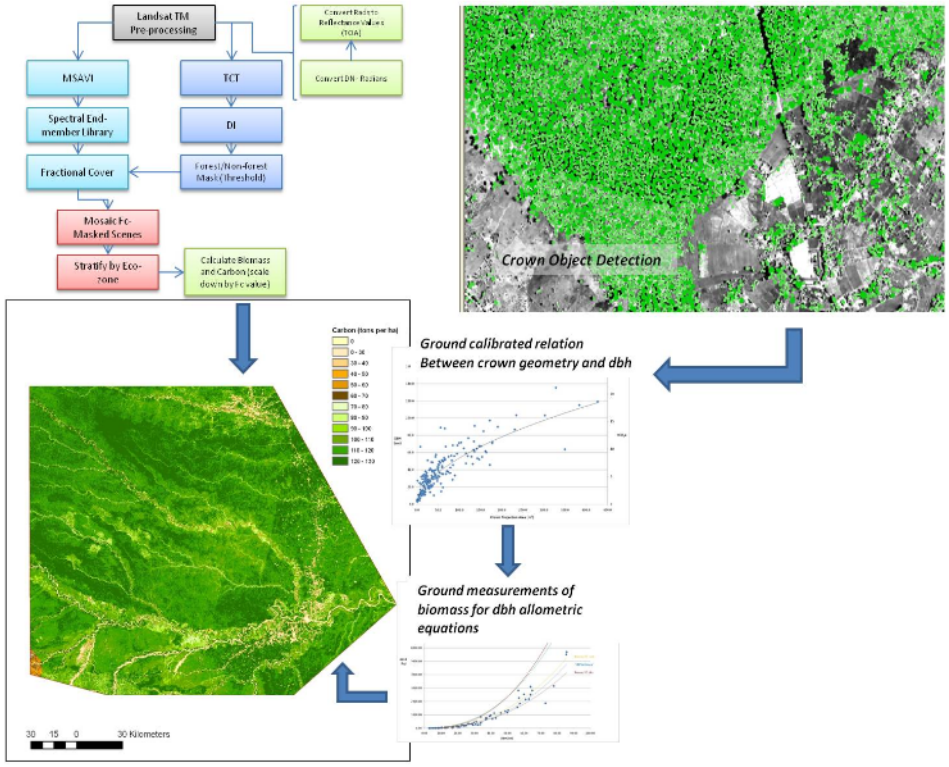
REDD+

The Carbon2Markets program is developing REDD+ tools and MRV systems for several countries including Thailand, Laos, Brazil, Indonesia, Peru, Ghana, Senegal and some others. The link to these projects is coming soon. Below is a diagram of our REDD approach.



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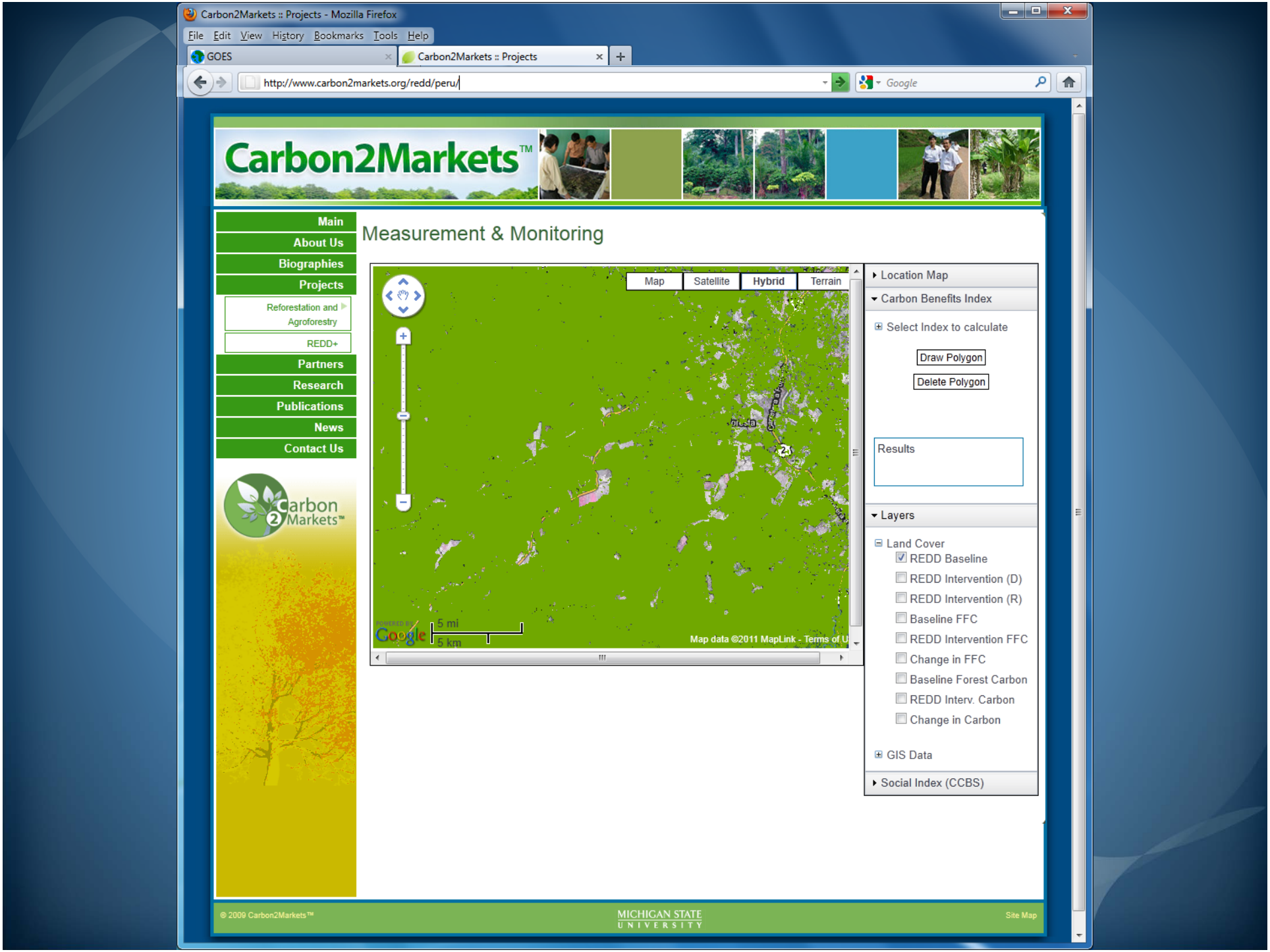
