Pre-Workshop Survey

Project Webpage

MICHIGAN STATE UNIVERSITY: FOREST CARBON AND CLIMATE PROGRAM

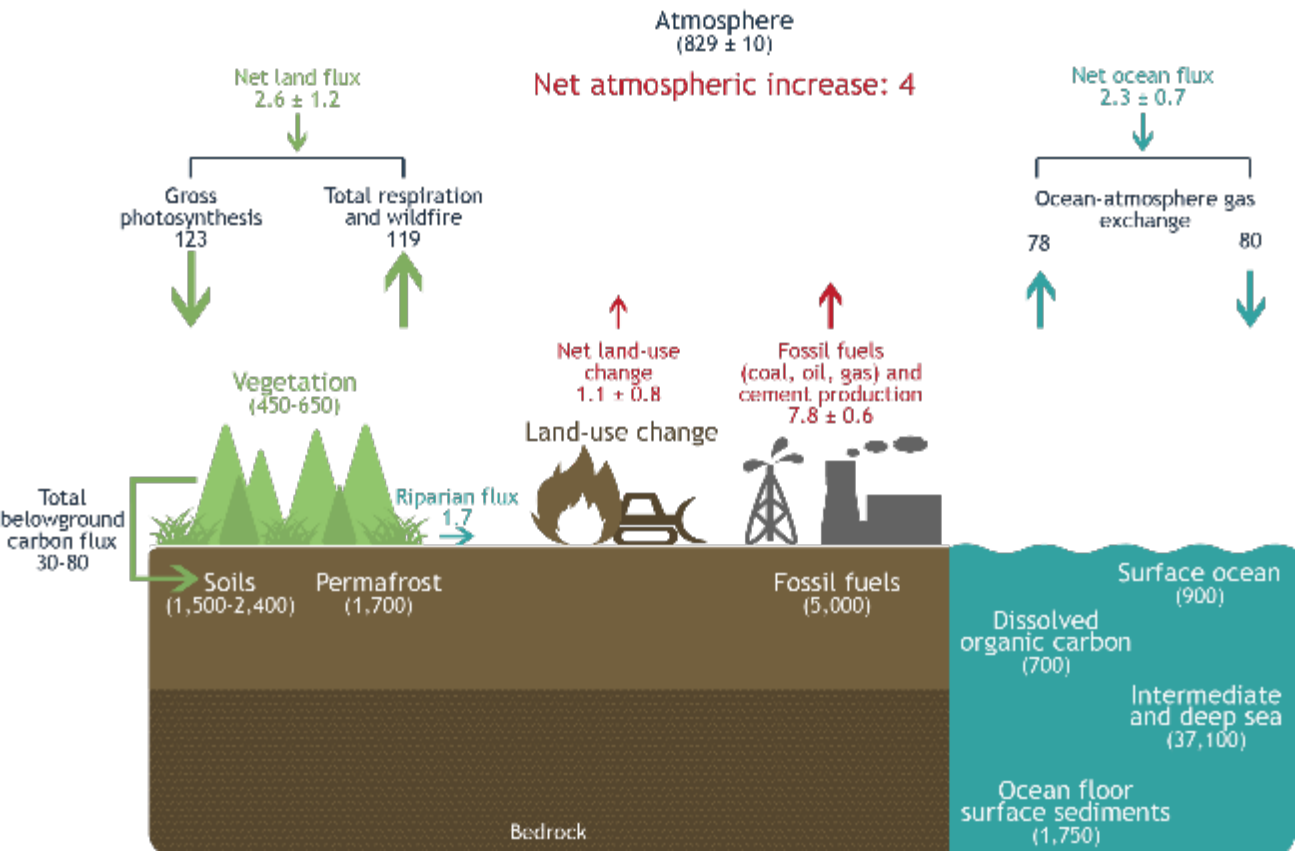
Building forest carbon market decision support

Chad Papa, Ph.D., director, forest carbon and climate program
Raju Pokharel, Ph.D., assistant professor, forest resource economics

Forest Carbon and Climate Program
Department of Forestry
MICHIGAN STATE UNIVERSITY

