

Putting data to work

Challenges and practical approaches to bring remotely sensed data into land use planning in the developing world

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CMS Policy Speaker
Series

NASA – Goddard

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winrock.org

In this presentation

- Winrock International's mission
- Winrock's Ecosystem Service unit experience
- Challenges for spatial land use planning in developing countries
- Case studies and tools developed
 - Cambodia watershed ecosystem service tool
 - Malawi forest monitoring
 - Ghana ecosystem service awareness
- Winrock global tools
 - AFOLU carbon Calculator
 - REDD+ Decision Support Tool
- Conclusions

A Powerful Mission

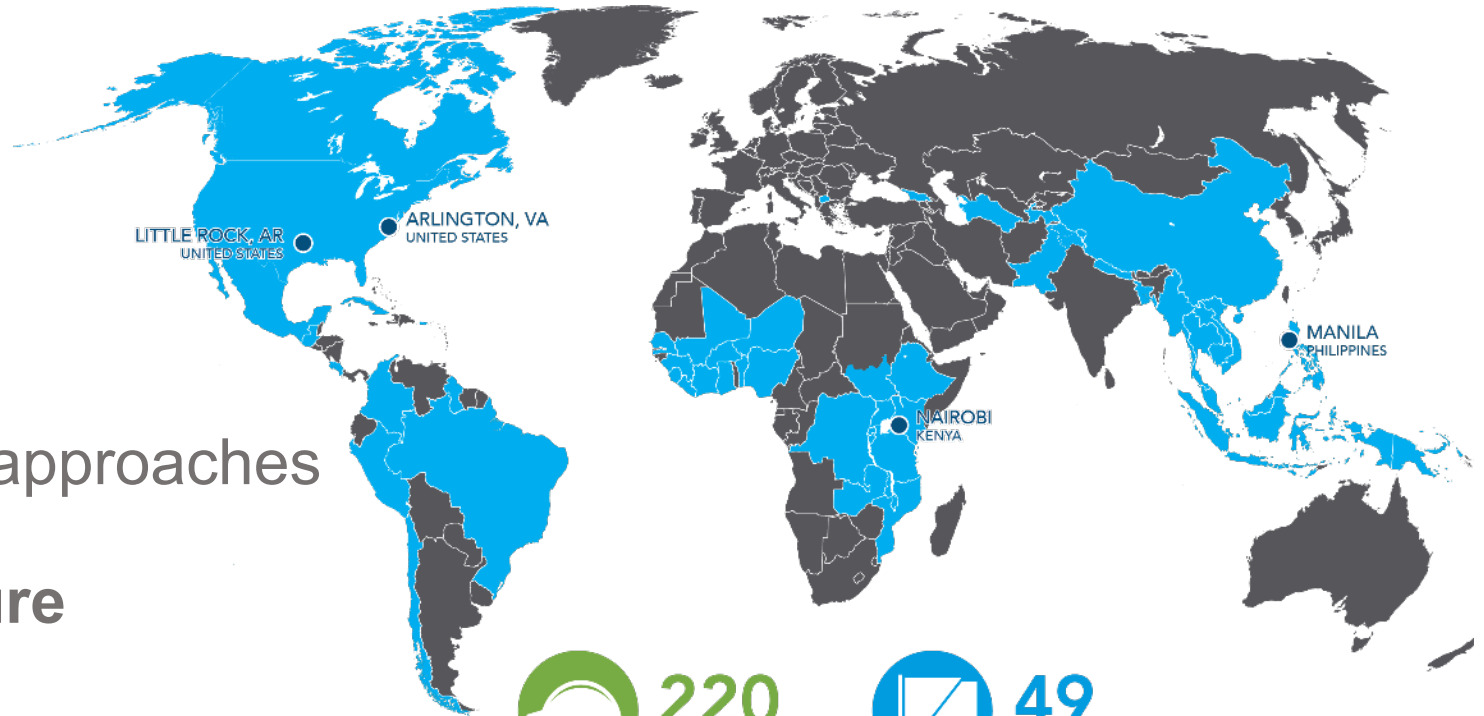
Winrock's mission is to **empower the disadvantaged, increase economic opportunity and sustain natural resources** across the globe.



Our Global Reach

Innovative approaches
in

- Agriculture
- NRM
- Clean energy
- Leadership development.



220
PROJECTS



49
COUNTRIES

Ecosystem Services Unit ('ECO')

Cutting-edge **ecosystem services evaluation** from forests, watersheds, and agriculture.

Science-based approach to develop tools, build capacity, methodologies, and technical guidance for broad audiences.

Ecosystem Services
Assessment

Pay for Services and for
Performance

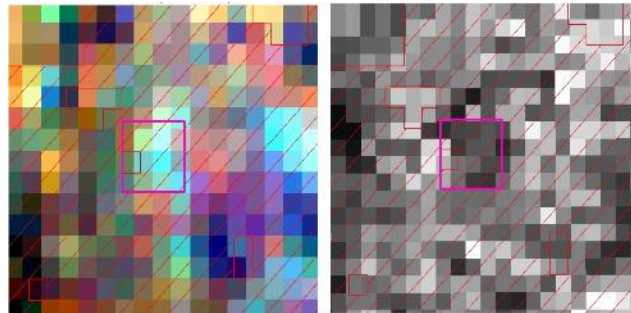
Interactive Tool
Development

GHG Support

Commodity Sustainability

How can remote sensing products be used in land use planning?

- Many remote sensing products exist—with loads of great data!
- These data can be **useful** for solving developing world land use problems
- However, they can be **difficult to interpret** for non-experts
- Need for **translation** between products and:
 - Governments + policy makers
 - Land use planners
 - Communities



