Carbon Sequestration Valuation of United States Forests and the Potential for Policy Impacts

Presentation by Kate Zook, USDA

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Why forest carbon?

- Forest Service Planning Rule
- USDA Building Blocks for Climate Smart Agriculture and Forestry
What makes this case study different?

- Scale
- Social Cost of Carbon
Part 1: quantifying and projecting forest carbon

- Forest Inventory and Analysis (FIA) data
- Forest trends and predictions
- Observations from over 350,000 monitoring locations across the US
- Wear and Coulston (2015)
- Projections of future land use and forest carbon
- Land use and disturbance (e.g. cutting, fire, insects & diseases) derived from plot records are integrated
Part 1: quantifying and projecting forest carbon

Modeled Scenarios:

1. **Reference**: no net gains in forestland in the next decade followed by a slight decline in forest area through 2050
2. **Reduced development**: less conversion to development and no net loss of forest beginning in 2025
3. **USDA afforestation/reforestation policies**:
   - CRP policy in the Eastern US (30 million acres)
   - Reforestation of federal forests in the Western US (about 7.4 million acres)
4. **Fire suppression policy**: 10% reduction of fire occurrence throughout the US
## Part 2: applying SCC

### Table 1. SCC estimates ($U.S. 2016) per Ton of CO2 Sequestered (Emitted)

<table>
<thead>
<tr>
<th>Year</th>
<th>5%</th>
<th>3%</th>
<th>2.5%</th>
<th>3% discount rate and 95\textsuperscript{th} percentile Equilibrium Climate Sensitivity (ECS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>$13</td>
<td>$42</td>
<td>$65</td>
<td>$121</td>
</tr>
<tr>
<td>2020</td>
<td>$14</td>
<td>$49</td>
<td>$72</td>
<td>$142</td>
</tr>
<tr>
<td>2025</td>
<td>$16</td>
<td>$53</td>
<td>$79</td>
<td>$160</td>
</tr>
<tr>
<td>2030</td>
<td>$19</td>
<td>$58</td>
<td>$84</td>
<td>$176</td>
</tr>
<tr>
<td>2025</td>
<td>$21</td>
<td>$64</td>
<td>$90</td>
<td>$194</td>
</tr>
<tr>
<td>2040</td>
<td>$24</td>
<td>$69</td>
<td>$97</td>
<td>$212</td>
</tr>
<tr>
<td>2045</td>
<td>$27</td>
<td>$74</td>
<td>$103</td>
<td>$228</td>
</tr>
</tbody>
</table>

Methods

$C_1$ and $C_2$: CO$_2$e sequestered
$P_t$: SCC

- Computed a vector of annual SCC levels ($ per t CO_2$) for years 2015-2045 by assigning each SCC estimate in Table 1 to the midpoint of its five year range and interpolating between the midpoint SCC estimates
- Multiplied the vectors of annual carbon sequestration and SCC together and summed to get total NPV ($ million)
- For each year between 2015 and 2045, we multiplied annual carbon sequestration times nominal SCC, and discounted to the base year (2015) to get net present value ($ million)
Results: Carbon Projections

Projected annual carbon sequestration in forests of the coterminous U.S. under different policy scenarios (Coulston and Wear, unpublished).
**Results: Dollar values**

Present net value ($ billion) of projected CO$_2$ sequestered in US forests from 2015 to 2045 under alternative forest carbon policy and SCC discount rates

<table>
<thead>
<tr>
<th>Policy scenario</th>
<th>Discount rate</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5%</td>
<td>3%</td>
<td>2.50%</td>
<td>3% and 95th Percentile</td>
</tr>
<tr>
<td>Reference</td>
<td>110.7</td>
<td>449.7</td>
<td>704.6</td>
<td>1339.6</td>
</tr>
<tr>
<td>Reduced development</td>
<td>117.6</td>
<td>480.7</td>
<td>753.6</td>
<td>1433.9</td>
</tr>
<tr>
<td>Afforestation and Reforestation</td>
<td>135.1</td>
<td>556.5</td>
<td>872.5</td>
<td>1661.6</td>
</tr>
<tr>
<td>Fire Suppression</td>
<td>147.3</td>
<td>566.0</td>
<td>887.5</td>
<td>1690.0</td>
</tr>
</tbody>
</table>
## Results: Marginal dollar values

Increase in present net value ($ billion) of each forest carbon policy relative to the reference scenario under alternative SCC discount rates

<table>
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<th>Discount rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5%</td>
</tr>
<tr>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>Reduced development</td>
<td>6.9</td>
</tr>
<tr>
<td>Afforestation and Reforestation</td>
<td>24.4</td>
</tr>
<tr>
<td>Fire suppression</td>
<td>36.6</td>
</tr>
</tbody>
</table>
Results: Summary

• There is a high value associated with the impact of both current (reference) and hypothetical modeled policies on U.S. forest carbon.

• Changes in USDA policy can have a large effect on the value of carbon stored in U.S. forests.

• Other things to consider:
  • Additional costs and benefits
  • Co-benefits (water quality, habitat, resource outputs, etc.)
  • Policy costs (estimates are needed for a full cost-benefit analysis)
  • Sources of uncertainty
    • Forest carbon estimates
    • Social Cost of Carbon
    • Voluntary incentives and adoption
Research needs for improvement

• **Continued support of USDA’s Forest Inventory Analysis is important.**

• **Support for research and development efforts to improve data on both quantifying and projecting carbon in forests, and estimating the per-ton value of carbon is needed.**

• **Research on private landowner response to afforestation or reforestation incentives is needed.**
Thank you!

This effort would not have been possible without the help of many collaborators:

- Robert Haight, USFS
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