Regional Development *versus* Global Mitigation: Insights from GLOBIOM

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Introduction

- Large demands for mitigation from the land use sectors
  - Direct non-CO$_2$ emissions reduction
  - Avoided CO$_2$ emissions and carbon sequestration
  - Biomass for energy

- Agriculture plays a key role in developing countries
  - Source of food in often food insecure regions
  - Source of economic growth

- Trade-offs need to be considered in mitigation policy design
## Scenarios

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<th>SSP</th>
<th>RCP</th>
<th>SPA</th>
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<td><strong>REFL</strong></td>
<td>SSP2</td>
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<td><strong>SPA0</strong></td>
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### Preliminary results:
- Focus on 2050

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**CO2 price [USD/tCO2]**

- SPA0 World
- SPA2 CentralEastEurope
- SPA2 FormerSovietUnion
- SPA2 LatinAmericaCarib
- SPA2 MidEastNorthAfrica
- SPA2 NorthAmerica
- SPA2 OtherPacificAsia
- SPA2 PacificOECD
- SPA2 PlannedAsiaChina
- SPA2 SouthAsia
- SPA2 SubSaharanAfrica
- SPA2 WesternEurope
Modeling approach

Common drivers: POP, GDP, storylines

Land: GLOBIOM

“Look-up tables”

Energy: MESSAGE

CO2 price, bioenergy demand

Land: GLOBIOM

Energy: MESSAGE
GLOBIOM

Population, GDP, preferences

Demand

Food  |  Fibers  |  Energy  |  Industry

Markets

ECONOMIC MARKET + Spatial equilibrium trade → PRICES

Production

EPIC
Rain, Snow, Chemicals
Evaporation and Transpiration
Subsurface Flow

18 crops (FAO + SPAM)
Wheat, Rice, Maize, Soybean, Barley, Sorghum, Millet, Cotton, Dry beans, Rapeseed, Groundnut, Sugarcane, Potatoes, Cassava, Sunflower, Chickpeas, Palm Fruit, Sweet potatoes
3 different systems

RUMINANT
Digestibility model
→ Feed intake
→ Animal production
→ GHG emissions

7 animals (FAO + Gridded livestock)
Cattle & Buffalo
Sheep & Goat
Pig
Poultry
8 different systems

BIOENERGY
Processing
→ MJ biofuel
→ MJ bioelectric
→ Coproducts

G4M
Global Forest model
→ Harvestable wood
→ Harvesting costs

Land use

Global Land Cover 2000

Cropland
Grassland
Short rotation plantations
Managed forest
Natural forest
Other natural land

Land cover
AFOLU emissions globally to reduced by 50% (40% in SPA2) to today

- 30% of reduction coming from LAM and 24% from AFR
- The proportional contribution does not change between SPAs
Biomass supply for bioenergy to DOUBLE compared to reference

- 45% to come from LAM and 17% from AFR
- Potential source of new income
Crop production [tDM]

- Crop production to increase by 87% globally, 94% in LAM and 255% in AFR
- Increase lower by 22% in LAM and 29% in AFR under SPA0
- Increase lower by 13% in LAM and 19% in AFR under SPA2
Livestock production to increase by 73% globally, 107% in LAM and 194% in AFR

- Bovine meat, small ruminant meat, and small ruminant milk production -20%
- Poultry production -6%
- Increase in total production lower by 32% in LAM and 39% in AFR under SPA0
GHG emissions efficiency

Herrero et al. 2013
Globally, intensive systems share increase from 30% to 40% in SPAs
In AFR, intensive systems represent 37% under mitigation compared to 24% in the baseline
Industrial round wood production [Mm3]

- Industrial round would supply to increase by 87% between 2000 and 2050
- Little effect of mitigation policie (+/-10%)
  - Incentives for sequestration outweigh bioenergy demand
Little effect on total global income, forestry benefits, agriculture looses

LAM: +22% (+16% in SPA2) – agriculture and forest products + forest carbon

AFR: -20% (-20% in SPA2) – losses in agriculture, no compensation in forests
Crop price increase by 14% (8% in SPA2), by 9% in AFR (5% in SPA2)
Livestock price increase by 25% (13% in SPA2), by 47% in AFR (30% in SPA2)
Opportunity for producer threat for consumers
In REFL, food availability in AFR increases by 25%
Only 66% of increase under SPA0, 78% under SPA2
Developed regions much less affected than developing
Total abatement calorie cost (TACC)

Havlík et al. 2014
Total abatement calorie cost (TACC)

Havlík et al. 2014
Conclusions

- Mitigation presents opportunities for land use sectors
  - New demands (biomass)
  - Payments for carbon sequestration
  - Higher prices (producers)
- Mitigation presents also challenges
  - Higher production cost
  - Restructuring of the sectors
  - Higher prices (consumers)
- Sectors and regions affected very differently
  - Forestry tends to benefit and agriculture to loose
  - Developed regions marginally affected and least developed most affected
- How to make mitigation work for least developed countries?
Thank you!

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