Expanding data availability

- Medium-resolution land multispectral options

Comparison of Landsat 7 and 8 bands with Sentinel-2

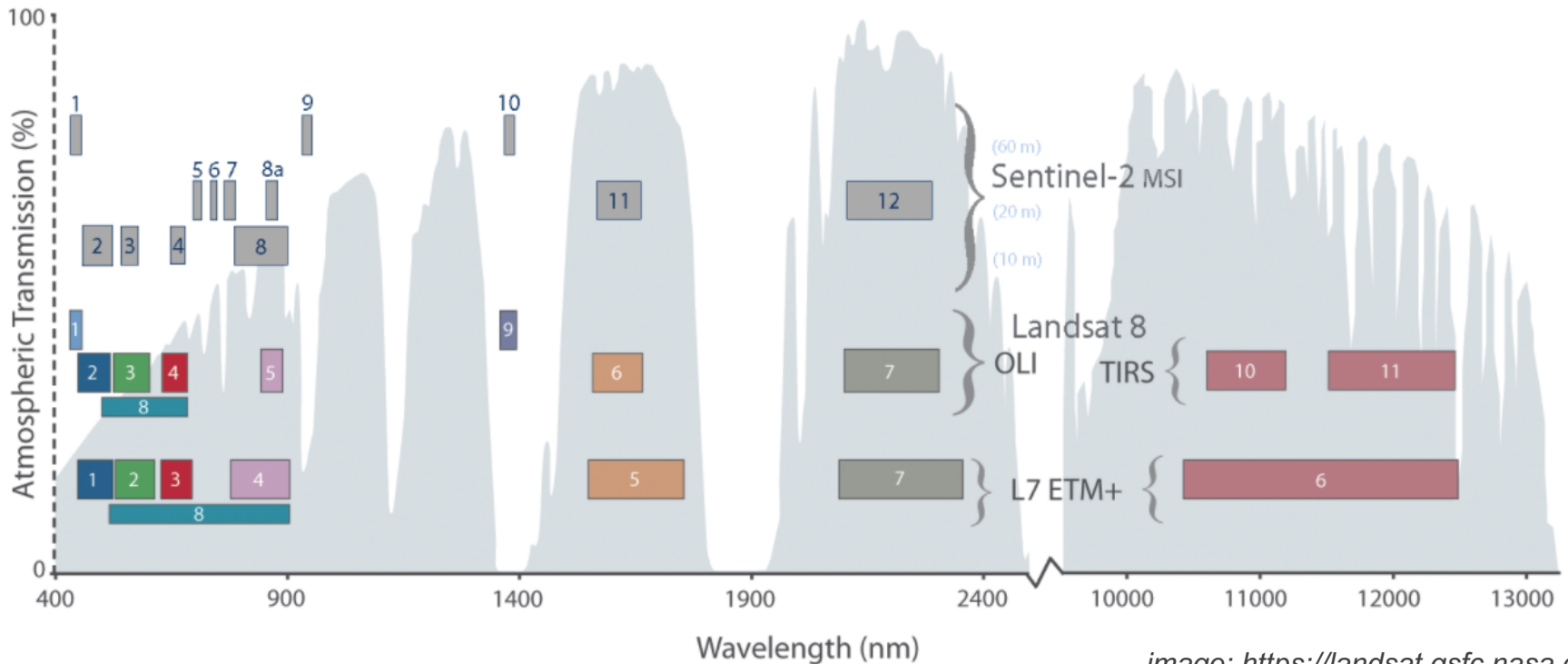


image: <https://landsat.gsfc.nasa.gov>

Expanding data availability

- New SAR/Radar options

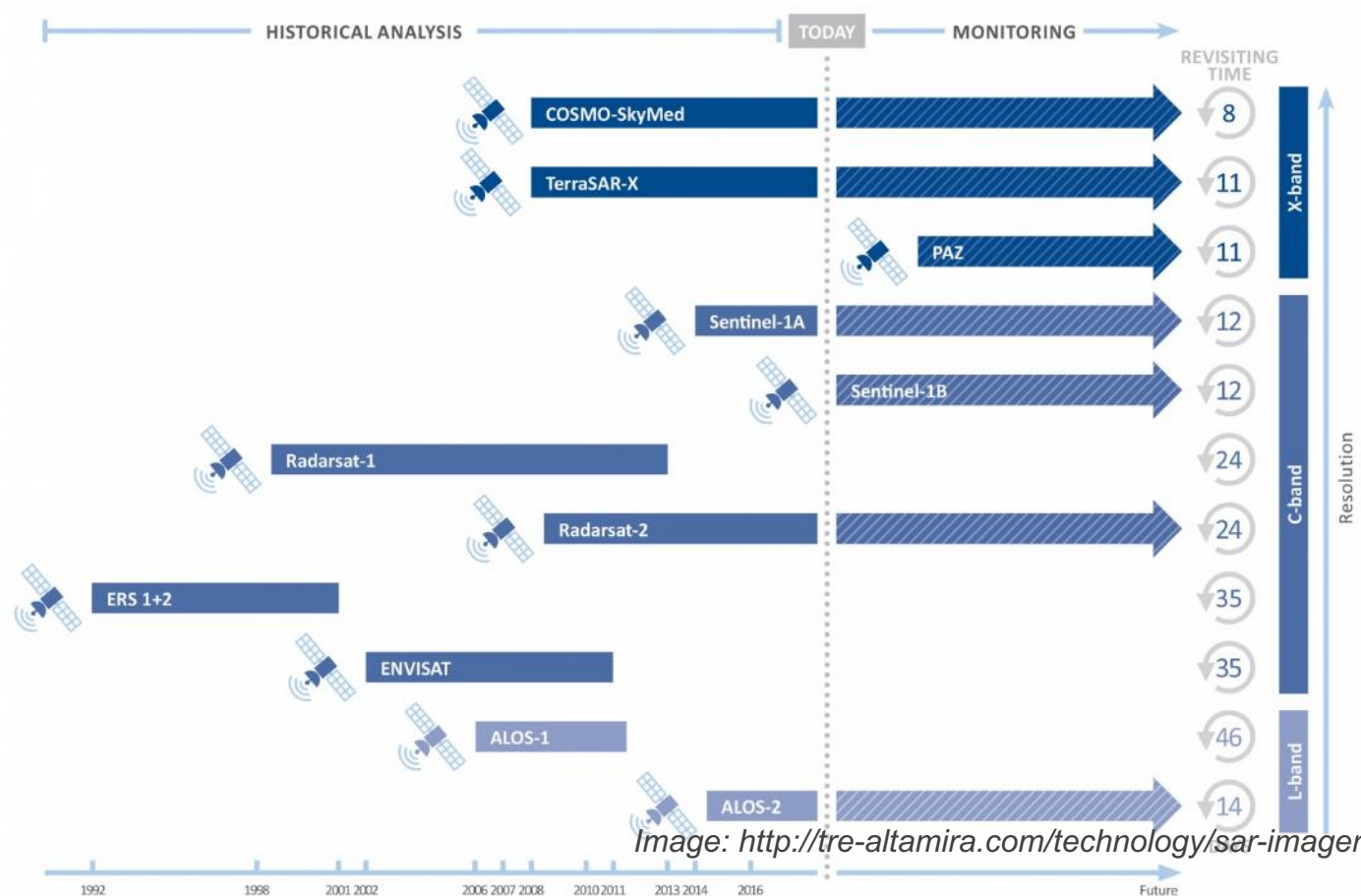


Image: <http://tre-altamira.com/technology/sar-imagery/>

Expanding data availability

- FireSat
- GPM - Global Precipitation Measurement
- GEDI; ADLAN (space-borne LiDAR)
- ECOSTRESS
- *Not to mention numerous new ultra-high resolution commercial optical platforms...*

