Workshop Report

Land Use Changes due to Bioenergy: Quantifying and Managing Climate Change and Other Environmental Impacts

Suomenlinna, Helsinki, Finland
30 March – 01 April 2009

Summary

On March 30th and 31st, 60 participants attended a workshop entitled *Land Use Changes due to Bioenergy: Quantifying and Managing Climate Change and Other Environmental Impacts*. The workshop was organized and sponsored by Task 38, VTT and Tekes. Task 38 NTLs participated, as did Adam Brown, IEA Bioenergy Technical Coordinator, and Göran Berndes, leader of Task 30.

There were presentations on greenhouse gas emissions and other impacts from both direct and indirect land-use change which prompted lively discussion amongst participants. It was shown that:

1. calculation of the mitigation benefits of bioenergy must include emissions due to changes in soil organic carbon and biomass stocks resulting from direct and indirect land-use change; and
2. Emissions from indirect land-use change are difficult to quantify, due to difficulties in isolating impact of biofuels from other drivers of land use change such as demand for food and fibre, and because emissions vary widely between different land use systems. It could require between 20 and 75 years (or more) to pay back emissions from indirect land use change through emission reductions from use of bioenergy in place of fossil fuels.

The following strategies to reduce the risk of emissions from indirect land use change were identified:

a) increasing the efficiency of biomass utilization (e.g. through cascading, and efficient energy conversion technologies),

b) development of land use strategies that integrate production of biomass and food, with social, biodiversity and other environmental services and

c) increasing productivity of agricultural land use.

Policy approaches that seek to promote only those bioenergy options that deliver mitigation benefits above a specified threshold show some promise, but inclusion of indirect emissions in the calculation of emissions reduction is challenging. Many participants felt that simple estimation methodologies such as the iLUC factor may not adequately capture the emissions caused by indirect land-use change. Due to the lack of transparency and specificity of simple methodologies, policies may be poorly enacted and penalize good strategies (for example, production of bioenergy feedstocks from marginal lands) and create incentives for poor strategies. The problem of indirect land use change resulting from bioenergy could be significantly decreased by the development of an effective mechanism to discourage deforestation, such as the “REDD” initiatives under discussion for the post-2012 climate change agreement.

Meeting Format

The workshop had two intense days of presentations and closed with a 1.5 hour discussion in two breakout groups. All presentations are available on the Task 38 website (http://www.ieabioenergy-task38.org/helsinki2009). In this report we highlight some significant presentations and summarize the comments from the break-out groups.

Plenary Sessions

The plenary sessions were broken into three topics:

1. Introduction, background, methodological issues;
2. Direct land use change; and
3. Indirect land use change.

In the opening session, Adam Brown gave an overview of IEA Bioenergy that highlighted the roles of Tasks and how the Helsinki workshop would provide input to the paper on Bioenergy and Land Use Change being prepared by Göran Berndes, and the upcoming ExCo-63 Workshop on the same topic.

A noteworthy paper in the opening session was given by Helmut Haberl (Klagenfurt University, Austria). In this paper he introduced an indicator, HANPP, which is the proportion of **n**et **p**rimary **p**roduction that is **a**ppropriated for **h**uman use. He emphasized that HANPP is already very large in many environments, and that harvesting biomass for bioenergy will further increase HANPP. He claimed that there is very little “unused land”, and that truly “unused” land has low productivity, so cannot produce large amounts of biomass. Therefore, increasing biomass use will displace other land uses, leading inevitably to increasing HANPP at the expense of pristine forests, unless there is cascading of the utilization of biomass and an integrated optimization of food, fibre and energy from biomass. He pointed out some potential to increase HANPP through intensified management of grazing lands, and use of cereals with low Harvest Index. Florence van Stappen (Walloon Agricultural Research Centre, Belgium, and Task 38 NTL) gave a comprehensive overview of the various approaches to sustainability, including the methods for dealing with impacts from direct and indirect land-use change, that have been developed by European countries.

In the second session, on direct land use change, Annette Cowie (NSW Department of Primary Industries, Australia, and Task 38 co-Task leader) clearly demonstrated the importance of changes in soil organic carbon in bioenergy systems. Ben Delbaere (ECNC, the Netherlands) presented the BioScore system for scoring biodiversity impacts of land use decisions and demonstrated that either abolishing or doubling the EU RED target will impact biodiversity.

