Evidence for indirect land use so far is lacking

Quantifying indirect land use effects of biofuel production: defining a research agenda

Biofuels have been accused of reducing food availability, and to be a major contributor to increasing food prices, undernutrition and deforestation. These are mostly indirect effects, whereby biofuel expansion allegedly leads to indirect changes in land use elsewhere. Studies supporting these accusations are however mainly based on local biofuel statistics and changes in local land cover while economic models used to predict long term effects do not include full land balances. As a result, highly relevant data on crop production systems are neglected, while calibration of economic models is making very limited use of historic crop and land use statistics.

So far, evidence for the indirect land use changes has not been provided. Only a few studies analysed land use changes related to biofuel expansion in a systematic way, i.e. at a larger scale and/or covering a longer period. The book 'Biofuel cropping systems'[1], presents a complete analysis of ten years of biofuel production in the most important biofuel producers of the world.

The book provides a unique example of a generic analysis of changes in land use related to agriculture, bioenergy, forestry and non-biomass related uses. The authors provide an overview of changes in land cover that have been reported in Brazil, the USA, the EU, China, Indonesia, Malaysia, South Africa and Mozambique. Land and biomass balances were calculated from land and crop statistics of the Food and Agriculture Organization of the United Nations (FAO). Local data provide a realistic description of practices related to land preparation, crop production, biomass conversion and co-product generation.

The analysis made use of the following concepts:

- '**Harvested area**', crop area harvested in a given year. This is not similar to arable area, as land may be harvested multiple times or kept under fallow
- '**Agricultural area**', area of agricultural land. This includes arable land (food or feed crops), permanent grassland and tree crops (fruits, coffee, etc.)
- '**Cropping intensity**', the ratio of harvested crop area per unit of arable land.

Cropping intensity is expressed as the sum of all harvested crop area during a given year divided by the total arable land (the Multiple Cropping Index or MCI).

Main results of the book:

- Nearly half of biofuel crop area expansion (13.5 of a total of 25 million ha) is associated with the co-products which are applied in the livestock industry
- Between 2000 and 2010, 30 million ha of agricultural land was lost to urbanisation, expansion of infrastructure, industrial areas, touristic areas, etc. This loss was partly compensated by expansion of agricultural area (net expansion 9 million ha)
- Increase of the Multiple Cropping Index (MCI) allowed farmers to harvest 41.5 million ha extra, sufficient compensation for arable land dedicated to biofuel expansion. This phenomenon is explained by a reduction of fallow and expansion of

[1] Langeveld, H., J. Dixon and H. van Keulen, 2014. Biofuel cropping systems. Carbon, land and food. London, Earthscan. http://www.taylorandfrancis.com/books/details/9780415539531/

double cropping (two harvests in the same year)

- Expansion of biofuel production may affect existing local land use practices. It is crucial that local land use rights are respected

It is concluded that expansion of biofuel is not likely to be a major cause of food crop price increases, deforestation, or other indirect land use effects (indirect land use change or ILUC).

"We knew farmers are keen to cover the increased demand for crops, and we expected them to reduce the amount of fallow land", according to the authors. "One response was for farmers to increase multiple cropping. It allowed them to compensate land losses caused by urbanisation."

So far, biofuel watchers had to rely on model projections which have been heavily criticised. "Our approach revealed a major change in multiple cropping. ILUC models have overlooked this." Langeveld adds: "Competition for land does occur. Locally, biofuel producers may use land that was used for other crops."

"In major biofuel producing countries, farmers apparently provided sufficient crops to compensate for biofuel expansion, serving both food and fuel markets". It remains uncertain, however, if this will remain the case in the future.

Main research questions that need to be addressed include:

- Assess the extent and causes of yield gaps in major food crops
- Explain backgrounds of recent changes in Multiple Cropping
- Modelling changes in Multiple Cropping Index
- Introduction of full land balances in crop commodity models
- Improve the assessment of (indirect) land use effects

Hans Langeveld
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Hans Langeveld is director of Biomass Research a consulting company based in Wageningen, the Netherlands (www.biomassresearch.eu). Previously, he worked at the Centre for World Food Studies (Free University, Amsterdam) and Wageningen University and Research Centre. Earlier books by Langeveld focussed on the biobased economy, and on analysing and improving European farming systems. **John Dixon** is Principal Regional Coordinator, Asia and Africa at the Australian Centre for International Agricultural Research. **Herman van Keulen** worked as a professor of Wageningen University and Research Centre. **Foluke Quist-Wessel** is Director of Agri-Quest and senior researcher at Biomass Research.

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Note: More information can be obtained from Hans **Langeveld** (ph. +31 65 20 58 537) or from Foluke **Quist-Wessel** (ph. +31 6 25 40 17 72)