Sugarcane Ethanol Production in Malawi

A ‚Real World' Case Study on Greenhouse Gas Emissions Due to Direct and Indirect Effects

Workshop on Quantifying and Managing
Land Use Effects of Bioenergy 2011
Campinas, Sao Paulo, Brasil, 20.09.11
Elisa Dunkelberg
IÖW – Institute for Ecological Economy
Research, Berlin

i | ö | w

Outline

1. **Introduction**
2. **Background, objectives and methods**
3. **Sugarcane ethanol production in Malawi**
4. **LCA results**
5. **Indirect effects in Malawi**
6. **Conclusions**

Brief introduction to IÖW and “Fair Fuels?”

- **Institute for Ecological Economy Research (non-profit)**
  - Independent research and consulting institute
- **Several projects on biomass and renewable energies**
  - Further information on www.ioew.de/en/

- **A four-year research project on biofuels: “Fair Fuels?”**
  - Junior research group with four dissertations, two habilitations; interdisciplinary approach
  - Three case studies: Sub-Saharan Africa (Malawi, Tanzania), Brazil, EU/Germany
  - Further information on www.fair-fuels.de/en/

Background, Objectives and Methodology

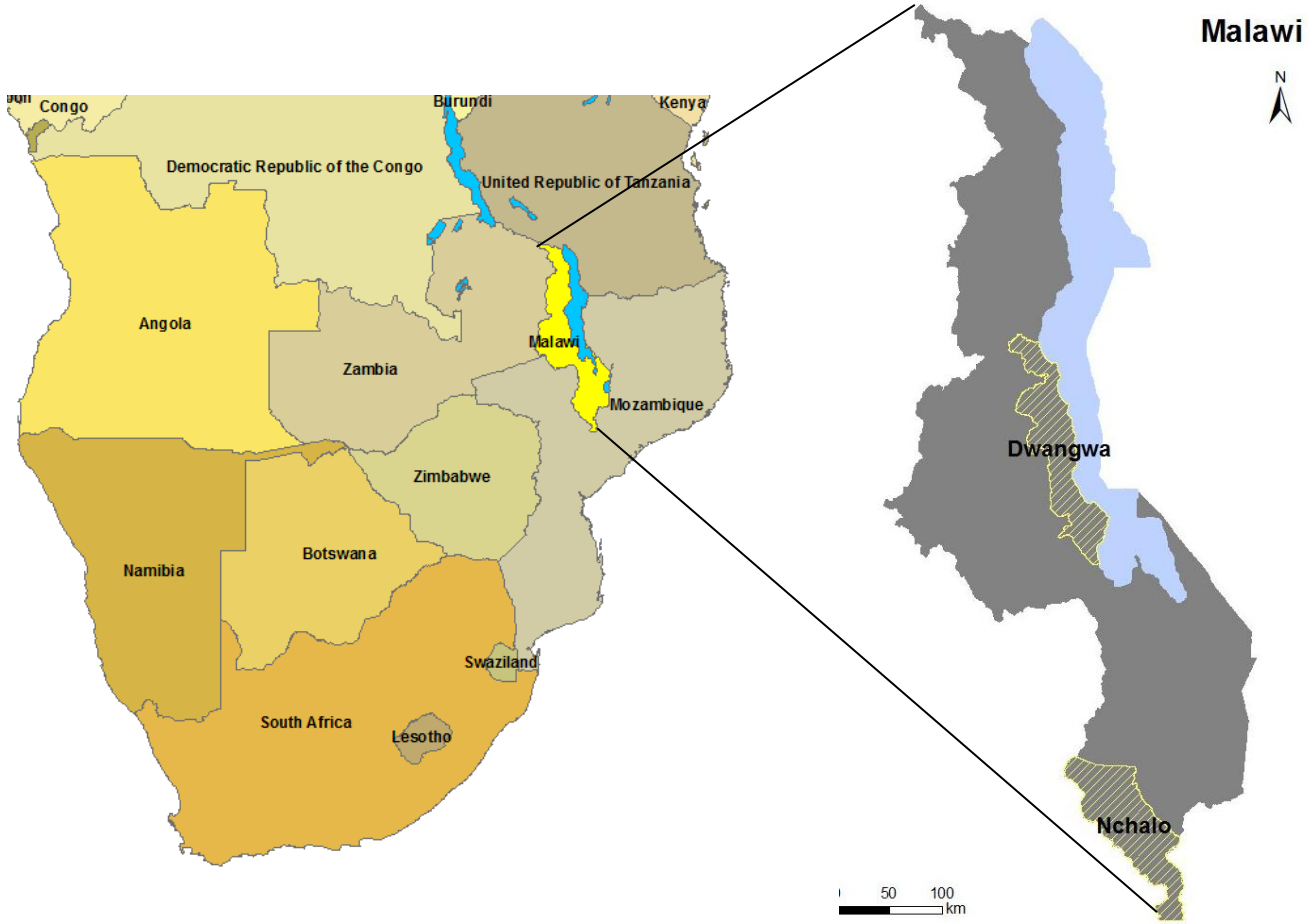
	Background	Objectives	Methodology
Direct emissions	GHG balances for sugarcane ethanol relate to South America and Asia so far	Assess a GHG balance for sugarcane ethanol produced in Malawi Identify optimization potentials	LCA: input output data from companies involved in the whole production process
Indirect emissions	Economic and deterministic modeling to quantify ILUC Limited knowledge on regionally specific indirect effects	Identify regionally specific indirect effects regarding the ethanol production in Malawi (Partly) quantify the GHG impact of these indirect effects	Data on land use in Malawi and the sugarcane areas Interviews with local authorities, NGOs, scientists Evaluation of planned expansions
Mitigation	ILUC should be avoided in order to guarantee sustainability	Identify regionally specific measures to avoid ILUC	Interviews with local authorities, NGOs, scientists Evaluation of planned expansions