MSU FERM
MSU Department of Forestry
Forest Economics & Resource Management

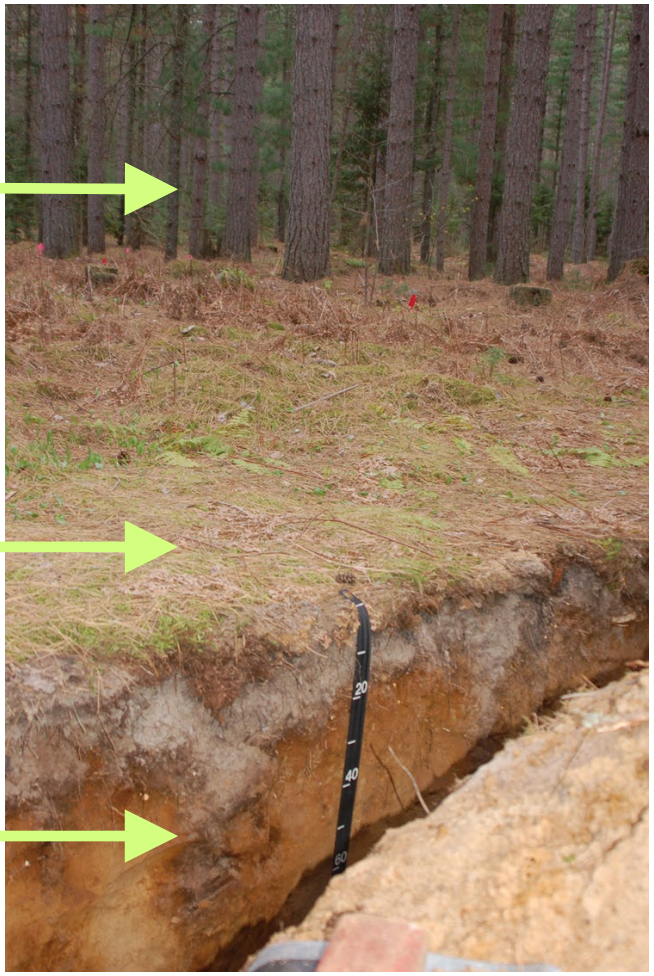
Forest carbon pools (stocks) vs fluxes



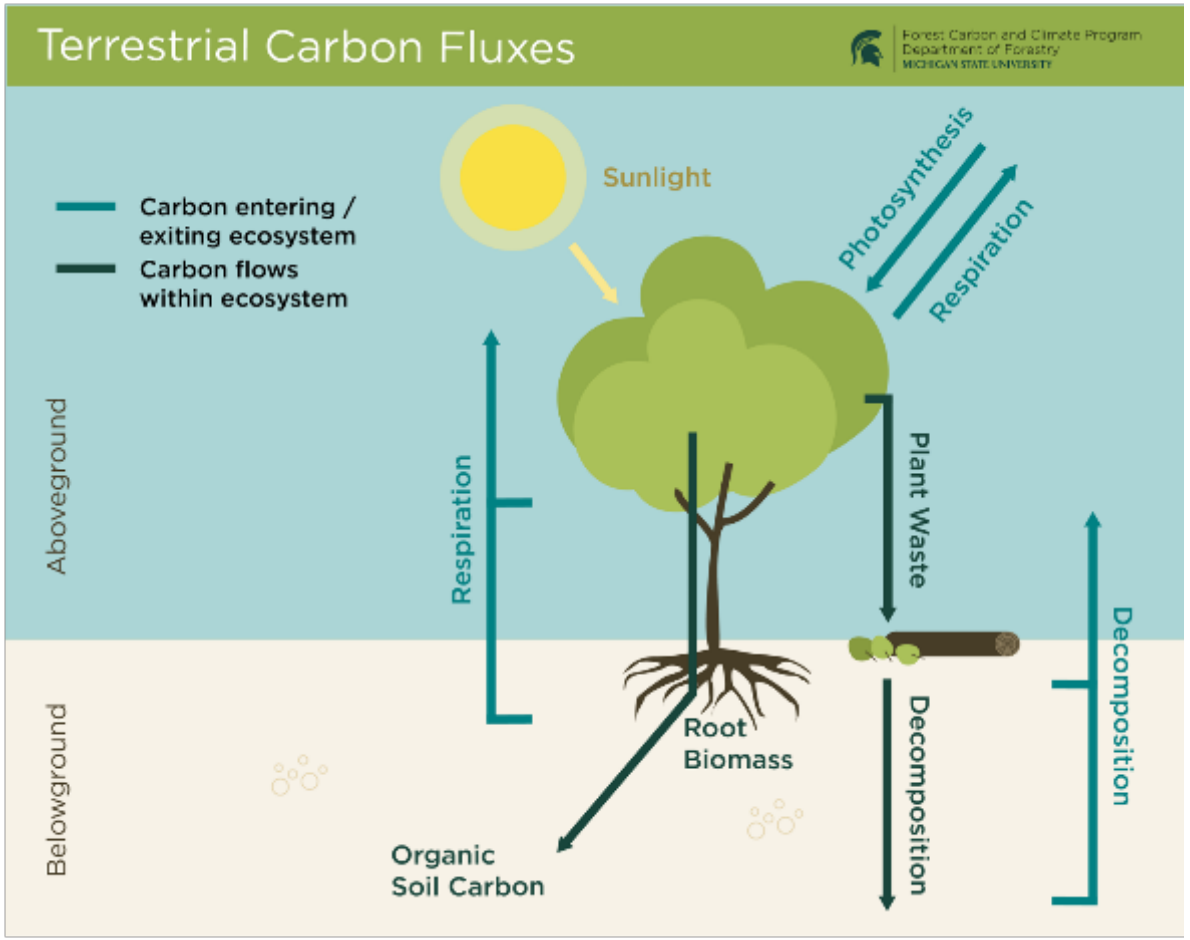
Living Biomass

Dead Biomass

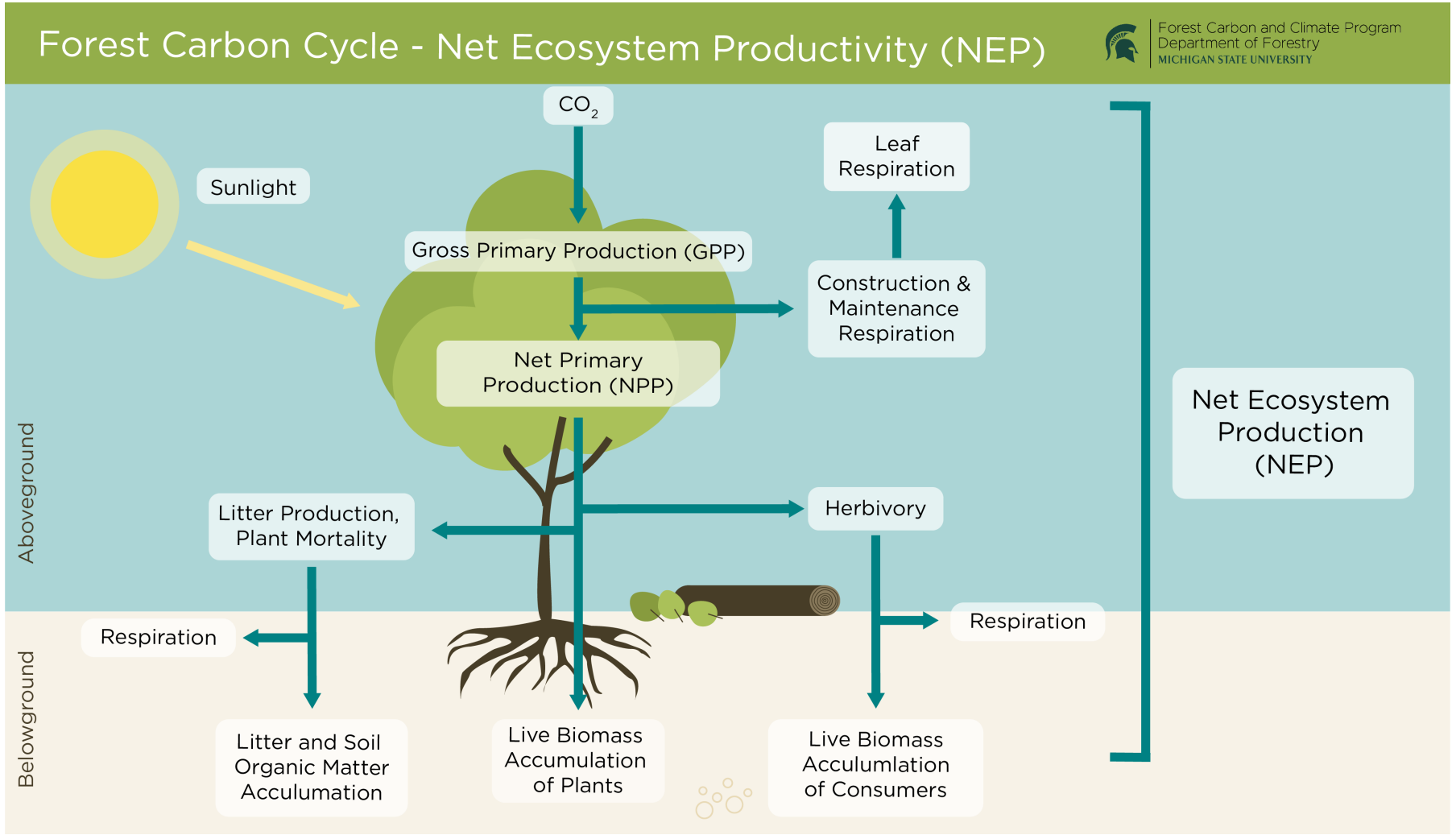