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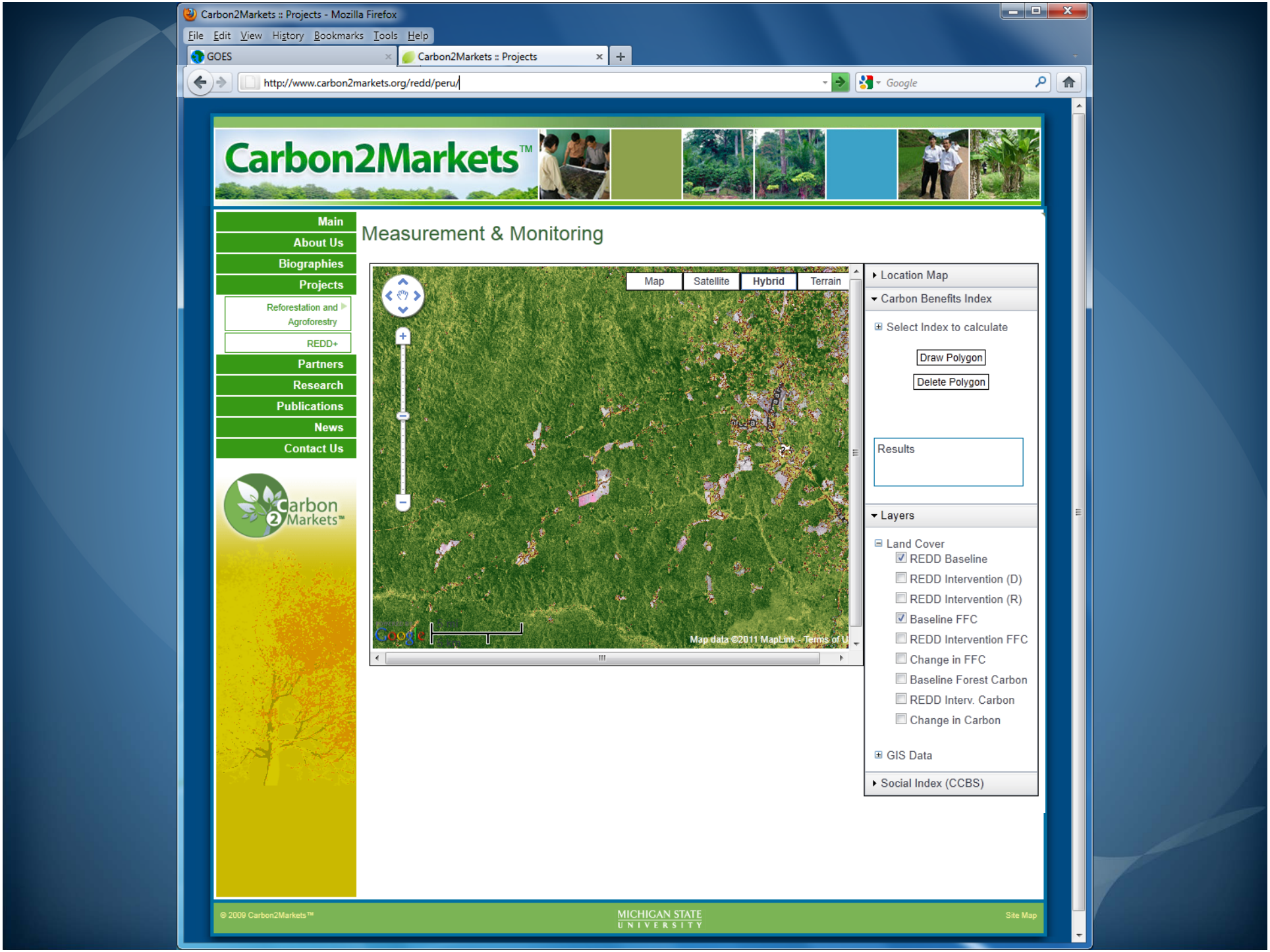
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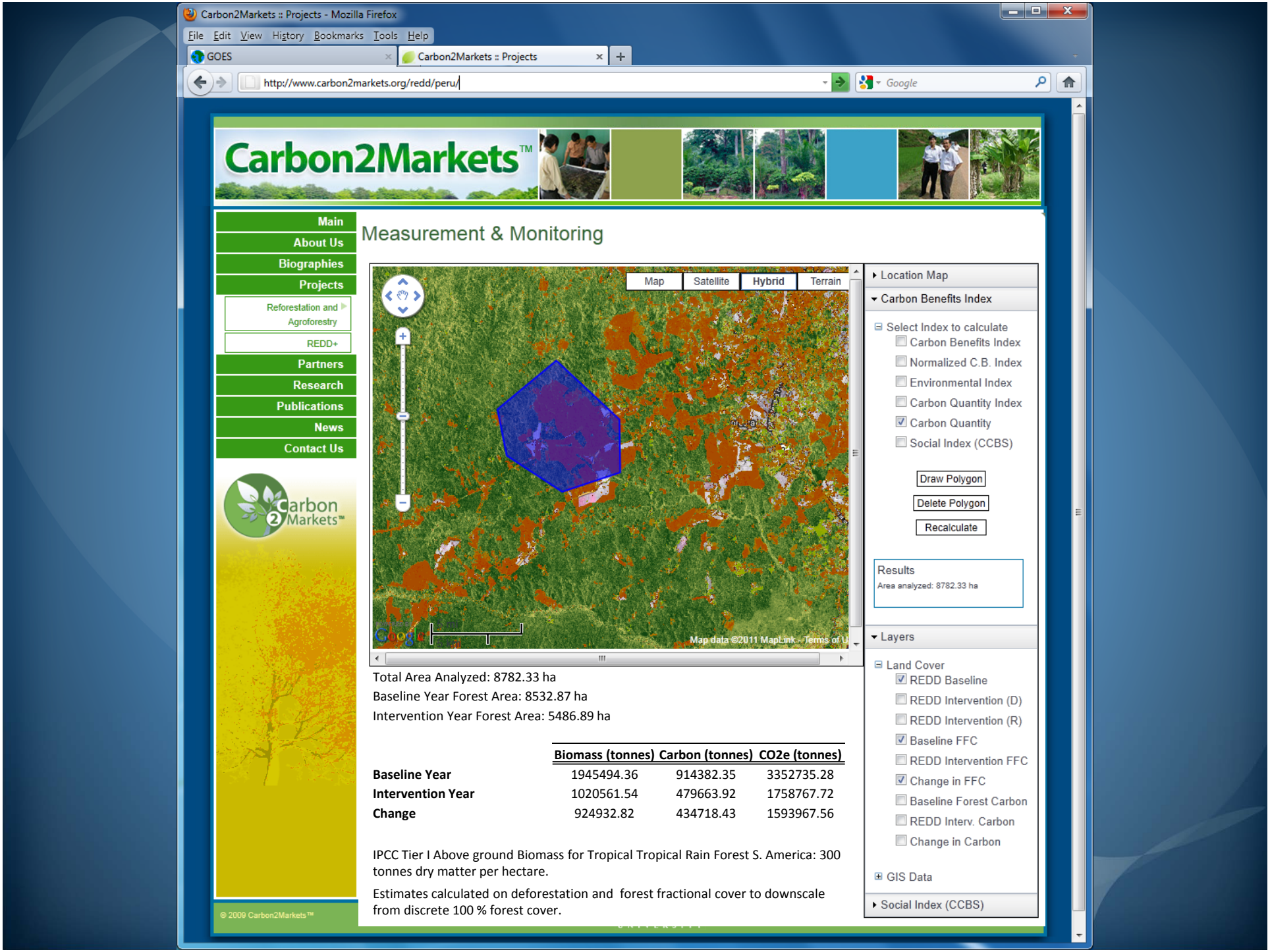
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Normalized C.B. Index
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Draw Polygon
Delete Polygon
Recalculate
Results
Area analyzed: 8782.33 ha
Layers
Land Cover
REDD Baseline
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REDD Intervention (R)
Baseline FFC
REDD Intervention FFC
Change in FFC
Baseline Forest Carbon
REDD Interv. Carbon
Change in Carbon
GIS Data
Social Index (CCBS)
Total Area Analyzed: 8782.33 ha
Baseline Year Forest Area: 8532.87 ha
Intervention Year Forest Area: 5486.89 ha
Biomass (tonnes) Carbon (tonnes) CO2e (tonnes)
Baseline Year 1945494.36 914382.35 3352735.28
Intervention Year 1020561.54 479663.92 1758767.72
Change 924932.82 434718.43 1593967.56
IPCC Tier I Above ground Biomass for Tropical Tropical Rain Forest S. America: 300 tonnes dry matter per hectare.
Estimates calculated on deforestation and forest fractional cover to downscale from discrete 100 % forest cover.

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Thank You

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