Sugarcane Ethanol Production in Malawi

- **23,000 ha plantations, 20,000 estate plantations, 3,000 ha outgrower schemes**
  - Dwangwa, Central Region: 8,000 ha fuel ethanol production since 1982
  - Nchalo, Southern Region: 15,000 ha fuel ethanol production since 2004
- **18 Mio. l ethanol per year**
- **Blending rate of 20% since 2011; sugarcane area expansions**

i | ö | w

Sugarcane Ethanol Production in Malawi



LCA results

Scenario 1:

– Status quo

Scenario 2:

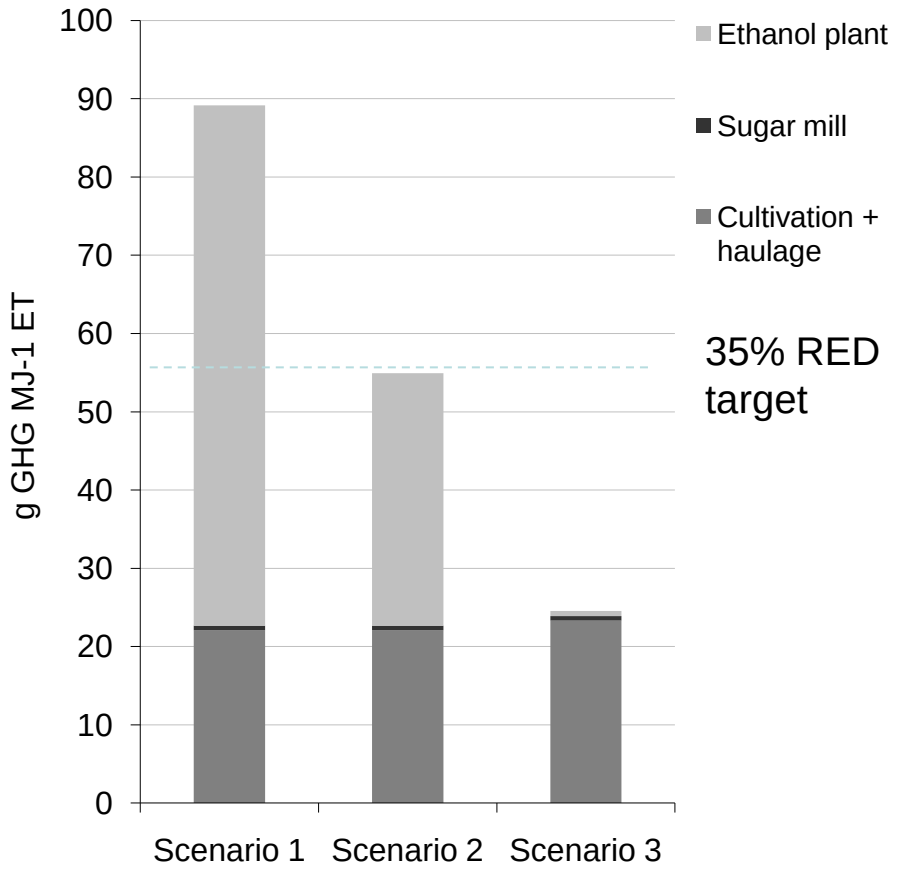
– Vinasse is used for biogas production

– Coal used in the ethanol plant partly substituted by biogas

Scenario 3:

