Food Security in SSA and Biofuels: Quantitative Analyses

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Humboldt University, April 6 – 9th 2008
What LUC for Food security and Biofuels?
Intensive SFM

Optimal Rotation Period
4 Years

Courtesy: StoraEnso
Extensive SFM

Ordinary retention
Corridor habitat
Restoration area
Key habitat
## Matrix of key options

### Overview key options

<table>
<thead>
<tr>
<th>Type of activity</th>
<th>Activity</th>
<th>Practice</th>
<th>specific management (change)</th>
</tr>
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<tbody>
<tr>
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<td>Rapeseed</td>
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<td>Wood products</td>
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### Matrix of Key Options

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<th>Type of Activity</th>
<th>Timing of Impact</th>
<th>Timing of Costs</th>
<th>CO2</th>
<th>CH4</th>
<th>N2O</th>
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<td>Sequestration</td>
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<tr>
<td>Conservation</td>
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<td>+</td>
<td>+</td>
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<tr>
<td>Reduction</td>
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<td>+</td>
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**Mitigation Effect [+, 0 or -]**
## Matrix of Key Options

The matrix below outlines various land-use, land-use conflict, deforestation, greenhouse gas (GHG), and biodiversity options, along with their sustainability implications and socio-economic standards. Each cell represents the sustainability criteria applicable for each option:

1. **Land-use, land availability and land-use conflicts**
2. **Deforestation**
3. **GHG balance**
4. **Loss of biodiversity**
5. **Water concerns**
6. **Soil degradation**
7. **Other environmental concerns**
8. **Socio-economic standards**

### Sustainability Implications

<table>
<thead>
<tr>
<th>Option</th>
<th>Theme 1</th>
<th>Theme 2</th>
<th>Theme 3</th>
<th>Theme 4</th>
<th>Theme 5</th>
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Policy and Socio-economic Drivers

- Ag-Trade and AgPolicies
- Avoided Deforestation Policy
- Financial Markets
- GDP and Pop as demand drivers
- Forest sector and biorefinery industry
- ....
IIASA modeling framework

**G4M: Geogr. explicit forest biomass growth, Afforestation, Deforestation, harvest, supply curves**

**EPIC Model: Agriculture, crop production, environmental factors, biogeochemistry**

**Bio-Tech Model: Product chains of bioenergy and biomaterials, GHG balance of options**

**BEWHERE Model: Optimal location of plants according to supply and demand, competition between biomass production types**

**GLOBIOM Model: Trade and competition between regions, competition between sectors**

**FORMICA Model: Regional forest management, GHG budget at forestry sector level, case studies**
2 Factor Analysis
Number of undernourished people in SSA & Climate Change Crop Impacts
Derived Hotspots for Hunger

Hotspots of food insecurity projected for the year 2100
- Orange: Hotspot
- Red: Severe Hotspot
- Maroon: Very Severe Hotspot
Integrated Competition over Land

LAND - fixed production factor

Competition: Biofuels x Food x Forests

- Biofuels expansion
- Food security
- Deforestation

→ Comprehensive modeling frameworks required
Model presentation

**Biomass**
3 land based sectors:

- **Forestry:** traditional forests for sawnwood, and pulp and paper production
- **Agriculture:** major agricultural crops
- **Bioenergy:** conventional crops and dedicated forest plantations

**Optimization Model (FASOM structure)**
Maximization of the Social Welfare (PS + CS)

**Partial equilibrium model:** endogenous prices
Numerical analysis: Scenarios

2030 estimated FOOD and WOOD demand

+ 

Substitution of 10% of transport oil consumption

according to IIASA A2r baseline scenario 2030 by BIOFUELS

Variants

a) ETHAHOL (sugar cane + corn)

b) METHANOL (industrial plantations)
Endogenous food demand

Daily Energy Intake per Head (in kcal): Ethanol

- North America
- Western Europe
- Pacific OECD
- Central Eastern Europe
- Former Soviet Union
- Planned Asia China
- South Asia
- Other Pacific Asia
- Middle East North Africa
- Latin America Carib
- Sub-Saharan Africa
Endogenous food demand

Malnutrition

Prevalence of Malnutrition in Sub-Saharan Africa (%)
Deforestation Area

CO2 based deforestation tax

![Graph showing the relationship between deforestation tax (USD/tCO2) and deforested area (in 1000 000 ha). The graph includes two lines: one for Ethanol and one for Methanol.]
Emissions from Deforestation

CO2 based deforestation tax

Greenhouse Gas Emissions from Deforestation (in MtCO2)
Total Land-Use GHG budget

CO2 based deforestation tax

Annual Greenhouse Gas Emissions (in MtCO2)

Deforestation tax (USD/tCO2)

- Ethanol
- Methanol
Deforestation vs. Malnutrition

CO2 based deforestation tax

Prevalence of Malnutrition in Sub-Saharan Africa (%)

Deforestation tax (USD/tCO2)

Ethanol  Methanol

IIASA
Conclusions

- Partial Analysis only Partially Useful
- Biofuels in conflict with eradication of malnutrition.
- Ambiguous effects on GHG emissions from biofuels because of LUC.
- Avoided deforestation policy may have negative effects on food security.
- PRELIMINARY! – numerical results to be checked with the full model.
- NEXT: Income effects – to be analysed next (C. Llull)
  - avoided deforestation policies *eq.* development policies ??