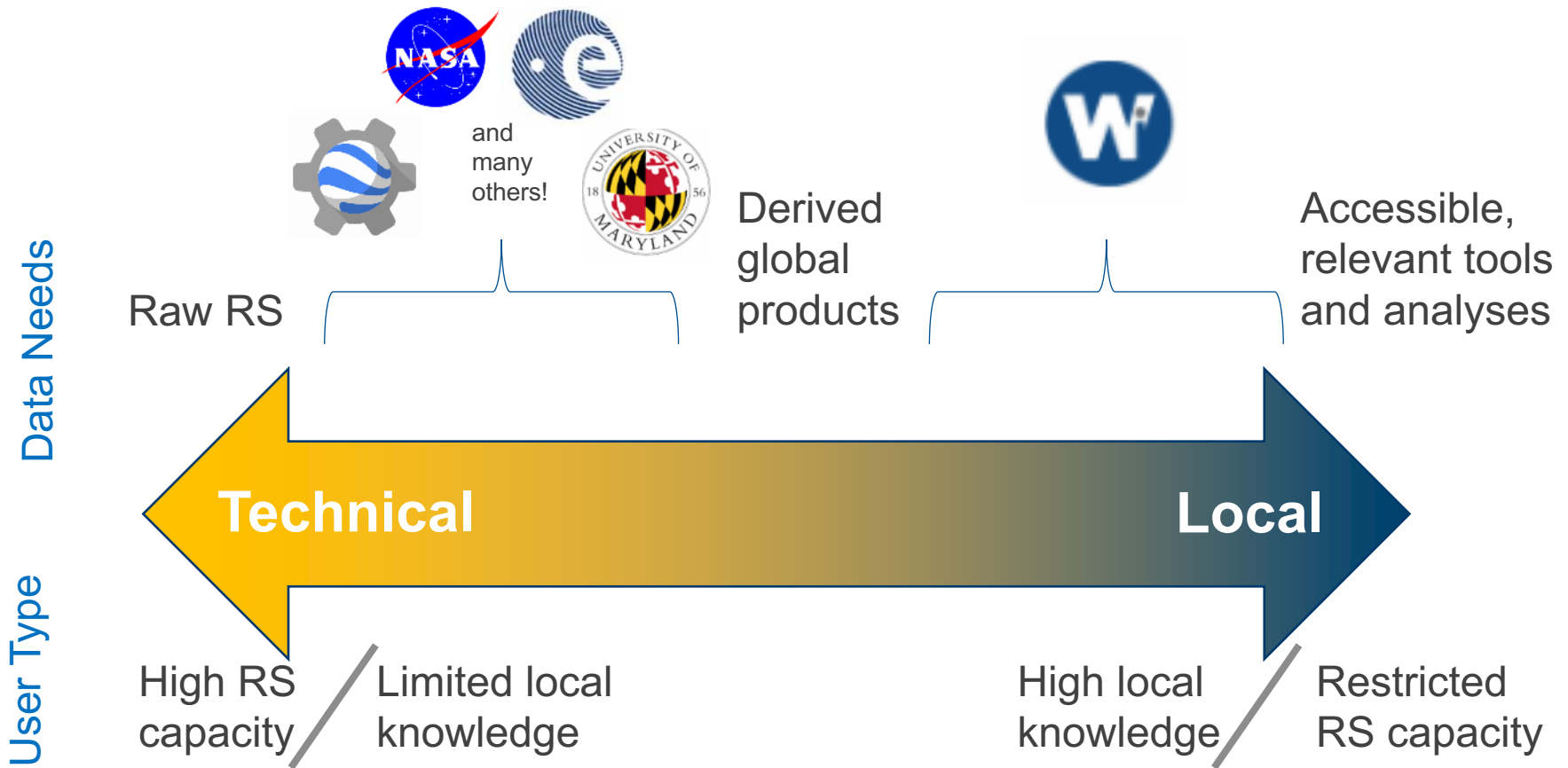
Developing country context

- Limited technical capacity
- Lack dedicated funding to projects – donor-driven priorities
- RS/GIS talent must stretch attention across multiple initiatives, departments
- Limited opportunities to update skills
- Analyst and QA/QC roles conflated to single position

Developing country needs for RS

- Focused assessments
 - Understand current “state of” the landscape
- Ongoing monitoring
 - Compare baselines to performance of initiatives
- What data characteristics are needed?
 - Repeatability and time series consistency
 - Relate to real land planning needs
 - Automated updating
 - Approaches accepted by scientific community
 - Comparability across jurisdictions, countries (wall to wall)

Bridging scientific and local knowledge for RS in development



Case Study: Cambodia

- Issues at play
 - High dependence on natural resources for basic subsistence (forest, fish, agriculture)
 - Lack of land use planning → degradation of natural resources → lower resilience
 - Poor government coordination and transparency
- Priority Needs
 - Reliable monitoring of natural resources over time to improve development and act as warning system
 - Credible estimates of past/future impact from land cover change
 - Provide development options and decision-support

Cambodia: what is the goal?

- **Harness** tools that can assess environmental degradation in an integrated and timely fashion
 - Quantification that can lead to valuation (\$) is a primary barrier to:
 - Incorporating ecosystem services in land use planning
 - Valuation of Natural Capital for PES
 - Adaptive planning in a changing climate
- Tools that can link farm scale to the larger region (country, watershed, etc.)



Watershed Ecosystem Service Tool (WESTool)

- Online interactive map-based tool
- Estimates historical and potential future impacts of land use change on **ecosystem services** in Cambodia
- Informs decision-making on **land use**, **sustainable development** and **climate change adaptation**
- Based on objective, science-based datasets
- Highly accessible
- No-GIS skills needed
- No modeling skills needed

<https://www.winrock.org/westool/>



Audience

Who is the target audience for the tool?

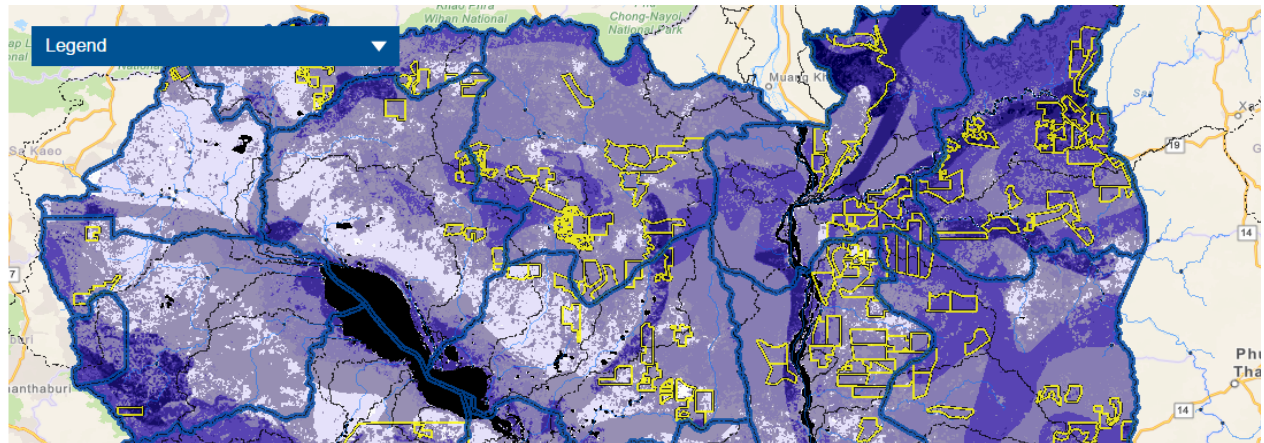
- Cambodian gov. for initial environmental impact assessments
- Researchers reporters and NGOs interested in doing their own analysis
- Industries interested in assessing the impact that land use change could have on their business

WESTool Capabilities

- Assess past and future impact on Ecosystem Services: Water – Soil – Carbon – Biodiversity
- Assess future Climate Change and areas vulnerable to Climate Change
- Provides information on population and economy



Data Layers



Water

■ Freshwater availability

- Forests regulate runoff to the river, pushing water into the ground to fill aquifers and slowly percolate across the landscape.