Soil Carbon



Forest carbon pools vs fluxes



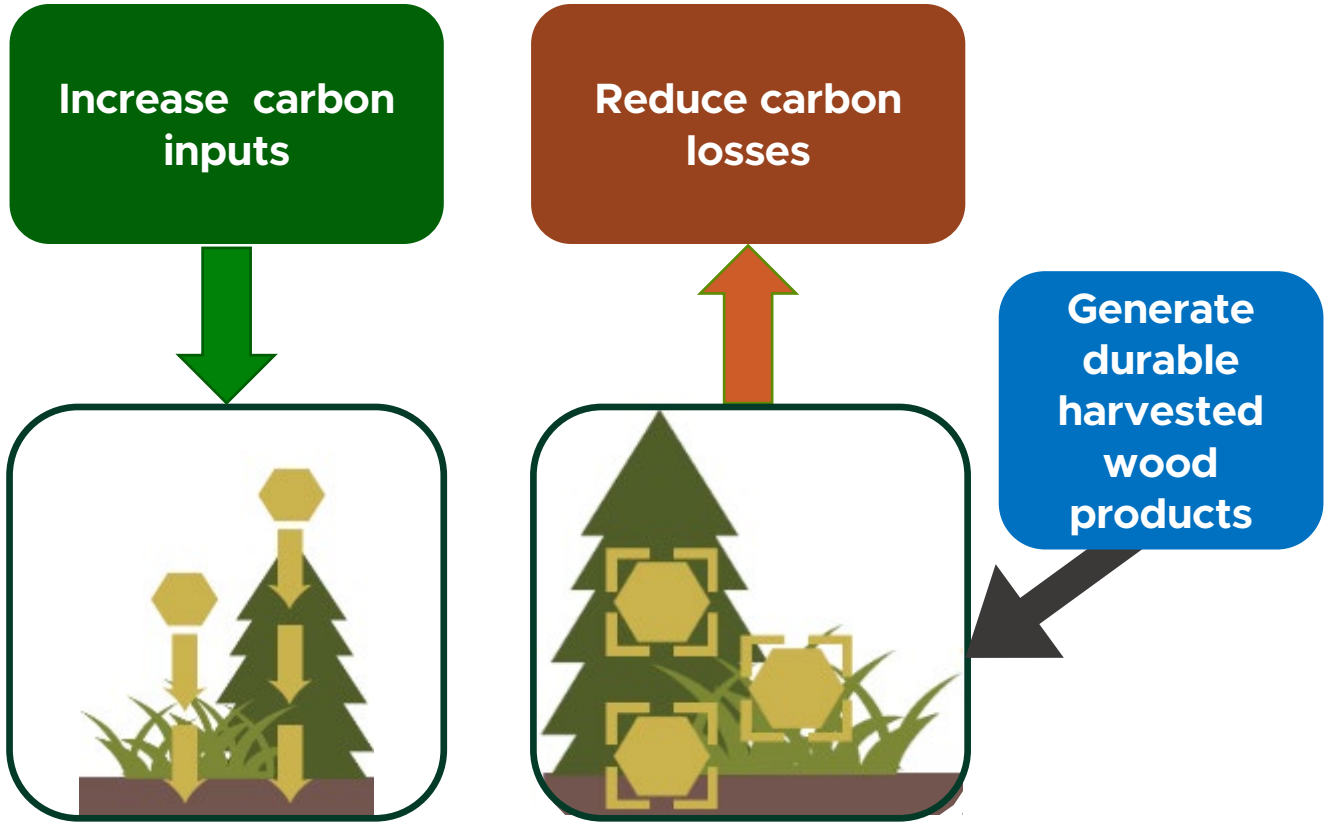
Forest Productivity



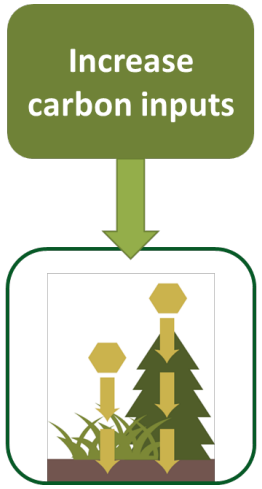
Forest Management Actions for Carbon

Management opportunities that create a more positive carbon balance in the ecosystem:

