International SCOPE Biofuels Project

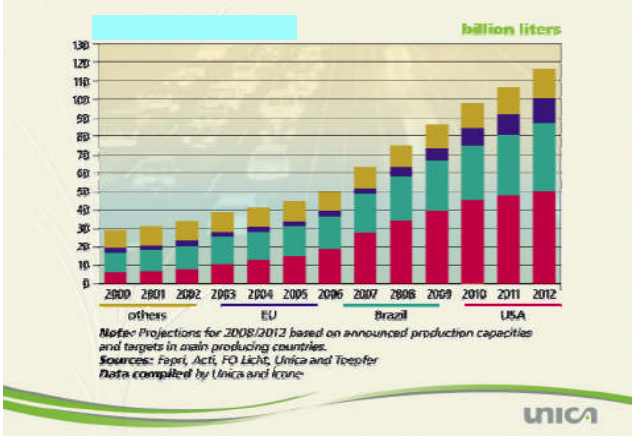
Rapid Assessment Workshop

Biofuels: Environmental Consequences and Interactions with Changing Land Use

22-26 September 2008, Germany

Background: The International SCOPE Biofuels Project

Biofuels are combustible materials recently derived from biomass and considered renewable over short time scales. Biofuels are often viewed as a potential alternative to fossil fuels, and their use is being promoted as a way to increase energy independence and security and reduce greenhouse gas emissions. Much of the recent attention has been on liquid biofuels (particularly ethanol and biodiesel), as these are seen as a ready source of energy for vehicles. Global production of liquid biofuels grew rapidly following the oil shortages of the 1970s, from virtually nothing in 1975 to approximately 15 billion liters in 1985. Little further growth occurred until 2000, but by 2005, global production had risen to 40 billion liters (World Watch Institute 2006). As of 2005, liquid biofuels contributed slightly less than 1% of the energy equivalent of liquid petroleum energy productions globally (Jank 2008). Ethanol accounts for over 90% of the global production of liquid biofuels, and biodiesel somewhat less than 10%, although production rates for both are rising rapidly. Global production of liquid biofuels is expected to double again by 2009 and to almost triple by 2012 (relative to 2005) to some 120 billion gallons (Jank 2008; see figure to right). Brazil and the US currently dominate the production of liquid biofuels, a trend expected to continue for at least the next several years. The recent acceleration in production has led to huge increases in the price of corn and has contributed to a large depletion of global stocks of both corn and wheat (http://www.fao.org/docrep/010/ah881e/ah881e04.htm). The projected further growth will place even greater strains on regional and global food supplies (OECD/FAO 2007).



There is growing concern over environmental consequences of increased biofuel production and use. The scientific community has only recently begun to focus on the issue in terms of environmental cost-benefit analysis, though an increasing number of scientific studies are highlighting potential problems (WWI 2006; Hill et al. 2006; Tilman et al. 2006; Keeney and Muller 2006; Martinelli and Filoso 2007; Crutzen et al. 2007; Bringezu et al. 2007; Searchinger et al. 2008; Donner and Kucharik 2008; Simpson et al. 2008). Most recent analyses indicate a range of environmental concerns and benefits that vary greatly depending on several factors, including: (1) the biomass feedstocks used; (2) the type of biofuel; (3) the technology used to convert the biomass into fuel; (4) the type of energy used to power the conversion; (5) the region or biome where the feedstocks and biofuels are produced; and (6) the extent to which a growing demand for biofuels induces changes in land use and land cover. This project is designed to provide a comprehensive, systematic and comparative analysis of the environmental benefits and costs of commonly used and potential

future biofuels. More information on the Project can be found at:
http://www.eeb.cornell.edu/howarth/SCOPEBiofuels_home.html

The Rapid Assessment Workshop

The first phase of the project will be a SCOPE Rapid Assessment to be held in Germany, in September 2008. This will help lay out the road map for the larger, more sustained effort that is required given the complexity of the science involved. The aim is to engage approximately 45 experts from diverse disciplines in an interactive manner to produce an authorative book which reviews the key environmental problems and outlines future perspectives of a more sustainable production and use of biofuels. Cross-cutting aspects of economic and social concerns will be considered as well. The results will provide policy relevant information to support decision making by national governments, international institutions, indstury, and NGOs and will also be summarized in one or more policy briefs.