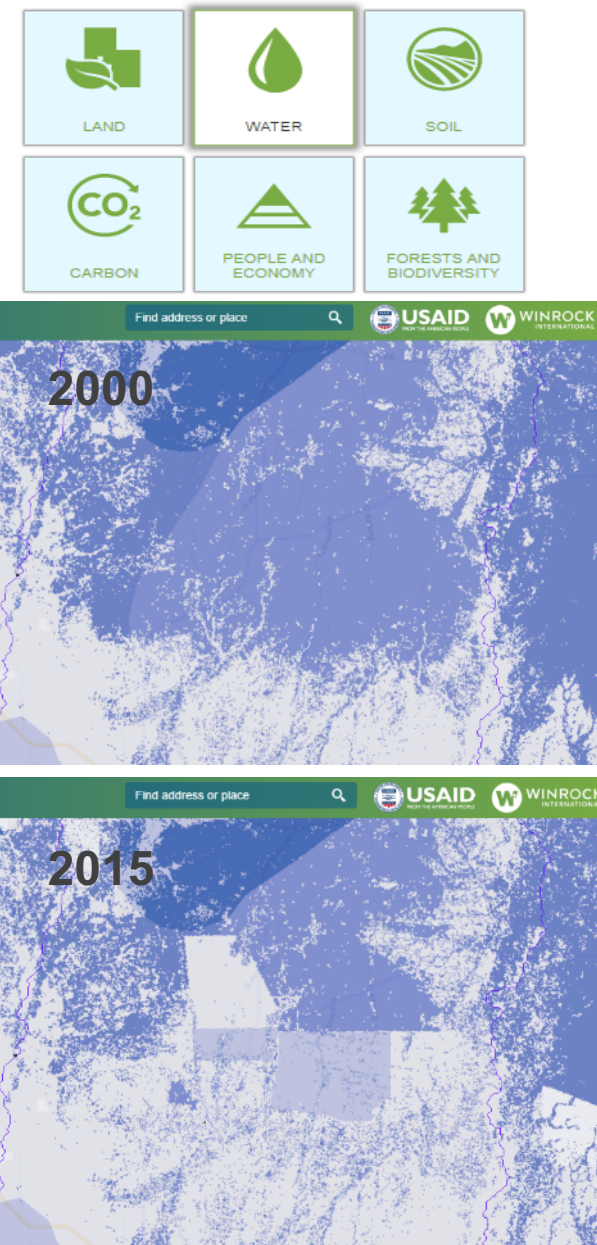
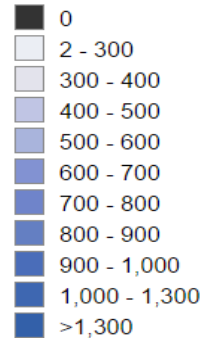
■ Regulation of flow

- Slower flow regulates floods during high rainfall and maintains water in the river and soil during the dry season.

■ Regulation of water quality

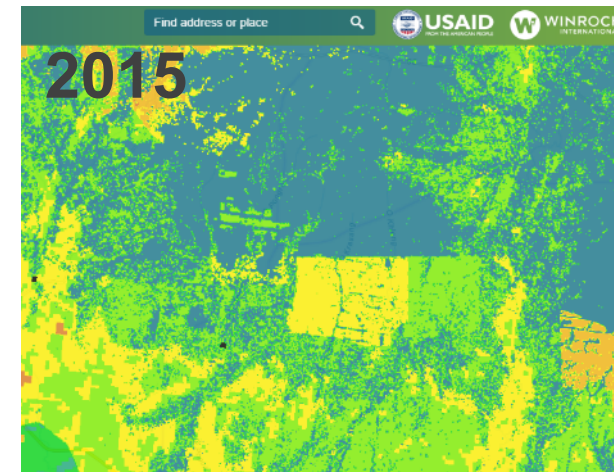
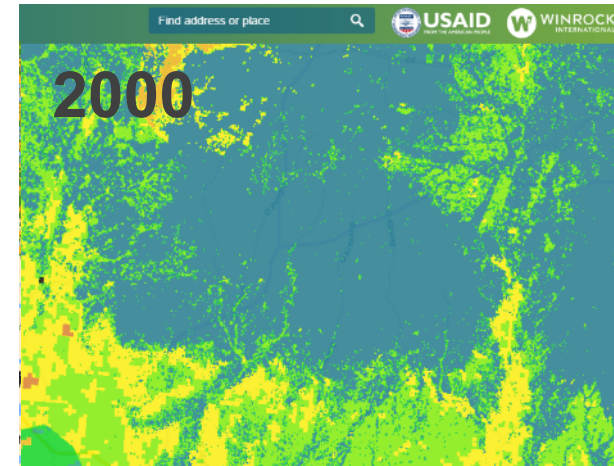
- Water that runs through the ground is filtered, trapping nutrients and pollutants in the soil and protecting surface water.

Aquifer Recharge (mm/y)

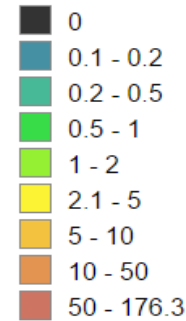


Soil and Nutrients

- When forests are converted the soil and is more prone to erosion.
 - agriculture,
 - plantation or
 - other development (roads mining urban areas)



Sediment Loss (t/ha/y)

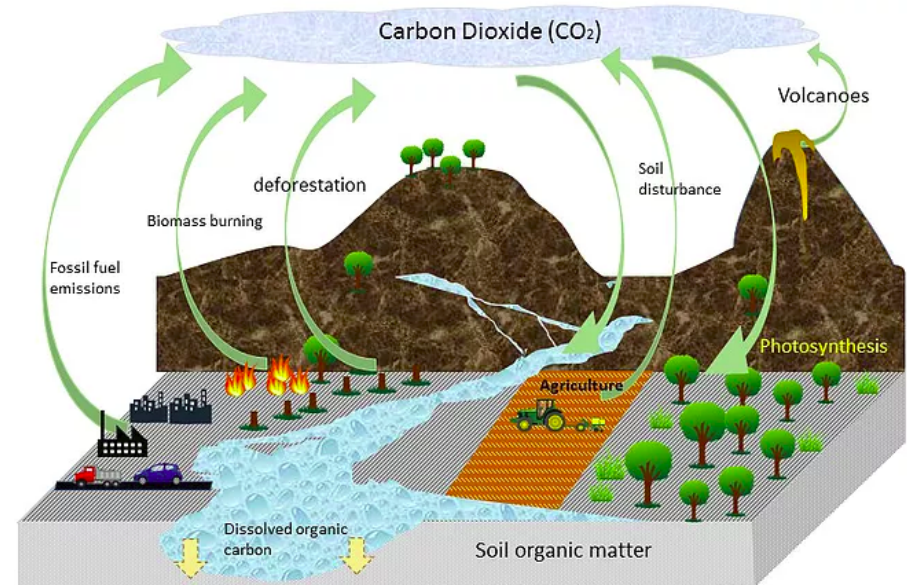
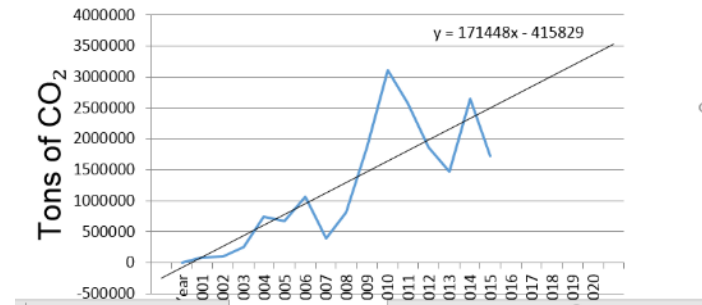


Carbon and GHG Emissions



- WESTool can be used for
 - GHG emission baseline for land use change
 - Assessing existing carbon stocks
 - Avoided GHG emission
 - Agricultural emissions

