The Economic Case for Nature: A global Earth-economy model to assess development policy pathways

September 16, 1963
World Bank in partnership with University of Minnesota and Purdue University
Is there an economic case for conserving ecosystem services and nature more generally?
Yes, there is!
A novel approach: Integrating 4 ecosystem services in a global CGE

Policy changes
- Fiscal reform
- Expansion of PES
- Intensification of agriculture
- Trade policies

Change in land use

CGE Economic Model (without ES) → Natural Capital → Ecosystem Services Model → CGE Economic Model

1. Pollination
2. Timber
3. Fisheries
4. Carbon

• GDP
• Welfare
• Factor use

Ecosystem Services Model
- Pollination
- Timber
- Fisheries
- Carbon

Natural Capital
- Factor use

CGE Economic Model
- GDP
- Welfare
- Factor use
A partial collapse of ecosystem services would cost $2.7 trillion, with higher impacts on poorer countries...

Difference in 2030 GDP under collapse scenario vs. baseline scenario, by income group

- **Global change to GDP:** -2.3% ($2.7 trillion)
- **% change in 2030 real GDP**
  - Low income: -10%
  - Lower middle income: -7.3%
  - Upper middle income: -3.6%
  - High income: -0.7%

This does not include the direct effects of climate change, making it a highly conservative estimate of losses.
..and especially in Sub-Saharan Africa and South Asia

### Difference in 2030 GDP under collapse scenario vs. baseline scenario, by regions

<table>
<thead>
<tr>
<th>Region</th>
<th>% change in 2030 real GDP</th>
<th>Pop. 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>-9.7%</td>
<td>1.1B</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>-6.5%</td>
<td>1.9B</td>
</tr>
<tr>
<td>South Asia</td>
<td>-3.4%</td>
<td>2.4B</td>
</tr>
<tr>
<td>East Asia &amp; Pacific</td>
<td>-3.3%</td>
<td>0.7B</td>
</tr>
<tr>
<td>Latin America / Caribbean</td>
<td>-2.2%</td>
<td>0.5B</td>
</tr>
<tr>
<td>Middle East / North Africa</td>
<td>-0.7%</td>
<td>0.9B</td>
</tr>
<tr>
<td>Europe / Central Asia</td>
<td>-0.5%</td>
<td>0.4B</td>
</tr>
<tr>
<td>North America</td>
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Global change to GDP: -2.3% ($2.7 trillion)

This does not include the direct effects of climate change, making it a highly conservative estimate of losses.
Win-win policies exist..

Basic policy options

- **P2**: Domestic forest carbon payment
- **P1**: Decoupled support to farmers
- **P3**: Global forest carbon payment

**P1**: Decoupled Support to Farmers (subsidy repurposing);
**P2**: Domestic Forest-Carbon (FC) payment;
**P3**: Global forest-carbon payment;
..and are especially effective when combined

Combined policy options
- P4: P5 = Decoupled Support to Farmers + Global FC payment

Basic policy options
- P1: Decoupled Support to Farmers (subsidy repurposing)
- P2: Domestic Forest-Carbon (FC) payment
- P3: Global forest-carbon payment
- P4: Subsidy reform + Domestic FC payment

..and are especially effective when combined

**Research & Development**

- **P6**: Decoupled Support to Farmers + agricultural R&D;
- **P7**: Decoupled Support to Farmers + agricultural R&D + Global FC payment

**Combined policy options**

- **P4**: Subsidy reform + Domestic FC payment;
- **P5**: Decoupled Support to Farmers + Global FC payment;

**Basic policy options**

- **P2**: Domestic forest-carbon payment
- **P1**: Decoupled support to farmers
- **P3**: Global forest-carbon payment
Policies can be both nature- and economy smart

Basic policy options

Good for the economy
Change in real GDP rel. to BAU (billion US$)

Good for nature
Avoided natural land conversion (percent)

**P1:** Decoupled Support to Farmers;  
**P2:** Domestic forest-carbon (FC) payment;  
**P3:** Global FC payment

<table>
<thead>
<tr>
<th>Policy</th>
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<tr>
<td>P1</td>
<td>56.5</td>
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**Basic policy options**

**Good for the economy**
Change in real GDP rel. to BAU (billion US$)

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**Good for nature**
Avoided natural land conversion (percent)

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<th>Policy</th>
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**Combined policy options**

Adding forest carbon payment schemes improves the policy

**Good for the economy**

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<th>Policy</th>
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<td>P4</td>
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**P1**: Decoupled Support to Farmers;
**P2**: Domestic forest-carbon (FC) payment;
**P3**: Global FC payment

**P4**: Subsidy reform + Domestic FC payment;
**P5**: Decoupled Support to Farmers + Global FC payment
Policies can be both nature- and economy smart

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**Good for the economy**
Change in real GDP rel. to BAU (billion US$)

- P1: Decoupled Support to Farmers
- P2: Domestic forest-carbon (FC) payment
- P3: Global FC payment

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- P4: Subsidy reform + Domestic FC payment
- P5: Decoupled Support to Farmers + Global FC payment

**Research & development**
Adding research & development improves the policy

- P6: Decoupled Support to Farmers + RD
- P7: Decoupled Support to Farmers + RD + Global FC payment
What is the net effect of the 30x30 goal?

- Determine the BAU land use pattern
- Define how that would change under 30x30 (optimized conservation)
- Assess the net effect of
  - Improved ecosystem service provision
  - Declined value added from reduced production
Globally, small net cost: but with important geographic differences

Draft Target 2 of the post-2020 global biodiversity framework:

By 2030, protect 30 percent of the planet

A negligible cost to the world, and the need to mobilize resources in low-income economies

- US$ -115 billion (-0.10%) without CC co-benefits
- US$ -13 billion (-0.01%) with CC mitigation co-benefits

Globally, the costs of achieving the 30 x 30 target are largely offset by the benefits from ecosystem service gains, but there are important geographic differences
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Winners and losers: Political economy poses the biggest challenge going forward

Although at the global aggregate level the case for adopting nature-smart policies is clear...

