New Frontiers in Forest Economics & Policy

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Pine Plantation Research and Decision Support Tool Rollout
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PINEMAP- Economic and Policy Team

- Multi-scale policy and economic analysis of forest benefits and services
- Framework to guide land manager decision-making in projected climatic conditions
- Analyses used to evaluate regional tradeoffs and interactions

Example Studies

1. Optimal harvest in southern pine plantations considering the risk of wildfires and payments for carbon sequestration
2. Impacts of climate change disturbance risk in even-aged forest management
3. Impacts of a hypothetical arrival of novel forest pest that infests loblolly pine forests
4. Efficiency of ecosystem services in loblolly pine forests under climate change
5. Impacts of forest management on water yield and altered climatic conditions on the profitability of loblolly pine forests

1. Optimal harvest with wildfires and carbon prices

- Two generalized models
  - Natural disturbance risk
  - Carbon sequestration payments

- Disturbance risk and C payments affect rotation age and economic returns:
  - Higher future C payments → shorten current harvest age, lengthen future harvest age
  - Higher future risk → lengthen current harvest age, shorten future harvest age

- Net impacts depend on which signal is stronger

- **Policies** with long lasting effects on the carbon markets could influence forest landowners to **invest in current reforestation or divert other lands to timber production**

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2. Impacts of climate change on even aged stand management

- Assuming an increased disturbance risk and forest productivity (up to 20%)
- Increased disturbance risk → reduced economic returns (LEV)
- Economic rents are very sensitive to disturbance events
- At some levels, investing in forestry *not* economically viable regardless of the silvicultural efforts to mitigate climate change
  - Changes in productivity a *big* caveat

2. Impacts of climate change on even aged stand management

- Tradeoffs between the potential market (and social) value of sequestered C and economic rents
  - Greater economic rents from Loblolly-low density than Lob-high density (sawtimber)
  - Less C from Lob-low than Lob-high

- Mitigating climate change-forced disturbances (if C is adequately priced)
  - **Adaptation strategies more efficient in Lob-low** (LEV/C) compared to baseline Lob-high
  - **Lob-low generate more LEV per Mg of sequestered C** (economically more efficient)

- Planting fewer loblolly pines per hectare expected to generate higher LEVs (depending on C price)

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3. Impacts of new pest insects on loblolly pine forests

- Nationally, invasive species cause over $120 billion/year

- Every 5 to 6 years, one new alien-forest insect species results in significant ecological or economic damage in the U.S.
  - Will increase with CC and trade

- We determined the partial economic impact of a hypothetical threat (ambrosia beetle) by comparing two alternative scenarios:
  - 1) *status quo* (no additional control of a new ambrosia beetles)
  - 2) a proactive scenario combining more prevention and detection (30 and 100% prevention)

3. Impacts of insect on loblolly pine forests

- Increased enforcement of **international phytosanitary standards** (ISPM) for preventing the establishment of ambrosia beetle (30% and 100%) increases economic revenue by **$791 and $2772 per ha**, respectively

- Economic gains (around $4.6 billion dollars), would greatly outweigh the cost of programs that reduce establishment of exotic insects (e.g. EDRR program)

- Critical Future Research: consider damages of new pests to non-timber benefits:
  - Assess the real magnitude of costs
  - Inform the design of feasible and economically-effective control policies that ensure the sustainability of forestlands in the US

4. Efficiency in ecosystem services production with CC

- Assessed efficiency in the production of ecosystem services from loblolly pine forest plots
- Nonparametric approach known as data envelopment analysis
- We defined inputs (site index, age, number of trees and climatic variables) and outputs (timber, carbon sequestration, and species richness)

4. Efficiency of ecosystem services under climate change

- Climate change-driven altered temperatures and precipitation over time has a *small* negative impact on ecosystem services efficiency

- However, silvicultural practices that reduce the number of trees (e.g., thinnings and lower planting density) significantly improve the supply of timber production, carbon sequestration and species richness.

5. Impacts of forest management on water yield

- We assessed the impacts of climate change, forest management, and different forest productivity conditions on the water yield and profitability of loblolly pine stands in the SE US
- Using the 3-PG (Physiological Processes Predicting Growth) model, we determined different climatic projections, and incorporated prices for timber and increased water yield

5. Impacts of forest management on water yield

- Under changing climatic conditions, **water yield increases with thinnings and low levels of tree planting density**
- On average, under moderate climatic conditions, water yield increases by 584 kL per ha and 97 kL per ha for low and high productivity conditions, respectively
- Under extreme climatic conditions, water yield increases by 100 kL per ha for low productivity conditions.
- Economic returns increase by 96% ($6653.7 per ha) and 95% ($6424.1 per ha) for each climatic scenario compared to unthinned loblolly pine plantations managed only for timber production and under current climatic conditions

Big picture…

- CC-related disturbance risks offset productivity gains
  - Reduces forests' ability to provide timber, biodiversity, and C sequestration
  - Importance of disturbance risk and C sequestration prices to optimal management
  - Novel tree pests (signal may be greater than primary effects of CC)
- Adaptation (e.g., more resilient species) comes at a cost
  - Offsets losses, but less C sequestered
  - C markets help
  - Most landowners would participate
- Value of other ecosystem services
  - Notable C-water yield tradeoff
  - Forest water yield is economically feasible
  - Conflict with C sequestration efforts

Thank you.

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References

- Paper 1 (water), 2 (invasive), 3 and 4 (efficiency), 5 and 8 (risk and carbon), 6 and 7 (impacts of CC).

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