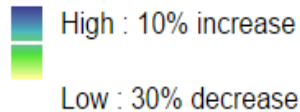
Emissions from Deforestation



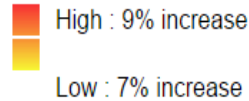
Climate Change Adaptation Features

- Projected Climate Change
c.2046-2064

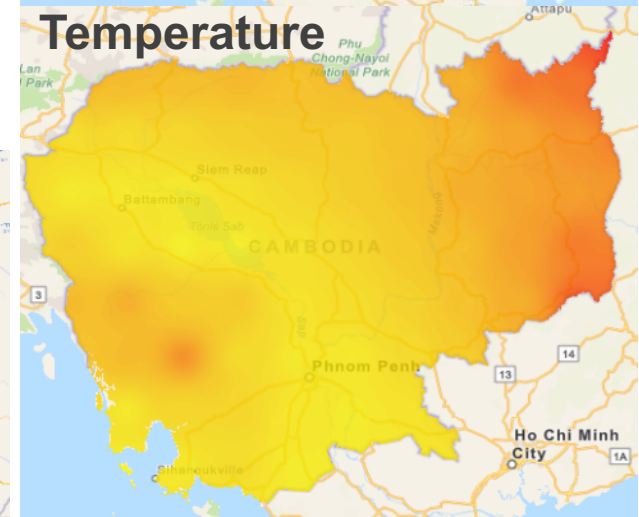
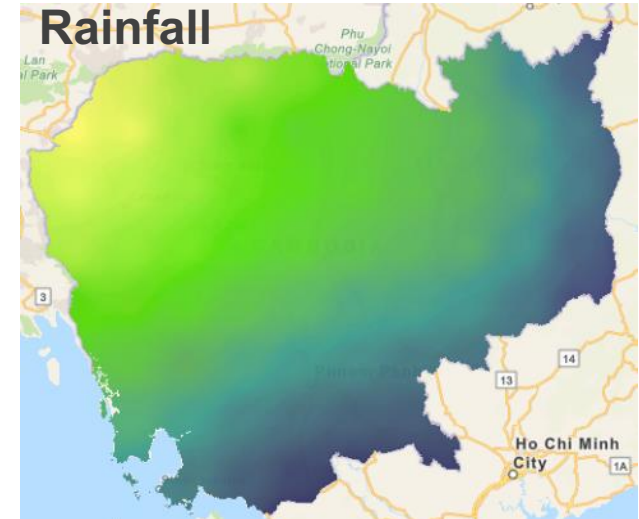
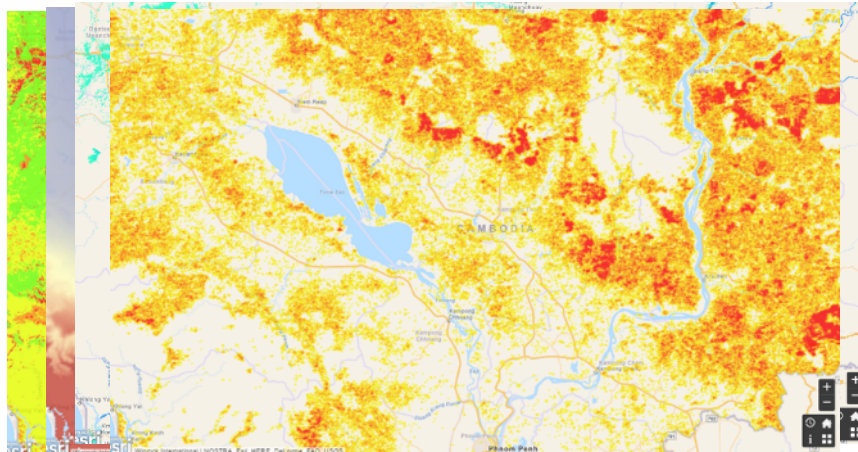
Percent change in rainfall c.2046-2064



Percent change in temperature
c.2046-2064



- Estimated impacts of Climate Change
Overall vulnerability **Drought** **Flood** **Fire**



What makes WESTool Unique?

- **Integrates assessment** of both ecosystem services and Climate Change
- **Farm-scale to country analysis** allowing for integrated planning anywhere in Cambodia
- **Online interactive interface**, accessible to all
- **Historical and potential future impacts** on ecosystem services and Climate Change
- **Offers analysis outputs in multiple formats:**
 - Online maps graphs and charts
 - Downloadable statistical tables, graphs, and charts (excel format)

Case Study: Malawi

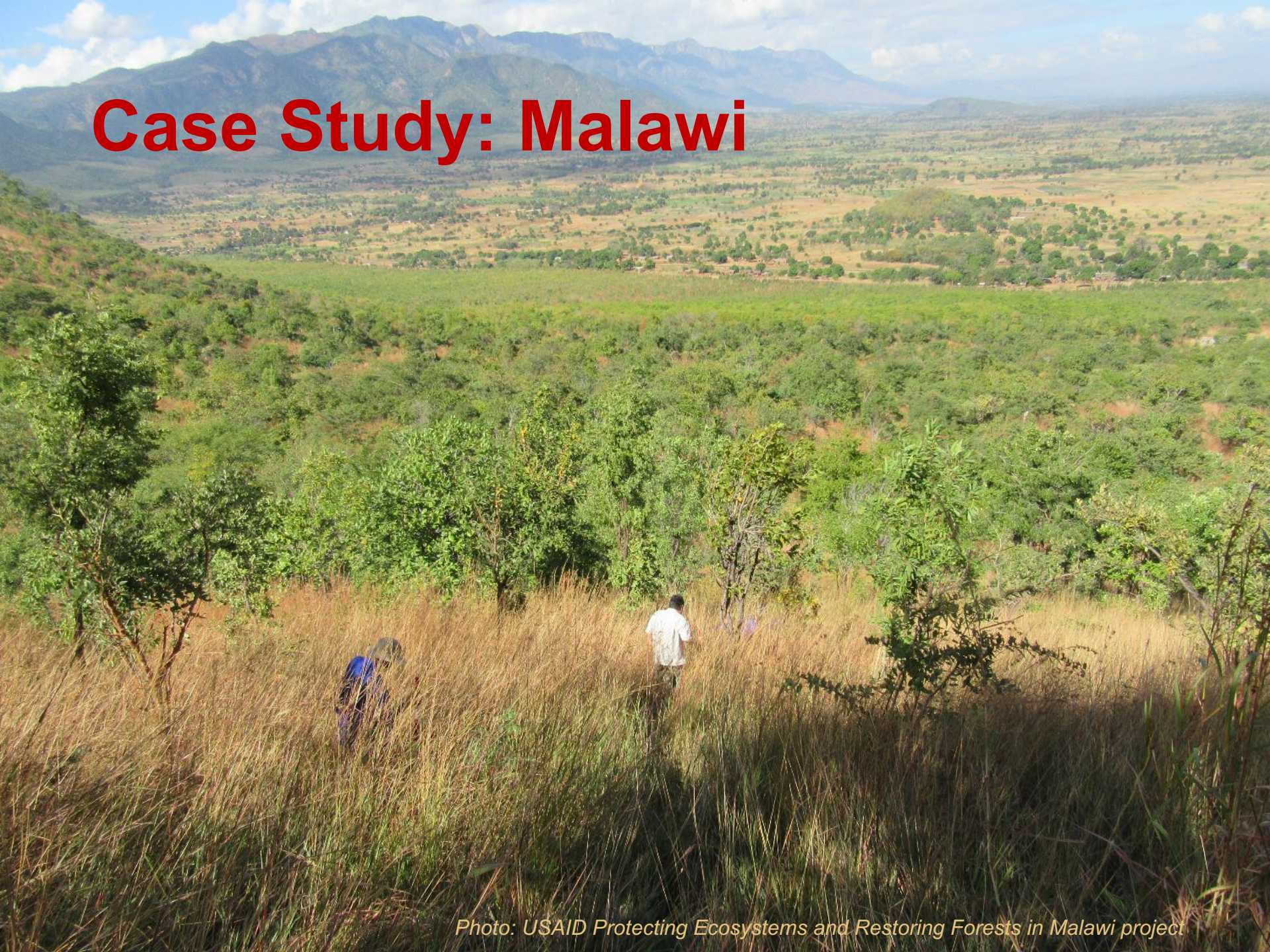


Photo: USAID Protecting Ecosystems and Restoring Forests in Malawi project

Case Study: Malawi

- Winrock supporting REDD+ RL development
- RL should be compatible with future NFMS that serves multiple needs

