Optimal Use of Forestland Under Future Bio-Energy Demand Scenarios

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The Future of Forest Products in a Changing Climate: Bioenergy from Forests, Yale Forest Forum

February 1, 2022
Outline

• Why are we talking about bio-energy?
  • Overview of IAMs results
• What is the bio-energy debate about?
  • Potential issues
• Assessment of the effects of woody biomass demand on the timber market, land use and forest carbon stock
• Discuss policy instruments to address potential externalities
• Open questions
Why are we talking about bio-energy?

- Its consumption is likely to increase as the stringency of the temperature targets increases.
- Increasing role of bio-energy in the energy mix (e.g. 27% energy in 2050 under 1.5°C target).

Source: IIASA IAMC 1.5°C Scenario Explorer
Risks of using bio-energy from forests:

1. Decrease forest carbon sequestration (e.g. carbon debt) (Buchholz, et al. 2016; Birdsey, et al. 2018)
2. Reduce ecosystem services provided by primary forests (Searchinger et al. 2018; DeCicco et al. 2018)
The debate

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• Use the Global Timber Model (GTM) under different biomass demand pathways to assess these risks

Results based on:
• Alice Favero, Adam Daigneault, Brent Sohngen and Justin Baker (2022) “A system-wide assessment of forest biomass sustainability” Working Paper
Why GTM?

GTM is a forward-looking model:

• It maximizes the net present value of consumers’ and producers’ surplus in the forestry sector by selecting the age of harvesting timber and land conversion and management decisions

• System-wide approach: multiple ecosystem services / goods are considered simultaneously

• Intertemporal and spatial assessment: forests within and across regions are linked through markets
  • Today’s demand for woody biomass will affect future investments decisions
  • Today’s supply of woody biomass in one region will affect investment and land use decision in all the other regions
Baseline scenario

[Graphs showing trends for various metrics such as pulp quantity, timber quantity, timber price, total harvest, forest area, unmanaged forest area, carbon stock, and plant area from 2020 to 2100.]
Input: bio-energy demand pathways

Source: Favero et al. 2022
Market effects

Source: Favero et al. 2022
Land use effects

- **Zero**: Natural/Unmanaged Forests
- **Medium**: Naturally regenerated forests (managed with a wide range of harvesting techniques, but regenerated naturally)
- **High**: Intensively managed plantations

Source: Favero et al. 2022
Forest carbon stock effects

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Summary results

Effects of woody-biomass demand (value of wood increases)
1. more land will be converted to managed forests
2. more investments will be devoted to increasing growth and yield of managed forests
3. some traditional timber products will be replaced by woody biomass production
Summary results

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3. more investments will be devoted to increasing growth and yield of managed forests

Corresponding effects on forest carbon?

- **Carbon debt under low bio-energy demands** because higher timber prices encourage more harvesting of natural forests but not enough to drive an increase in investments in forest regeneration
Summary results

Effects of woody-biomass demand (value of wood increases)

1. more land will be converted to managed forests
2. some traditional timber products will be replaced by woody biomass production
3. more investments will be devoted to increasing growth and yield of managed forests

Corresponding effects on forest carbon?

- **Increase forest carbon stock (after initial reduction*)** under high demand pathways because they will encourage investments in forest management increasing the global carbon balance

*this study does not include avoided emissions because of fossil fuel substitution
Summary results

Effects of woody-biomass demand (value of wood increases)

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2. some traditional timber products will be replaced by woody biomass production
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Corresponding effects on natural/unmanaged forest?

- All demand scenarios project a loss of unmanaged forests, higher under high demands
Policy solutions

Policy options proposed to regulate bio-energy demand and avoid carbon debt:

• Tax on bio-energy consumption (Schlesinger et al. 2018)
  • Tax on bio-energy demand is not efficient because it does not recognize that forests also sequester carbon through growth
  • An efficient approach needs either a carbon tax and subsidy (Van Kooten, et al. 1995, *AJAE*) or carbon rental (Sohngen & Mendelsohn, 2003, *AJAE*)

• Carbon rental approach (Favero et al. 2020)
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Test both policies with GTM

• Rental scenario: forest owners receive rents for the stock of carbon in forests
• Tax scenario: tax on carbon emissions upon harvests for energy

Measure policy efficiency as the policy that delivers the highest level carbon benefit (=increase in forest carbon) per quantity of bio-energy produced
Effects of the policies on forests carbon stock

The tax scenario delivers lower forest carbon stock (lower carbon benefits) than the Rent scenarios for all the biomass demand pathways tested.

Source: Favero et al. 2020
Effects of the policies on forests carbon stock

The tax scenario delivers lower forest carbon stock than the Rent scenarios for all the biomass demand pathways tested.

Source: Favero et al. 2020
The tax scenario delivers lower natural forest preservation than the Rent scenarios for all the biomass demand pathways tested.
Conclusions

Regulation

• Policy instruments available to reduce negative effects of bio-energy demand
• Other policy options: direct constraints on supply
  • No bio-energy sourced from residues, natural forests etc. (see EU REDII)
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• Policy instruments available to reduce negative effects of bio-energy demand
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  • No bio-energy sourced from residues, natural forests etc. (see EU REDII)

• Other important aspects:
  • Climate change effects of forests availability and productivity
  • New wood-based products & their mitigation potential
  • Valuing ecosystem services of forest
  • Assess role played by the forestry sector in the mitigation portfolio: Link forestry model with an IAM
Thank you!

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