1. Increase inputs to carbon pools
   - Enhanced productivity (sequestration)
   - Transfer of existing carbon into other pools while maintaining sequestration rates
2. Avoid forest carbon losses from disturbance
   - Catastrophic wildfire
   - Widespread tree mortality (*e.g.* drought, pests or diseases)
3. Generate durable wood products



In the end, what matters is the NET GAIN of carbon to the OVERALL system (Forest + HWP)



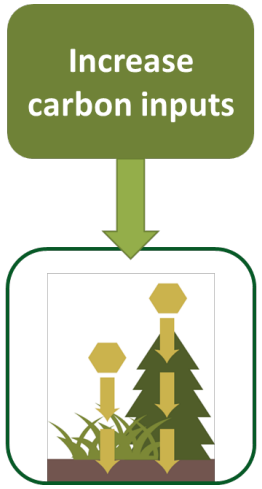
Management to Increase Carbon Inputs

Forest Productivity & Regeneration

- Enhancing growth of existing mature trees
- Improving forest health
- Improving tree regeneration to increase future productivity

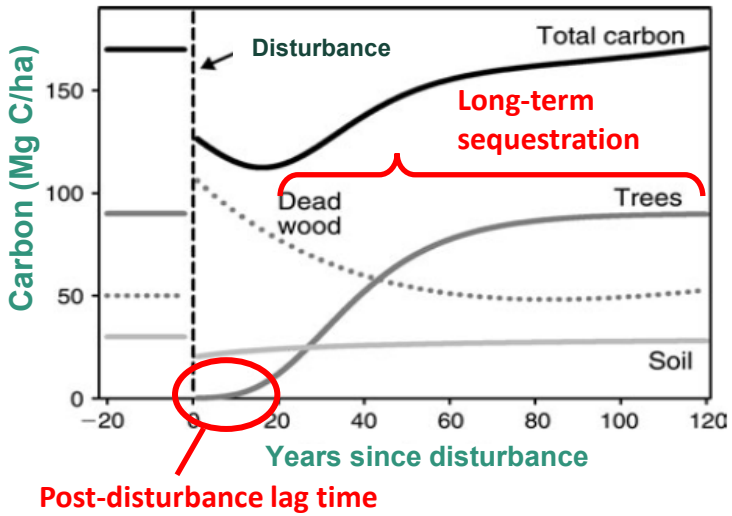
Existing Carbon Pools

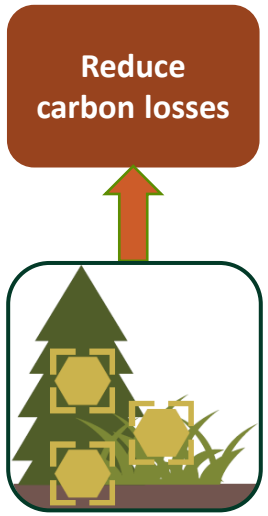
- Increasing stocking levels
- Enhancement of carbon in soil, litter, and coarse woody debris or standing dead pools



Afforestation and Reforestation

- **Afforestation**: planting of trees on non-forested lands, such as marginal agricultural sites, abandoned pastures, or other non-forest locations
- **Reforestation**: planting trees on understocked stands, often lacking in natural regenerations
- Both practices benefit carbon sequestration by increasing the density of trees and increasing site productivity as trees establish and grow larger





Management for Avoiding Forest Carbon Losses

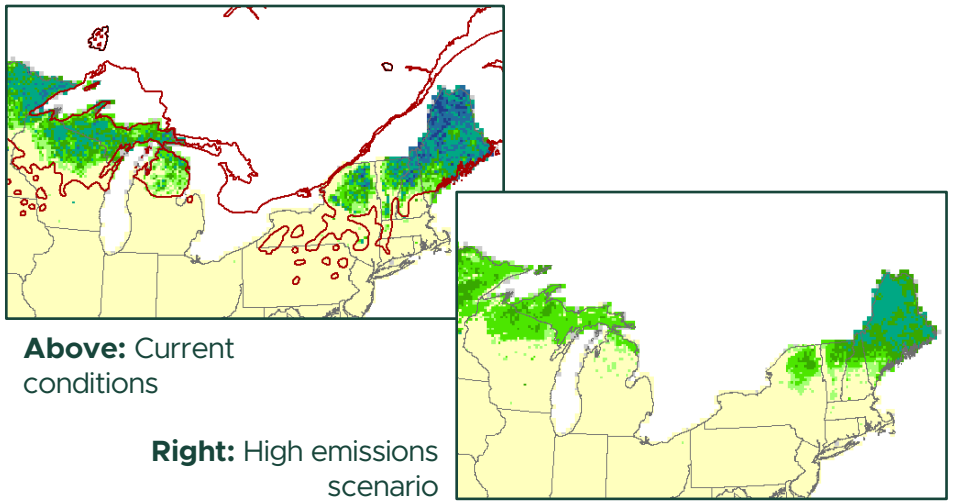
Reducing carbon losses requires assessment of risk for both immediate and long-term losses from a variety of disturbances

- Addressing vulnerability for forest productivity declines (*e.g.* forest health or regeneration concerns)
- Widespread mortality or loss of tree canopy cover

Vulnerability to large-scale carbon loss from insect damage

Photo: Widespread tree mortality in Rhode Island due to *Lymantria dispar*.