Self-Expressed national needs:

- Bonn challenge – 4.5m ha reforest by 2030
- NDC – increase forest cover by 2%
- NAMA
 - reduce from baseline 2.4% deforestation rate
 - A/R (~700,000 Gg tCO₂e)

Case Study: Malawi – Institutional Challenges

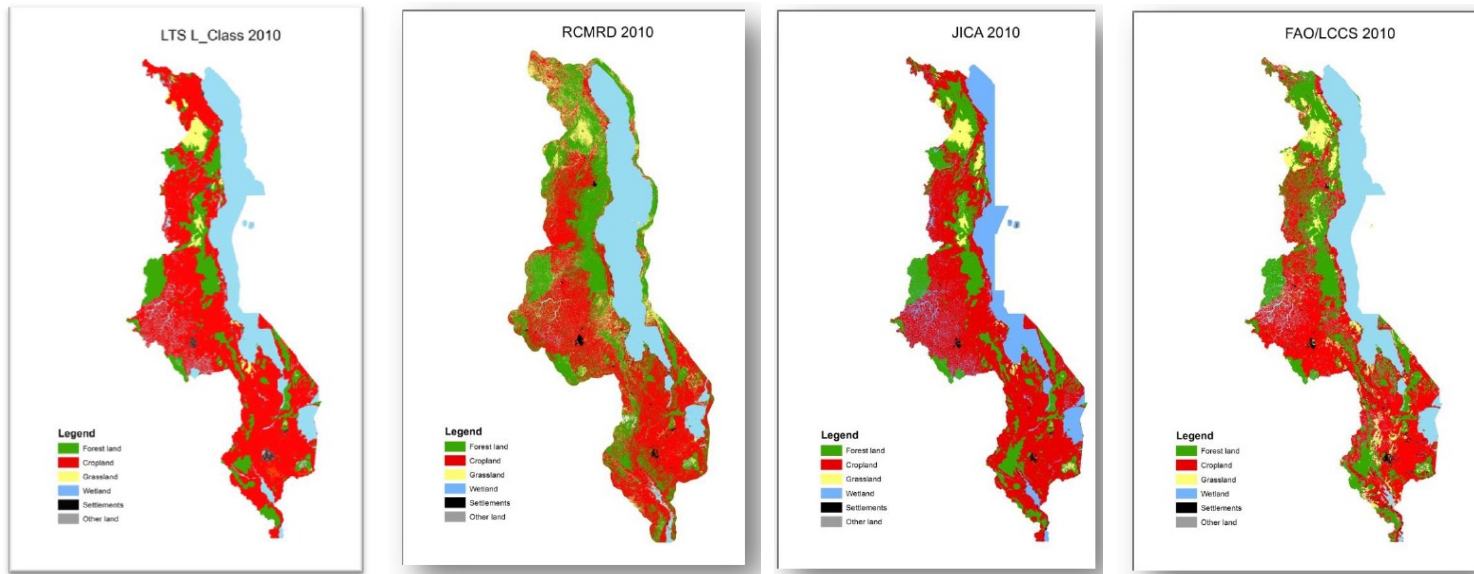
- Limited, overstretched local technical capacity
- Multiple intersecting national priorities
- Loss of continuity across donor funded initiatives

Case Study: Malawi

- Inconsistent approaches
- No planned continuity
- Available data are ‘pilots’

Table 1. Comparison of MMUs and forest cover for each mapping effort.

Mapping Effort	Forest Cover (% area)
FAO	28.7%
JICA	20.4%
LTSI/WB	18.2%
RCMRD	28.7%



Figures: USFS (2015) Malawi REDD+ Readiness Program: Final Report on Developing a Recommended Suite of Land Use/Land Cover Standards for the Government of Malawi

Malawi - Technical RS Challenges

- Smallholder driven land cover change
- Dry forest / savannah less studied from RS
- Shifting Cultivation confused with land cover change
- Widespread small-scale AR cannot be attributed to drivers

Challenging enough for world-class scientists.
Result in extreme uncertainty in LCC

Malawi - Winrock lessons learned

- Must move past pilot RS analyses
- Lack of consistency and institutional sustainability much greater threat to NFMS/MRV than finding the ‘perfect’ algorithm
- Simplified, automated, web-based and externally audited workflows needed
- Avoid local data storage – never ‘touch the ground’

Malawi – Working towards a sustainable RS-based forest monitoring system

- Rely exclusively on existing global, stable, multi-decadal data products
- May require international community to ‘stitch together’ missions, past current and future.
- Need focus on tropical dry forests – an underserved biome

Case Study: Ghana



USAID-Ghana AgNRM

- Northern Ghana—savannah region, rural
- Landscape focus—link ecosystem services (ES) with value chains (shea, dawadawa etc.)
- Steady land degradation—shifting cultivation
- Need to protect ecosystem services



USAID-Ghana AgNRM

- Remote sensing/mapping needed to understand changes in ES- LUC, water balance, biodiversity

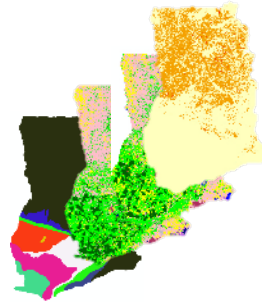


- Translate science → COMMUNITY decision support:
 - Land use planning needed
 - No internet/computers
 - High local knowledge of weather, ecosystem

USAID-Ghana AgNRM



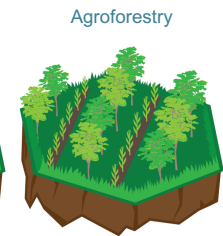
Satellite images



GIS layers

SWAT Soil & Water Assessment Tool

- Hydrological modeling
- Carbon analysis



Analysis by ES, land use

	IMPROVEMENT				DETERIORATION				Notes
	0 to 50	50 to 100	100 to 150	150 to 200	0 to 50	50 to 100	100 to 150	150 to 200	
Water Quality	↑	↑	↑	↑	↓	↓	↓	↓	
Soil Health	↑	↑	↑	↑	↓	↓	↓	↓	
Carbon Sequestration	↑	↑	↑	↑	↓	↓	↓	↓	
Water Availability	↑	↑	↑	↑	↓	↓	↓	↓	
Soil Erosion	↑	↑	↑	↑	↓	↓	↓	↓	
Water Pollution	↑	↑	↑	↑	↓	↓	↓	↓	

Decision support tool



ECO games

Ghana-lessons learned

- Mapping products important even at community level
- Translation of remote sensing conclusions has additional challenges at local level
- Need for integrated/interdisciplinary approaches

Winrock's Global-scale tools

- REDD+ Decision Support Tool
 - Allows countries to prioritize the scope and elements of REDD+ program
 - User-driven priorities drive rapid assessment of priorities for emissions reduction
- AFOLU Carbon Calculator
 - Determine baseline and hypothetical project emissions scenarios for AFOLU interventions in USAID projects

HOW TO ESTIMATE HOW USAID AGRICULTURE AND FORESTRY PROJECTS IMPACT THE CLIMATE?