The impact of land use change on albedo (surface reflectance) was highlighted by Neil Bird and Ilkka Savolainen: both demonstrated that a change in albedo can affect radiative forcing, leading to potentially significant reduction in the climate change mitigation benefits of bioenergy.

The session on the impacts of indirect land use change was highlighted by three key papers on estimates of iLUC. Vincent Camobreco (U.S. EPA) showed an analysis of the U.S. biofuel mandate based on general equilibrium economic modelling. He demonstrated that within the U.S. there would be very little land use change other than crop switching to match increased demand. Outside the U.S. the impacts of land-use change could be large with areas of grassland (savannah) being converted to cropland as a result of bioenergy feedstock demand or to replace lost food production from the U.S. This LUC would result in a carbon debt that would take 75 years of emission reductions from biofuel consumption to pay back. These results were also supported by the presentation of Petr

Havlik (IIASA, Austria – invited). The IIASA group uses a partial equilibrium model to estimate the land use change due to bioenergy targets. It would take 60 years to pay back the initial emissions resulting from LUC induced by the combined impact of the US and EU biofuel goals. The pay back time for emissions resulting from the EU RED biofuel goals would be 20 years if biofuel trade was allowed and 40 years if biofuel trade was not allowed. The emissions could be significantly decreased if biofuel goals were complemented by an effective mechanism to discourage deforestation – under discussion for the post-Kyoto climate change agreement (the REDD initiatives). As well, Uwe Fritsche (Oekoinstitute, Germany) presented the iLUC Factor approach, which uses an analysis of historic FAO land use data to estimate the average greenhouse gas emissions from possible land use change assuming that the world can be simplified to the main players trading agro products – Brazil, EU, Indonesia and USA. He showed that the emissions due to indirect land use change could be between 5 and 20 t CO_2e/ha/year of land used for biofuel feedstock production and the value depends on the level of intensification of cultivation and extent to which biomass is sourced from set-aside or abandoned land.

The third session ended with some case studies of land use change from China (Madelene Ostwald, Linköping University, Sweden), Brazil (Göran Berndes, Chalmers University, Sweden, Leader of Task 30) and Southeast Asia (Harri Vasander, University of Helsinki). Madelene Ostwald showed that land use change results from many drivers, but economic return was the most significant. Göran Berndes demonstrated his analysis of the impact of expansion of sugar cane for ethanol in Brazil. In his case, there was some expansion of sugar cane into forest, but most moved onto grazing lands. The grazing lands were then replaced by forest clearing distant (100s of km) from the sugar cane production. Harri Vasander documented the large carbon losses from deforestation and fires in tropical peatlands in Southeast Asia. Finally Timothy Killeen (Conservation International, USA) proposed a joint biofuel and forest protection project with hypothetical analyses for Madagascar, Brazil, Indonesia, Columbia and Liberia.

Break-out Groups

After the plenary session, the participants divided into two break-out groups.

Group 1 – Policy consideration for indirect land-use change

Group 1 discussed the concepts that were presented as potential approaches that could be used in policy development to recognise and minimise indirect land use change.

The key messages from the discussion were:

- Bioenergy does have potential as a significant contributor to GHG mitigation, though the potential may not be as great as some studies have suggested.
- LUC is occurring as a result of policies that promote biofuels; loss of biomass, and particularly soil carbon stocks where peatlands are converted, reduces the benefits of bioenergy, and incurs significant payback times.
- Nevertheless, the policy response should not attempt to stop all international trade in bioenergy, because much of the potential biomass production is in developing countries that can benefit from supplying bioenergy to developed countries.
- Increased productivity of agriculture will reduce the incidence of LUC; there is perceived to be considerable potential in Africa and South America.
- Land use change per se is what matters; if possible one should expand the system boundaries of any analysis to encompass all LUC impacts.