Suitable habitat projections for Balsam fir (*Abies balsamea*)



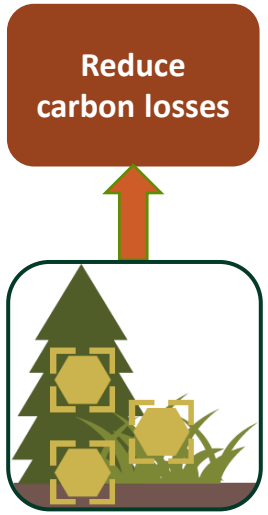
Above: Current conditions

Right: High emissions scenario

Risk of decreasing tree species habitat suitability

Images (left): NASA Earth Observatory

Figure (right): Peters et al. 2020

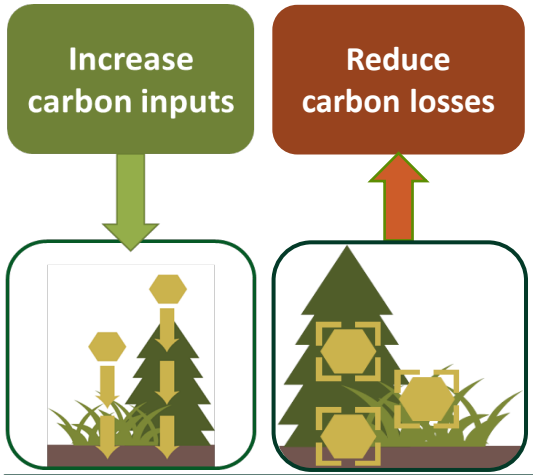


Carbon Implications of Common Forestry Practices:
Harvesting Infrastructure & Operations

Forestry best management practices (BMPs) for reducing physical impacts during forestry operations already exist, and become even more important in the context of a changing climate and managing to reduce carbon losses.

Practices include:

- Considering topography and soil type when laying out roads, skid trails, and landing sites: avoid slopes and wet soils
- Minimizing erosion: use bridge mats at stream crossing, water bars on slopes
- Minimize rutting and compacted soil: use slash on trails to spread equipment weight



Carbon Implications of Common Forestry Practices: Pre-commercial/ Commercial Thinning

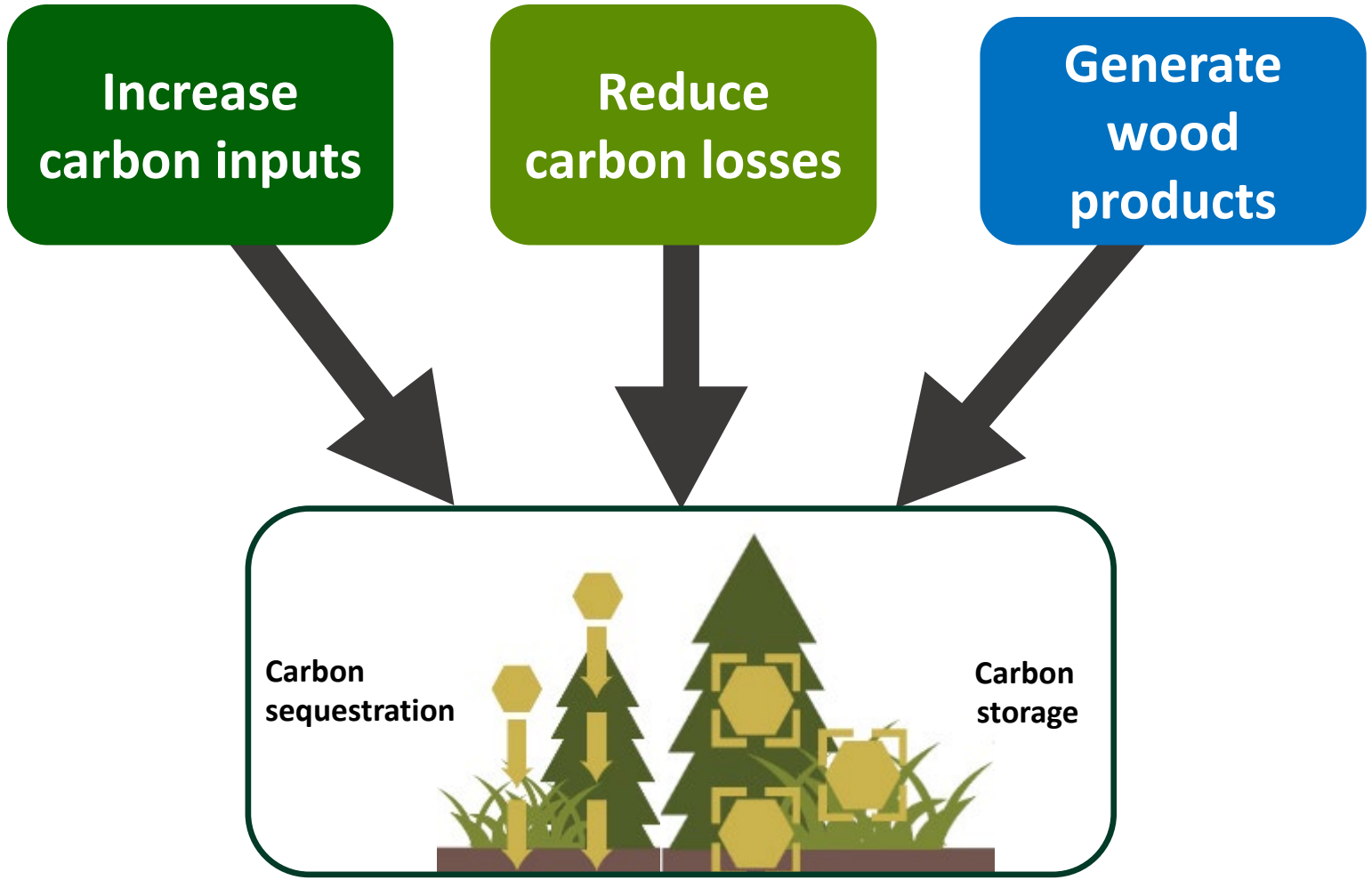
There are a multitude of benefits that result from thinning overstocked forest stands.