Before the workshop, a series of invited background papers will be written to cover many key aspects of the effects of biofuels on the environment. These papers will set the stage for the workshop and will also be included in the synthesis book from the workshop. A list of the topics for these papers follows below. We envision relatively short papers (10 printed pages).

At the start of the workshop, we will have several plenary lectures to further help set the tone. For the most part, these speakers will not be the authors of the invited papers, and the talks will focus more on cross-cutting analysis. For example, we might have talks on the biofuel situation in Brazil, on the interplay between food supplies and biofuel production, on the energy industry perspective, and on the NGO perspective.

Most of the workshop will be devoted to discussion of 4 further cross-cutting topics, as in previous SCOPE Rapid Assessments. These topics are presented in further detail later in the prospectus. The workshop will follow the proven scheme of the Dahlem conferences, with 2 woking groups meeting at any given time. This way, all workshop participants can take part in 2 of the 4 working groups. Each working group will produce a manuscript on their deliberations, with the writing of the first draft to be completed at the workshop.

By the end of the workshop, all of chapters for the book will be drafted, as will a draft of one or more policy briefs. With subsequent review and editing, the summary book should be published within 9 months of the workshop (ie, June 2009).

Background papers –

1. Introduction and conceptual model for the RAP; review of ongoing initiatives, and the role of SCOPE; global trends and projected capacity of biofuel production (in past and in the medium-term – 2020/30; put in context of fossil fuel use and IPCC scenarios); biofuels and bioenergy (concentrate on liquid biofuels for this RAP); brief introduction to net energy of various systems, and how this relates to net greenhouse gas emissions; brief introduction to other environmental issues, explaining the focus on impacts of land use change.

2. Current crops being used for biofuels: where they are grown, and how they are cultivated; also, where they might be cultivated in the future (in terms of limitations of climate, land and water, etc.); competition between food and fuel; include palm oil in southeast Asia, sugar cane in Brazil, corn in US, other oil crops such as soybean and canola. Future biofuel crops and where they may be grown.

3. Net energy return and net greenhouse gas emissions for current biofuel systems (including N2O and CH4) at present (not considering expansion and changes in land use).

4. Land use and land cover changes (direct and indirect, recent and projected) due to increased

biofuel production, and environmental consequences of expansion of fuel cropping, considering tropical countries (focus) and temperate regions, with an emphasis on net greenhouse gas emissions (including C storage and CO2 exchanges, as well as N2O and CH4). Future scenarios: what are prospects for land productivity improvements (particularly in Sub Saharan Africa where yields are far below potential)? What is the impact of alternative biofuel crops on land use?

5. Water needs for biofuel systems now, including for growing crops and for processing; some possible future scenarios in water use, including prospects of improvements of water productivity and alternative (less water demanding) crops. Possible impacts of increased water for biofuels on other water dependent sectors and ecosystems services downstream.

6. Changes in the cycling of phosphorus, nitrogen, and other nutrients from biofuel technologies, with an emphasis on flows through waste streams such as distiller's grain but also including field-scale agriculture. What are the water quality impacts from biofuel systems, including from crop production, waste streams, etc.; include both freshwaters and coastal marine waters. How can technologies be made more environmentally friendly, by fully considering these nutrient cycles?

7. Local air quality effects from biofuel systems, including biomass burning, ethanol use and NOx emissions, aldehydes, VOC emissions, ozone (including brief discussion of consequences).

8. Biodiversity and biofuels, including proximate drivers and effects of land use change, but also pollution/eutrophication effects.

9. Drivers of biofuel production and use; policies, economics, land use practices (special attention to displacement effects: e.g. soy-for-food-for-cattle-for-wilderness chain); global markets and trade; interplay with global food supplies and trade; issues of governance, certification, and other legal approaches.

10. Socio-economic consequences of increased biofuel production and use; price effects of increased fuel cropping on food supplies and impacts on households, especially in poor countries; structural effects of biofuel production on small-holders, and industrial business, especially in developing countries.

11. Possible future feed stocks for biofuel systems; use of genetically modified organisms; cellulosic ethanol; marine algae . Consider environmental impacts, and land requirements.