Agroforestry



Reforestation



Protected Area Establishment

Reducing agricultural inputs



Livestock Management



Improved Cookstoves



Reduced Impact Logging

THE AFOLU C CALCULATOR ALLOWS ESTIMATION OF THE CLIMATE IMPACTS

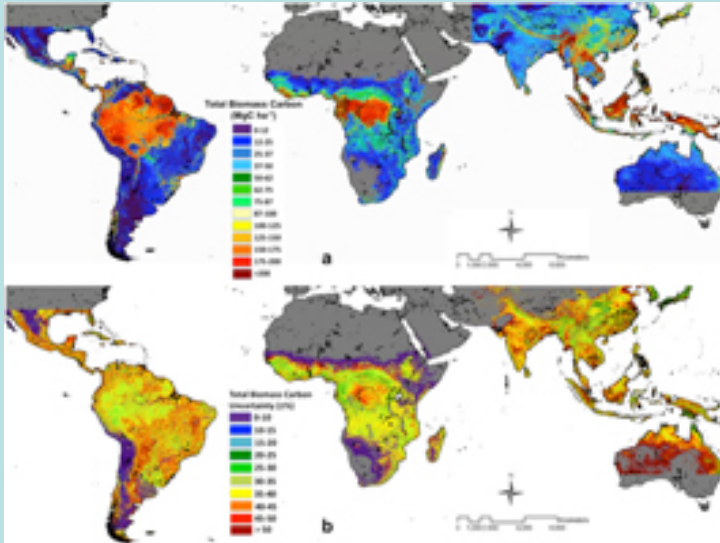
www.afolucarbon.org

- Free!
- Publicly available
- Online, easy-to-use platform
- Inputs can be saved and stored
- Transparent, scientifically sound methods and data sources

The screenshot displays the AFOLU Carbon Calculator dashboard. At the top, the USAID and Winrock International logos are visible. The dashboard includes a navigation menu with options for Dashboard, Projects, Groups, Support, and Info. The main content area is titled 'Dashboard' and features a 'Projects' section with a list of projects, each with a 'View' button. The projects listed are: 'Climate-Friendly Agriculture in Albania', 'Sustainable Livelihoods and Climate in the Philippines', 'Sustainable Agriculture and Communities in Pakistan', 'Restoring African Landscapes', and 'Sustainable Agriculture in Tanzania'. Below the projects list, there are buttons for '+ New Project' and 'My Projects'. A 'Reported Projects' section shows 'You have no completed reports.' and a 'My Reports' button. On the right side, there is a 'My Account' section for 'Lara Murray' with contact information and a 'My Groups' section for 'TestL' with a 'My Groups' button. A sidebar on the left contains a 'Welcome' message, a 'Where do I start?' section with 'Basic steps' (1. Create or edit a project, 2. Add or edit project activities, 3. Review results, 4. If reporting to USAID, submit report), and a 'Take a tour' section.

DEFAULT DATABASE

Global datasets



- Deforestation rates: Hansen et al. 2013. High-Resolution Global Maps of 21st Century Forest Cover Change. *Science*.
- Biomass: Saatchi, S.S. In preparation. Unpublished dataset.

- Intergovernmental Panel on Climate Change Tier 1 default data

IPCC Defaults & FAO data

Chapter	Chapter Name
1	Introduction
2	General Methodologies Applicable to Multiple Land-Use Categories
3	Consistent Representation of Lands
4	Forest Land
5	Grassland
6	Wetlands
7	Settlements
8	Other Land
9	Emissions from Livestock and Manure Management
10	Emissions from Livestock and Manure Management
11	N2O Emissions from Managed Soils, and CO2 Emissions from Lime and Urea Application
12	Harvested Wood Products

AFOLU C CALCULATOR RESULTS - REPORTING

- Downloadable, printable project reports can be generated as a PDF
- Can submit project results directly to USAID
- Data saved in calculator, making for reporting over many years easier and more consistent

The screenshot shows the Winrock International web application interface. At the top, there is a navigation bar with links for Dashboard, Projects, Groups, Support, and Info. Below this, the user is logged in as 'BrazilCarbon' with a 'Reporting' button and a star icon labeled 'Owner'. The main content area has tabs for 'Project Overview', 'Activities (12)', and 'Graphs'. Under 'Project Overview', it says 'No Description Available'. At the bottom of the interface, there are buttons for 'Clone Project', 'Submit Report', 'Edit Project', 'Delete Project', and 'Preview Report'.

AFOLU Carbon Calculator Project Report

Sustainable Livelihoods and Climate in the Philippines

Submitted by: Lara Murray
September 5, 2014

USAID reporting: No

Project Summary

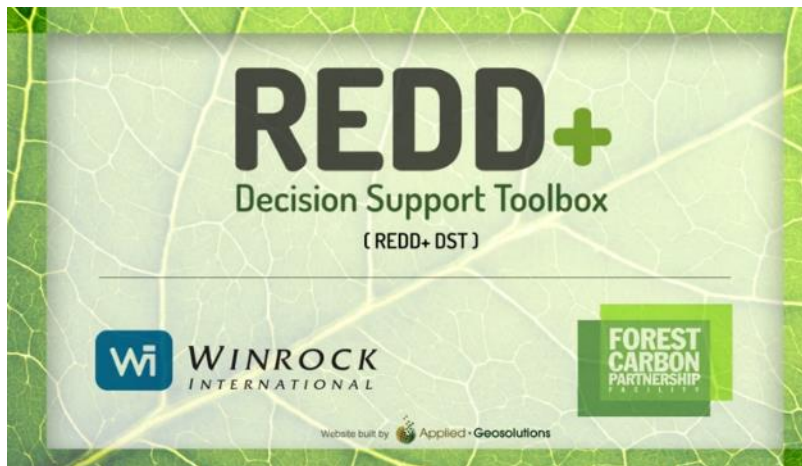
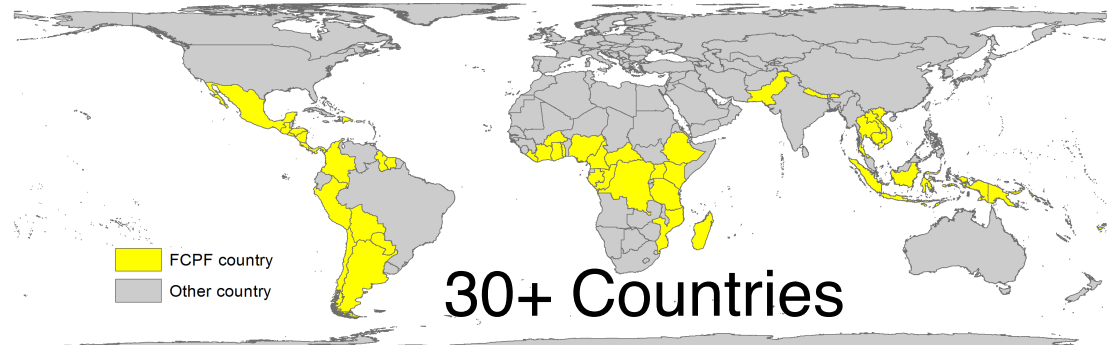
Table 1: Summary of project activities

Name	Location	Type	Area	Benefit t CO ₂ e
Climate-Friendly Rice Cultivation	Philippines Philippines	South Cotabato Sultan Kudarat	Cropland Management	2,300 0
Lowering inputs in Philippine farms	Philippines	Abay	Cropland Management	1,235 0
			Total	3,535 0

USAID WINROCK INTERNATIONAL 1

REDD+ Decision Support Toolbox

Developed to help countries explore REDD+ program development.



www.forestcarbonpartnership.org/dst

REDD+ Decision Support Toolbox

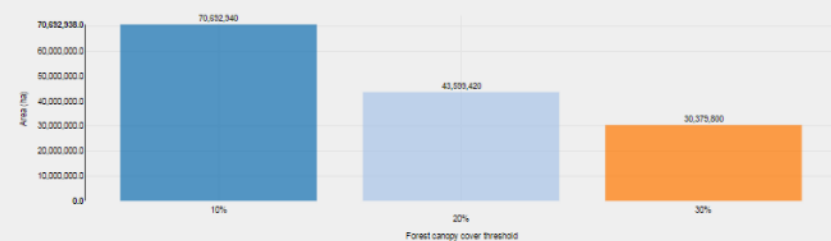
Interactive features to explore the impacts of decisions