Thinning can:

- Improve the growth of remaining trees (enhance long-term sequestration)
- Alter species composition and structure of old even-aged stands to favor adapted species (improve long-term storage)
- Increase the resistance of trees to the impacts of drought and insect pests that cause mortality (improve storage)
- Benefit wildlife habitat
- Reduce wildfire risk
- Help retain mature forest conditions that many landowners prefer

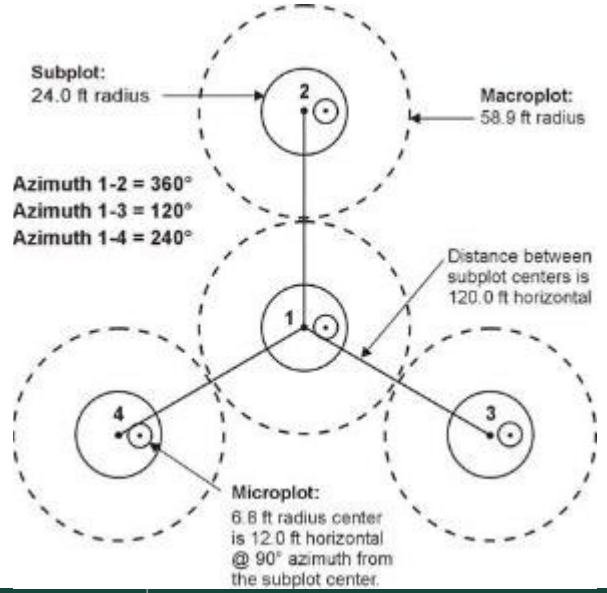
Image: Tony D'Amato

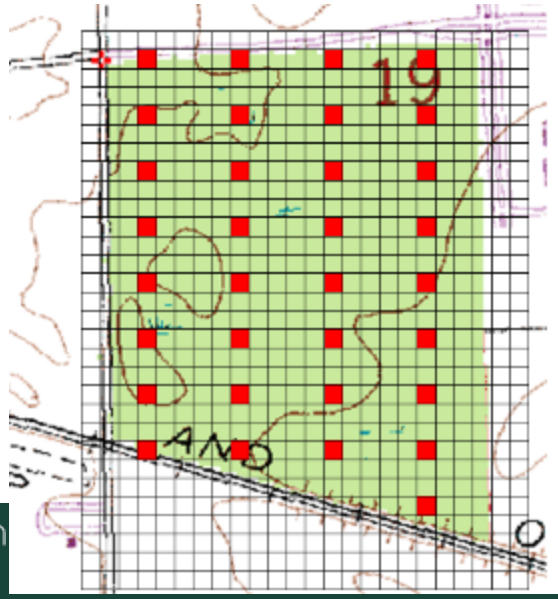
Pathways for Forest Carbon Mitigation

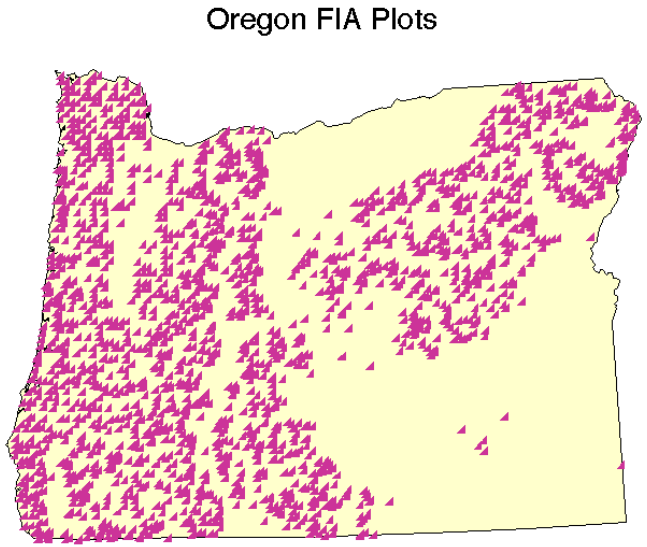


Forest carbon inventories

- Sampling trees and forest stands to collect information on:
  - Number, size, composition…
- Convert forest measurements to Carbon using specific gravities – called: Allometry



