Sustaining Southeastern Forests: The Economic and Water Use Impacts of Privately-Owned Pine Woodlands and Restored Longleaf Pine Forests

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Thank you!
Management Challenges

Landowners face real and perceived economic barriers with native longleaf pine restoration.

Drought period hydrology leads to declining aquatic biodiversity in some Southeastern streams.

Forest restoration of longleaf or loblolly pine may offer landscape-scale benefits, but costs to producers and partners must be quantified.
Key Take-Aways

1. Open pine management may improve wetland hydrologic function during drought periods.
2. Where strong pine straw markets exist, longleaf pine straw management is profitable without financial assistance.
3. Additional payments or restructuring of benefits could realize fuller benefits of loblolly and longleaf open pine systems.
4. Loblolly open pine systems may even be more cost-effective measure for water use management.
Longleaf Pine Ecosystems

Sparse overstory & diverse understory.
Multiple age classes.
Maintained through Indigenous and lightning-ignited fires.
29 threatened and endangered species.
A Landscape in Transition

Photos: Georgia Encyclopedia, Library of Congress/Lewis Hine, United States Forest Service, Bugwoodcloud.org
An Imperiled Ecosystem: 4 million acres to 8 million acres?
NRCS Longleaf Pine Initiative (2010)
2021 Leader in Longleaf Establishment: 52,406 acres
Environmental Quality Incentives Program (EQIP)

Practices including:

- 490 - Tree/Shrub Site Preparation
- 612 - Tree/Shrub Establishment
- 338 - Prescribed Burning
- 394 - Firebreak
- 666 - Forest Stand Improvement

Image: America’s Longleaf Restoration Initiative
Conservation Reserve Program (CRP): 250,000 Acres Established with native grasses on marginal croplands

Image: Natural Resources Conservation Service, United States Department of Agriculture,
Million-acre challenge for longleaf on public land – 80% complete!
USFS Forest Inventory and Analysis Data

Data: Oswalt et al. 2012, 2021
USFS Forest Inventory and Analysis Data

Data: Oswalt et al. 2012, 2021
A Sobering Reality

How to incentivize the continued management of longleaf pine into older age classes and desired conditions?

- *Private lands restoration*
- *Corporate partnerships*
- *Fee simple and easement acquisitions*

McIntyre et al. 2016
Emerging Ecosystem Service Markets

CARBON  WATER QUALITY  WATER QUANTITY?
Steamflows decrease during drought periods after groundwater withdrawals for agricultural irrigation.
Aquatic species of concern affected may lose habitat connectivity or living conditions during low flows.
Costly and insufficient.
Improved forest management.
Improved forest management.
Loblolly Pines: Native but offsite?
Loblolly Pines:
Primary Commercial Pine
Improved forest management.
Longleaf Savanna

Advantages

Sparse overstory.
Grass-dominated understory.
Drought-hardy plant adaptations.
Loblolly Savanna Advantages

Sparse overstory.
Grass-dominated understory.
Drought-hardy plant adaptations.
Research Questions

What are the economic barriers for landowners to adopt forest restoration?

What are the hydrologic impacts of restoring longleaf pine savannas compared to other forest management scenarios?

How could landscape-scale restoration improve water flows - and at what cost?
Methods

Forest planning
Vegetation modeling
Discounted cash-flow analysis
Hydrological Modeling
Key Assumptions

Land is an asset (and a liability).

Private landowners are diverse in objectives and approaches but generally share:
1. Cost Avoidance – financial assistance
2. Profit Maximization – management

*Others value wildlife, aesthetics, recreation or other aspects more than strict economics!*
Short-rotation Forest Management Parameters

*Draw financial distinction from long-rotation practices which improve ecosystem health.*

Longleaf Management: (Dickens, Paudel)
- Pine straw raking age 10 to first thinning;
- Thin at 115 ft²/acre to 65 ft²/acre
- Final harvest when Net Present Value maximized
- No burning

Loblolly Management: (Dickens, Paudel)
- Thin at 115 ft²/acre to 65 ft²/acre
- Clearcut when Net Present Value is maximized
- No burning
100-Year Restoration Management Parameters

*Draw ecological distinction from short-rotation practices which maximize income.*