- There are many interconnected drivers of LUC – it is difficult to distinguish the effects of bioenergy policy.
- Ideally, policy measures should seek to manage the whole land use system – ie all drivers.
- It is important to try to identify the impacts of bioenergy policies, because it is critical to ensure that these policies, that are implemented as a climate change mitigation strategy, do not deliver perverse outcomes by increasing emissions via ILUC
- Policy should be designed to provide incentive for the best bioenergy options with the least risk of land use change
- A cap on LUC was suggested as a simple solution, though the practicality of implementation and the effectiveness of the measure were questioned by some participants.
- The proposal to link REDD with biofuel production was considered to have potential merit.
- Certification schemes are considered a 'second-best policy option' with limited effectiveness.
- Simple policy approaches that require limited data for calculation and verification are attractive as they reduce transaction costs; but the tradeoff is that there is insufficient data to distinguish the drivers and to assess the impacts unless there is comprehensive monitoring to obtain accurate information on LUC.

Group 2 – Data and methodological considerations for indirect land-use change

About 25 people participated in Group 2. They had a variety of backgrounds and interests but most were interested in the quantification of iLUC for inclusion in life cycle assessment (LCA). The key take-home messages from the group were:

1. The iLUC factor approach was not adequate because:
   a. It was not transparent enough;
   b. The impacts should not be based on averages but should be system specific;
   c. It did not include the time frame over which it was calculated;
   d. Simple approaches could get imbedded in policy and the factors may not be re-evaluated at regular intervals, so changes would not be detected; and
   e. The emissions from iLUC may not be linearly related to the amount of biofuel produced.
2. In a best practice situation, the emissions from soil organic carbon (SOC) should be calculated from country-, climate-, and management practice – specific estimates (IPCC Tier 3), rather than using IPCC Tier 1 defaults (average factors) because the emissions are large and the Tier 1 method is inaccurate.
3. The quality of the land used for biofuel feedstock production is more significant than the quantity of land. HANPP could be used as an indicator of low biodiversity. Set aside and degraded lands have biodiversity value that should be considered in the analyses and subsequent decision process.

4. Other factors such as social benefits (local and national) and ecosystem services (for example, water quality and quantity) should also be considered in the analyses and subsequent decision process.

Field Excursion

On April 1st about 20 participants visited the Neste Oil refinery near Helsinki. The refinery includes a bio-refinery that processes palm and rapeseed oil and animal fats to produce biodiesel as well as bio-gasoline and bio-propane. Representatives from Neste Oil described their operations and presented data on life cycle greenhouse gas emissions for their NExBtl product from various feedstocks. They discussed Neste's approach to reducing direct GHG emissions (targeting high-emission stages in the process) and minimising the potential for iLUC (i.e., sourcing from plantations that have not been established on recently deforested land; implementation of chain of custody tracking) and future plans to produce their own feedstock. Neste does its own LCAs and has them verified independently. The analysis does not include carbon losses from below-ground biomass and soil organic carbon.

Impressions and Recommendations

Direct and indirect emissions from land-use change due to bioenergy, is a complex subject. In this section, we attempt to summarize our perceptions of the discussions in the workshop and make key points and statements for consideration. These statements are the opinions of the workshop organizers and do not necessarily reflect the opinions of all workshop participants.

Messages for policy-makers

The important messages from the meeting are:

1. Bioenergy does have potential as a significant contributor to greenhouse gas mitigation, though the potential may not be as great as some studies have suggested;
2. Bioenergy policy should not be considered independently of agricultural and forest management policy;
3. Impacts of bioenergy policies can be distant geographically from the site of biomass production;
4. Limiting trade is not necessarily the solution – at least when there is trade there is potential for optimal outcomes – i.e. biomass produced where there is greatest potential, and utilised where there is greatest mitigation benefit. However, current agricultural policies may not allow the optimal outcome.
5. There is room to reduce ILUC impacts by increasing the efficiency of bioenergy (i.e. conversion to energy products) and/or by increasing efficiency of biomass production;
6. Bioenergy may provide local energy sources and development but may not be optimal for large scale agri-business.

Messages for analysts and researchers

For analysts and researchers, it is important to recognize that:

1. Full estimation and accounting is complex, with high transaction costs – but policy-makers are looking for generalisations.
2. Analysts and researchers want greater accuracy but need to produce methods/tools that policy people can use. Perhaps the focus should be on minimizing risk rather than being accurate.
3. Top-down models may not fit with the reality of bottom-up experiences.
4. There is room to reduce ILUC impacts by increasing the efficiency of bioenergy (i.e. conversion to energy products) and/or by increasing efficiency of biomass production;
5. The current focus is on greenhouse gases, but other factors such as biodiversity, water, social impacts also need to be assessed.