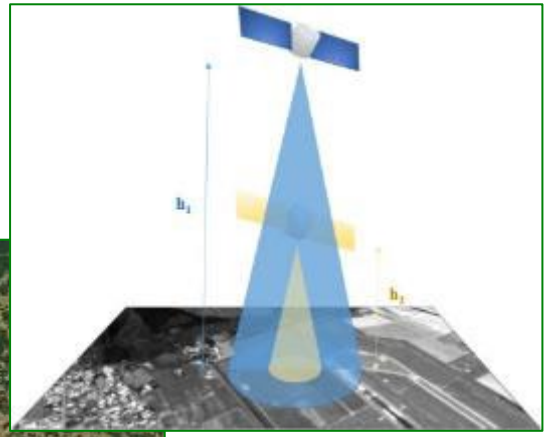




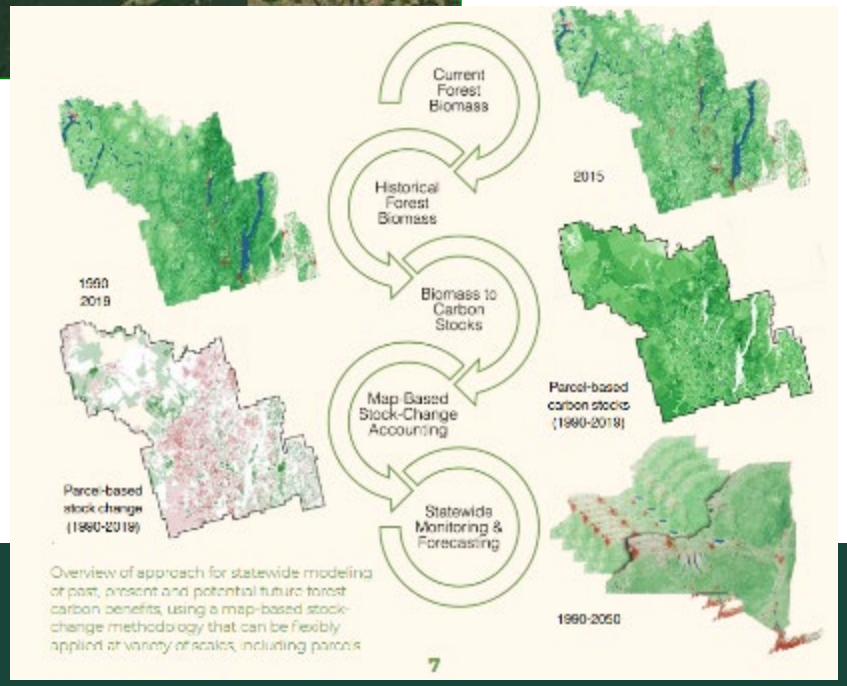
Remote Sensing: Satellite

Remotely-Sensed Observations

- Extent of forests
- Biomass quantification
- Changes in forests over time with repeat images
- Challenges with capturing degradation
- Resolution generally ranges from 1 m to 250 meters
  - Spatial resolution is a measure of the smallest object that can be resolved by the sensor



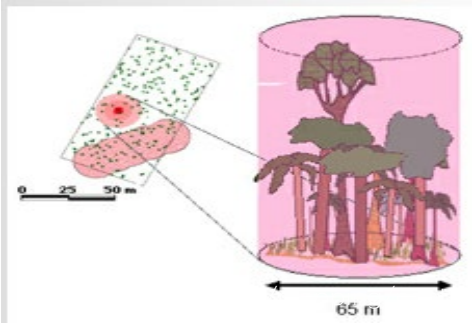
State of Rondônia in western Brazil, 2007
Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Terra satellite



1. Measure forest structures

2. Translate structure to mass / carbon

3. Estimation over larger spatial scales



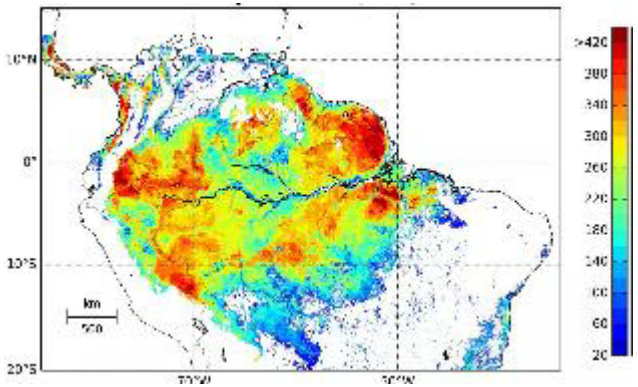
Remote Sensing Tools

Calibration & Verification

Ground Data: forest (tree) measurements / inventory

Biomass (allometric) Equations

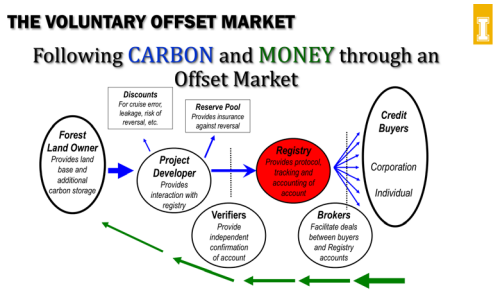
Forest Biomass/ Carbon Stocks



Source: Rödig et al., Global Ecol Biogeogr. 2017

CARBON 101 TERMINOLOGY

Carbon Offset vs Carbon Credit



Carbon Offset: A tool for claiming "rights" to carbon emissions reductions generated somewhere else in the world through the buying and selling of certificates representing a specific volume of emissions. To offset the GHG emissions that we cannot reduce in the short term, MetLife supports a diverse portfolio of third-party-certified emissions reduction and renewable energy generation projects in certain countries where we operate. MetLife seeks out and supports projects that empower local economies and align with the United Nations Sustainable Development Goals (UN SDGs).

What you do

Carbon Credit: A transferable instrument, certified by governments or independent bodies, and represents a reduction in GHG emissions of one metric tonne of CO_2e. As such, a carbon credit is a generic term for any tradable certificate or permit. These represent the right to emit a set amount of carbon dioxide, or the equivalent amount of a different greenhouse gas.

How you do it

2022 SUSTAINABILITY REPORT

MetLife

https://greenbusinessbureau.com/topics/carbon-accounting/carbon-offsets-vs-carbon-credits/

Green Business Bureau

Department of Forestry
MICHIGAN STATE UNIVERSITY

Slide credit: Greg Latta

CARBON 101 TERMINOLOGY

1. **Reliability** – the emissions reduction (*or sequestration*) must be additional and that includes onsite and offsite effects (*so leakage*)
   - **ADDITIONALLY**: Project must demonstrate how it is going to increase carbon stocks in the project area
   - **LEAKAGE**: Occurs when the GHG reductions in one area results in the increase of GHG reductions in another area
2. **Durability** – they also need to stick around (*or we need to account for the project timeframe*) and insure against unforeseen losses through reserve pools
   - **PERMANENCE**: Must show project maintains benefits for a period of time
   - **INSURANCE**: Projects must contribute to buffer pool to insure against potential future reversals