... Policy reforms tend to have a positive impact on labor wages and a negative impact on returns to land.

Country-level adoption of nature-smart policies crucially depends on reconciling incentives across social groups.

Number of policies that will benefit each factor of production per country unit

<table>
<thead>
<tr>
<th>Factor</th>
<th>All</th>
<th>5-6</th>
<th>3-4</th>
<th>1-2</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unskilled labor</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>Capital</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skilled labor</td>
<td></td>
<td></td>
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<tr>
<td>Land ownership</td>
<td></td>
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Summary

- Biodiversity loss is **financially material** (this work provides novel evidence at a global scale)
- **Developing countries are most at risk** but can also **gain from policy reform**
- A **whole-of-economy approach** is essential: design policies that protect nature, improve the economy and are inclusive
- **Synergies with the climate agenda** are crucial. Explicitly accounting for the carbon benefits of nature-smart policies considerably strengthens the case for action

Good economics is instrumental for a successful Post-2020 GBF

- **Target 2**: Protect and conserve 30 per cent of the planet
- **Target 7**: Climate change mitigation from national biodiversity strategies
- **Target 8**: Nutrition, food security, livelihoods from nature
- **Target 9**: Productivity, sustainability and resilience in agriculture
- **Target 13**: Biodiversity values into policies and accounts
- **Target 14**: Green production practices and supply chains
- **Target 17**: Repurpose subsidies and positive incentives
- **Target 18**: Financing from all sources
- **Target 19**: Quality information for decision-makers
Thank you!

The economic case for nature:
https://openknowledge.worldbank.org/handle/10986/35882
Yes, there is! Key messages

1. The world cannot afford to lose ecosystem services: even a partial collapse would be detrimental, particularly for low- and lower-middle-income countries

2. Win-win, nature-smart policies exist: they can reduce systemic risks and generate economic gains

3. Ambitious targets, including the 30x30 target, are within reach, particularly when synergies with climate change are exploited

4. Nature-smart transition needs to be inclusive and fair
The GTAP model is a multi-commodity, multiregional computable general equilibrium (CGE) model. Designed for analysis of trade agreements and national policies. Resolution is limited by national economic accounts. 141 regions, 65 sectors.

GTAP Agro-Ecological Zones (AEZ) model introduces competition for land resources across crops, pasture and forestry and heterogeneous land use and land endowments within each region.
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A partial collapse of ecosystem services would cost $2.7 trillion, with higher impacts on poorer countries...

Reaching selected tipping points hurts low-income and lower-middle-income countries the most...

Difference in 2030 GDP under collapse scenario vs. baseline scenario, by income group

Share of GDP change attributable to each ecosystem service
A novel approach: the integrated Global Earth-economy Model in a nutshell

Question 1: What happens when Nature services collapse?

(A stress test of the global economy)
A novel approach: the integrated Global Earth-economy Model in a nutshell

Policy changes
- Fiscal reform
- Expansion of PES
- Intensification of agriculture

Trade policies
- 1. Pollination
- 2. Timber
- 3. Fisheries
- 4. Carbon

CGE Economic Model (without ES)

Question 2: Are there win-win policies?

CGE Economic Model

- GDP
- Welfare
- Factor use

Change in land use

Ecosystem Services Model
- 1. Pollination
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Policies can be both nature- and economy smart

**Basic policy options**

**Good for the economy**
Change in real GDP rel. to BAU (billion US$)

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<td>57.8</td>
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<td>38%</td>
<td>53.1</td>
</tr>
<tr>
<td>P6: Decoupled Support to Farmers + RD</td>
<td>21%</td>
<td>147.9</td>
</tr>
<tr>
<td>P7: Decoupled Support to Farmers + RD + Global FC payment</td>
<td>50%</td>
<td>141.7</td>
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**Research & development**

**Adding research & development improves the policy**

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<td>P7 (P1 + P3 + R&amp;D)</td>
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**Legend**

- P1: Decoupled Support to Farmers
- P2: Domestic forest-carbon (FC) payment
- P3: Global FC payment
- P4: Subsidy reform + Domestic FC payment
- P5: Decoupled Support to Farmers + Global FC payment
- P6: Decoupled Support to Farmers + RD
- P7: Decoupled Support to Farmers + RD + Global FC payment
Impacts of meeting the 30x30 goal

Globally, the costs of achieving the 30 x 30 target are largely offset by the benefits from ecosystem service gains, but there are important geographic differences

Draft Target 2 of the post-2020 global biodiversity framework:

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<th>Population</th>
<th>% change in 2030 real GDP</th>
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<tr>
<td>Low income (Pop 0.7B)</td>
<td>-1</td>
</tr>
<tr>
<td>Lower middle income (Pop 2.9B)</td>
<td>-0.5</td>
</tr>
<tr>
<td>Upper middle income (Pop 2.9B)</td>
<td>0.5</td>
</tr>
<tr>
<td>High income (Pop 1.2B)</td>
<td>0</td>
</tr>
<tr>
<td>Global (Pop 7.8B)</td>
<td>0.5</td>
</tr>
</tbody>
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Biodiversity ecosystem services
Policy & other drivers
Total net (width based on population size)
A novel approach: the integrated Global Earth-economy Model in a nutshell

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- Intensification of agriculture
- Trade policies

Change in land use

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Fiscal reform
- Expansion of PES
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- Trade policies

1. Pollination
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• GDP
• Welfare
• Factor use

Question 3:
Who wins and who loses?