Choosing a Forest Definition

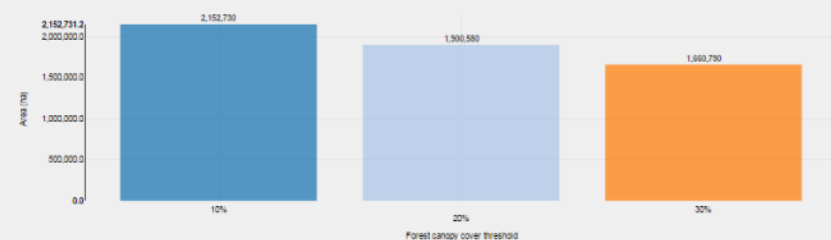
How forests are defined lies at the heart of which national areas will qualify to participate in REDD+. Within REDD+, it will also determine what counts as deforestation as opposed to forest degradation. How a country sets up its forest definition will affect the total area of the country that is considered forest. Using a very inclusive or broad definition will maximize forest area within the country by including both lands that have high tree cover as well as lands that are more open, degraded, marginal, or with trees of shorter stature. Using a very strict or narrow definition will minimize forest area within the country by excluding the most highly degraded or open lands that could perhaps be classified instead as open woodland, savanna, shrubland, or degraded land.

The United Nations Food and Agriculture Organization (FAO) defines forest as land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use. The DST allows you to select one of three forest definitions based on a 10%, 20%, and 30% canopy cover threshold and presents forest loss and enhancements accordingly. Below are some estimates that demonstrate how different forest definitions would impact the REDD+ Program.

Total Forest Area



Forest Loss 2001-2012



REDD+ Design
Reference Levels
National Forest Monitoring S...
Reporting and Verification
Summary
Resources

1. Reference Level Period
2. Average vs. Trend
3. Adjustments
4. Your Reference Levels

DST Defining Your Reference Period

The REDD+ DST has annual data for both deforestation emissions and fire emissions. As such, on this page, you can explore the implications of different reference level periods for emissions from deforestation and forest degradation by fire by selecting different start and end years for the two reference levels. If you entered a custom deforestation rate under Customized Inputs in the REDD+ Design module, it will not be reflected on this page. It will, however, be reflected in your final RL at the end of this module.

Deforestation Emissions

Explore the implications of different reference level periods for emissions from deforestation by selecting different start and end years for the deforestation RL. While the average historical emissions and trendline are presented here for comparison, the REDD+ DST will present your reference level as the average historical emissions from deforestation for the selected reference period.

	Average	Trend
Forest Loss (FL) (ha/yr)	15,832	$FL = -283 \cdot \text{YEAR} + 584,249; R^2 = 0.04, P = 0.53$
CO ₂ emissions (t CO ₂ /yr)	13,788,012	$Ems = -176,636 \cdot \text{YEAR} + 368,209,010; R^2 = 0.02, P = 0.63$

Deforestation start year

required

Deforestation end year

required

Fire start year

required

Fire end year

required

Fire Emissions

Explore the implications of different reference level periods for fire emissions by selecting different start and end years for the forest fire RL. Save your selection by clicking the 'Next' button at the bottom of the page. While the average historical emissions and trendline are presented here for comparison, the REDD+ DST will present your reference level as the average historical

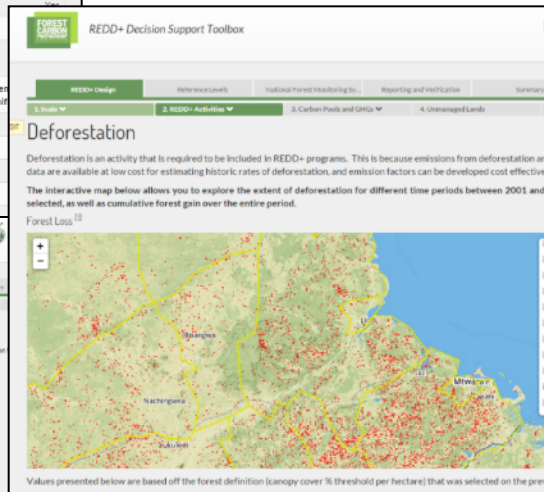
REDD+ Decision Support Toolbox

Helps informed decision-making by indicating where the greatest opportunities for emission reductions are

Deforestation				
Activity	Metrics	First-order Estimate	% of Total Emissions	Potentially Significant? [1]
Deforestation	tons CO ₂ e / year	260,064,900 [1]	64%	
Emissions from Peat Forests	tons CO ₂ e / year	0 [2]		

Degradation				
Activity	Metrics	First-order Estimate	% of Total Emissions	Poten Signif
Timber Harvesting / Forest Management	tons CO ₂ e / year	15,884,500 [1]	4%	
Fuelwood/Charcoal Production	tons CO ₂ e / year	1,400,000 [1]	0%	
Forest Fire	tons CO ₂ e / year	131,803,600 [1]	32%	
Total Degradation	tons CO ₂ e / year	149,088,100	36%	

Summary	
Activity	
Deforestation	
Total Degradation	
Total Emissions	
Potential Removals / Seg	



Emissions from forest degradation are approximately 35% of total emissions*

In accordance with FCPF Carbon Fund Methodological Framework requirements, if the estimated total emissions from forest degradation exceed 10%, you must include forest degradation in your REDD+ Design.

Include forest degradation in your REDD+ design?

* Yes

REDD+ DST Summary Report

Congratulations! You have completed all modules in the REDD+ Decision Support Toolbox. Below is a summary of the decisions you have made and customized reference levels of selected REDD+ activities.

Country: Colombia

Scale: Subnational, selected jurisdictions

Jurisdictions:

Forest definition: 20% canopy cover

Include unmanaged lands? None

Deforestation			
	Estimate (tons CO ₂ e/ year)	% of Total Emissions	Info
Reference Level	7,059,561	82.54%	This is an estimated deforestation reference level for the geographic area selected, based on the forest definition and carbon pools included. Estimates were produced by combining Activity Data derived from Hansen, et al. 2013, with Emission Factors derived from Saatchi, et al. 2011
Emissions from Peat Forests	0	0.00%	This is an estimated reference level for the emissions resulting from deforestation on peat lands in the geographic area selected. Estimates were produced by combining activity data derived from Hansen, et al. 2013 and a Map of Histosols from the Harmonized World Soil Database with Emission Factors derived from IPCC 2013 Wetlands Supplement
Carbon Pools/GHGs	Dead biomass, Litter, Methane (CH ₄), Nitrous oxide (N ₂ O)		
Reference Level Period	2001-2012		

Review - challenges

- Data diversity and volume is accelerating
- Attention spans are decreasing – more ‘non-GIS’ users expect to visualize, interact with, ask questions of data.
- Users in many countries lack capacity to appropriately act on RS data in a timely manner
- Developed-world based Researchers often do not have a window into how products are used ‘on the ground’ of development

Development Community's Role

- Long term, **stable relationships** needed between data producers and users are key
- Int. Development community, including Winrock, understand the **context** that drives decision making in countries
- Challenge for countries isn't just technical capacity, it's **bandwidth and continuity**. Int. NGOs can bridge this gap.
- **Curated products & tools** that can be jointly managed by researchers and country reps. are the way forward.
- If you package RS data and analysis in attractive way, it can be adopted without need to mandate via law or policy

THANK YOU

winrock.org



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