Slide credit: Greg Latta

How It Works

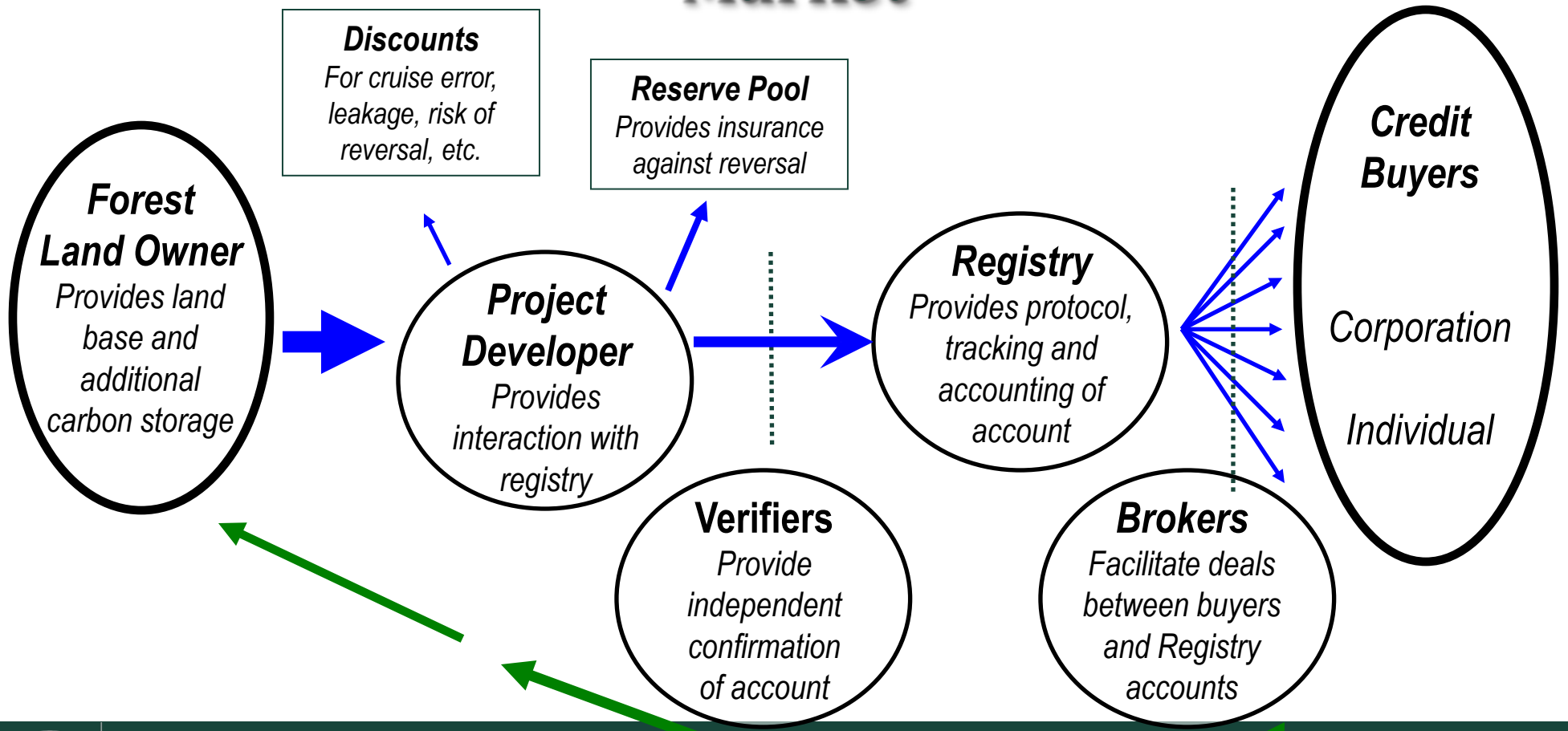
- Landowners enroll their forested lands into the program.
- They agree to specific practices, such as improving forest management, extending harvest rotations, or avoiding deforestation.
- Carbon credits are generated based on the additional carbon stored or emissions avoided.
- These credits are verified by third parties and sold to entities (e.g., corporations or governments) seeking to offset their carbon footprints

Slide credit: Greg Latta

THE VOLUNTARY OFFSET MARKET

Slide by Dr. Greg Latta, University of Idaho.

Following CARBON and MONEY through an Offset Market



How are landowners paid?

Paid for managing forests to sequester additional carbon compared to **Additionality**

Business-as-usual management activities (baseline)

There are two mechanisms of payment in general.

1. Paid on per tonne CO2eq (generally negotiated)

2. Paid on a per-acre basis

Slide credit: Greg Latta

How are landowners paid?

1. Paid on per tonne CO2eq (generally negotiated)

   - Project Developers work with landowners to establish a baseline, and change in management activity, leading to additionality
   - Developer help with the verification and sale of credits
   - Targeted to large landowners, at least a few thousand acres.

2. Paid on a per-acre basis

Slide credit: Greg Latta

How are landowners paid?

1. Paid on per tonne CO2eq (generally negotiated)
2. Paid on a per-acre basis

- Project Developers recruit landowners to change management activity and pay on a per-acre basis.
- The developer pools the land base from multiple landowners, estimates and verifies the additionality, and gets paid for the carbon sequestration credits.
- Targeted to small landowners
  - (40 acres and more, can be implemented on fewer acres if they are productive)

Slide credit: Greg Latta

Webtool to estimate economic tradeoffs of extending rotation for Forest carbon management

The tool is built using the Excel Workbook to support Level I Quantification Approaches for the managed Forest Systems Chapter within the 2024 update to the USDA Publication "Quantifying Greenhouse Gas Fluxes in Agriculture and Forestry: Methods for Entity-Scale Inventory."

https://msuresecon.com/carbon/

VERSION 1.0 Excel Workbook to Support 'Level I' Quantification Approaches for the Managed Forest Systems Chapter within the 2024 update to the USDA Publication *Quantifying Greenhouse Gas Fluxes in Agriculture and Forestry: Methods for Entity-Scale Inventory*

Stockmann, K.; Lister, A.; Murray, L.; Woodall, C.; Nepal, P.; Smith, J.; Gu, H.; Khatri, P.; Urbanski, S.; Riley, K.; Shaw, J. 2024. USDA Greenhouse Gas Flux Entity-Scale Guidelines for Managed Forest Systems Level 1 Workbook Tool (Version 1.0)