**Longleaf:** (NRCS and literature recommendations)
- 40-70 ft²/acre
- 2 Year Fire Return Interval
- Native Warm Season Grass, pollinator establishment
- Density and competition control

**Loblolly:** (Tall Timbers, Piedmont NWR)
- 40-70 ft²/acre
- 2 Year Fire Return Interval (After Year 12)
- Native Warm Season Grass, pollinator establishment
- Density and competition control

Image: Chambers English
Financial Calculations

Net Present Value (NPV)
Annualized Equivalency Value (AEV):

\[
NPV = \frac{R_t}{(1+i)^t}
\]

\[
AEV = NPV \left( \frac{i(1+i)^t}{(1+i)^t-1} \right).
\]

R = revenue (cost)

i = discount rate

t = time (years)
Financial Calculations

Net Present Value (NPV)
Annualized Equivalency Value (AEV):

\[ R = \text{revenue (cost)} = 100 \]
\[ i = \text{discount rate} = 5\% \]
\[ t = \text{time (years)} \]

<table>
<thead>
<tr>
<th>t (Years)</th>
<th>0 (Today)</th>
<th>5</th>
<th>10</th>
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<tbody>
<tr>
<td>NPV</td>
<td>$100</td>
<td>$78</td>
<td>$61</td>
</tr>
<tr>
<td>AEV</td>
<td>Present!</td>
<td>$18</td>
<td>$8</td>
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# Example Timeline: Longleaf Restoration

<table>
<thead>
<tr>
<th>Practice</th>
<th>Rotation Year</th>
<th>Cashflow</th>
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</thead>
<tbody>
<tr>
<td>Site preparation, tree establishment</td>
<td>0</td>
<td>(-)</td>
</tr>
<tr>
<td>Prescribed fire</td>
<td>Biennial</td>
<td>(-)</td>
</tr>
<tr>
<td>Firebreak, property maintenance</td>
<td>Annual</td>
<td>(-)</td>
</tr>
<tr>
<td>Taxes</td>
<td>Annual</td>
<td>(-)</td>
</tr>
<tr>
<td>Timber revenue</td>
<td>20, 30, 55, 85</td>
<td>(+)</td>
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</table>
**CRP:** 50% financial assistance, Sign-up Incentive, and 10-year rental payment

**EQIP:** 75% financial assistance
Loblolly Pine

Forest productivity

Graph showing the relationship between AEV and Site Index for different forest productivity scenarios:
- Loblolly Timber - Standard
- Loblolly Timber - EQIP
- Loblolly Timber - CRP
- Loblolly Rx - Standard
- Loblolly Rx - EQIP
- Loblolly Rx - CRP
Hydrological Impacts
Hydrologic Discussion

Gallons per acre
Dollars per gallon
Time to benefit
Broader Implications

Ecosystem service objectives

Long-term commitments

Contract existing stands:

- Improve AND retain long-term
- Opportunities beyond longleaf
Carbon versus Water?

Carbon offset markets

Trees ~50% carbon - Aboveground carbon most easily quantified

Pay landowners to plant more trees, grow longer, or otherwise manage to increase carbon
Carbon versus Water?

General hydrologic tradeoffs and specific regional ecological impacts have been highlighted.

Global vs. local markets:
1. Specific focal watersheds
2. Higher premium for restored open pine systems
3. Quantifying belowground carbon stocks


Easements or Annuities?

Long-term commitments to compensate landowners for timber value lost while managing restoration scenarios.

*Plant and walk away is not working!*
Easements or Annuities?

Difference in NPV may indicate potential easement values depending on site productivity above “baseline” loblolly income scenarios:

Easement values: $160-$700/acre

Annual payments: $11-$48/acre/year

Longleaf restoration cost 2-3x as much as loblolly restoration from this baseline.
Key Take-Aways

1. Open pine system management may improve wetland hydrologic function during drought periods.
2. Loblolly open pine systems may even be more cost-effective measure for water use management.
3. Where strong pine straw markets exist, longleaf pine straw is profitable without financial assistance.
4. Additional payments or restructuring of benefits could realize full benefits of loblolly and longleaf open pine systems.
Future Work

Spatial prioritization and optimization

Quantifying local stream impacts of restoration efforts

*Bring forest to water markets to life in Georgia and beyond!*
Thank you!