– Switching from pre-harvest burning to green-harvesting

– Coal substituted by cane trash



i ö w

Indirect effects in Malawi

Indirect effects:

1. ILUC linked to sugarcane area expansions
2. Interplay of increasing welfare and energy demand in sugarcane regions

Indirect effects in Malawi – expansions

- 9,000 ha expansion are planned within the SVIP (40,000 ha).
- SVIP will probably be financed as PPP by Malawian Government, Illovo Sugar and the World Bank.
- The extent of ILUC depends on whether food crops are cultivated within the irrigation system.
- Three Scenarios were calculated: High Yield, Low Yield, NOSVIP.

Indirect effects in Malawi – expansions

High Yield Scenario	Current utilization [ha]	Yield [t/ha]	Yield [t GE*]	Planned utilization [ha]	Expected yield [t/ha]	Expected yield [t GE*]
Staple crops						
Maize	19,625	0.53	11,341	16,748	8.0	147,382
Sorghum	2,987	0.59	1,489	1,282	10.0	10,768
Rice	1,235	1.1	1,249	6,613	6.0	36,503
Pulses	8,377	0.7	8,413			
Cash crops						
Cotton	9,304	8.1		8,297		
Sugar				9,200		
Other cash crops	612					
TOTAL	42,140		**22,493**	42,140		**194,653**

*Grain equivalents

Indirect effects in Malawi – expansions

NOSVIP Scenario

- **No compensation -> ILUC**
- **ILUC occurs presumably in Malawi itself**
  - Agricultural area is steadily increasing
  - Crop exports are mostly higher than crop imports
  - Low relation crop export/ crop production
  - Tendency to self-sufficiency

Indirect effects in Malawi – expansions

NOSVIP Scenario

Land use	Converted 1991-2008 ['000 ha]	Share of converted area [%]	CO_2 [t ha^{-1} yr^{-1}]	CO_2 (g MJ ET^{-1})
Forest / woodland	698.0	82.1	31.92	97.02
Grassland	20.3	2.4	3.45	0.31
O Dambo (wetland)	131.7	15.5	4.36	2.50
TOTAL	**850**	**100.0**	**26.97**	**99.3**

Indirect effects in Malawi – energy demand

Background:

- 90% of the energy consumption supplied by biomass, mainly fuel wood
- 5% of population has access to electricity
- Poverty increases the propensity of fuel wood collection from protected forest reserves (Jumbe 2009)

Observation:

- Welfare in sugarcane regions is higher than in other regions
- Villages were electrified with fair trade premiums

Indirect effects in Malawi – energy demand

Possible Concequences (theses):

Choice of energy source:

– Fuel wood collection from protected forest reserves decreases

– However, charcoal demand increases due to a higher purchasing power

  ➢ Fuel demand is (only) displaced in other regions

Effect of electrification:

– The effect depends on the energy source used for electricity production

– If hydropower stays the main energy source, positive effects are likely

Conclusions

Observations:

- Sugarcane ethanol does not meet the requirements of EU RED
- High optimization potentials regarding the GHG balance
- High compensation potentials regarding ILUC
- High emissions related to ILUC if compensation is not realised

Research questions:

- How does sugarcane investments affect the energy demand and the choice of energy source?
- What can we learn from regional case-studies for modeling?

Thank you for your attention!

Elisa Dunkelberg
IÖW – Institute for Ecological Economy Research, Berlin
elisa.dunkelberg@ioew.de

20.09.2011

References

GoM, *Malawi Biomass - Energy Strategy*, 2009.

C.B.L. Jumbe und A. Angelsen, „Modeling choice of fuelwood source among rural households in Malawi: A multinomial probit analysis“, *Energy Economics*, 2010.