12. Present technologies and future possible technologies; ethanol vs. biodiesel vs. methane, etc. (including storage, transport, use, and yield considerations); use of non-liquid biofuels for electricity production and/or heating (grasses, wood, etc., for direct combustion), and interaction with future transportation systems (ie, electric trains, cars, etc.). What is desirable in the long run, and how do we get there in the intermediate time?

Topics for Working Groups –

A) How can biofuels be made more environmentally friendly? Emphasize mitigation approaches for biofuel crops (ie, winter cover crops when growing corn or soybean); does the biofuel boom provide leverage for generally improving management practices in agriculture, including agriculture for food (ie, greater income flow to farmers combined with heightened societal awareness of increased environmental threats, leading to greater opportunity for change)? What is the best way to use non-food biomass in an environmentally beneficial manner (types of biofuels, production modes, but also including bioenergy and biomaterials)? Also discuss and elaborate on the issues presented in chapter 11, on choices of fuel and use.

B) Toward an integrated assessment of biofuel technologies; building on an example figure, plotting % greenhouse gas emissions on x axis and sum of other environmental aspects on y axis. Re-do this analysis, using several such plots, with ones for local air quality, water quality, water use, biodiversity, etc. (all relative to gasoline); be as quantitative as possible. Need to include growth and land use change effects (which may change the plot completely). Tradeoffs, how to weigh environmental pros and cons of biofuel production (for example less GHG emission versus adverse impacts on biodiversity and water scarcity).

C) Biofuels, hunger, and development in developing countries; potential focus on Africa, while drawing from experience in Latin America and South-East-Asia; can small-scale development of biofuels allow villages to have more sustainable livelihoods, e.g. through affordable energy sources? What are the consequences for food production? Can small-scale sources of biofuels feed into the global economy? How to minimize the risk for small-holders getting landless? Can industrial scale agricultural development of biofuel production in Africa (for export) provide capital for other development in Africa? What is the best mix of approaches, and what policies are needed?

D) What are the final land limits on expansion of current crops and technologies for biofuels? Which type of land, where and how much can be used in addition to existing crop land in a sustainable way? How to mitigate the conflict between food and non-food production, between different types of non-food biomass use, and between depletion, use and conservation of biotic resources? To be discussed in this context: How to estimate the land potentially available for sustainable non-food biomass production, esp. for biofuels? How to assess the status of "waste land", "marginal land" with regard to biodiversity, net greenhouse gas emissions, water use and water quality, etc.? What would be the implications if such land were taken under cultivation?

References cited:

Bringezu, S., S. Ramesohl,, K. Arnold, M. Fischedick, J. von Geibler, C. Liedtke, and H. Schütz, H. 2007. What we know and what we should know. Towards a sustainable biomass strategy. Wuppertal Papers 163. Wuppertal: Wuppertal Institut. (http://www.wupperinst.org/uploads/tx_wibeitrag/WP163.pdf)

Crutzen, R. J., A. R. Mosier, K. A. Smith, and W. Winiwarter. 2007. N2O release from agro-biofuel production negates global warming reduction by replacing fossil fuels. Atmos. Chem. Phys. Discuss. 7: 11191-11205.

Donner, S., D., and C. J. Kucharik. 2008. Corn-based ethanol production compromises goal of reducing nitrogen export by the Mississippi River. PNAS 105: 4513-4518.

Hill, J., E. Nelson, D. Tilman, S. Polasky, and D. Tiffany. 2006. Environmental, economic, and energetic costs and benefits of biodiesel and ethanol biofuels. PNAS 103: 11206-11210.

Keeney, D., and M. Muller. 2006. Water use by ethanol plants: Potential challenges. Institute for Agriculture and Trade Policy, Minneapolis, MN

Jank, M. 2008. Oral presentation on behalf of Unica at the IFA Technical Symposium, Sao Paulo, Brazil.

Martinelli, L., and S. Filoso. 2007. Polluting effects of Brazil's sugar-ethanol industry. Nature 445: 364.

OECD/FAO Agricultural Outlook 2007-2016 (http://www.oecd.org/dataoecd/6/10/38893266.pdf)

Searchinger , T., R. Heimlich, R. A. Houghton, Fengxia Dong, Amani Elobeid, Jacinto Fabiosa, Simla Tokgoz, Dermot Hayes, Tun-Hsiang Yu. 2008. Use of U.S. croplands for biofuels increases greenhouse gases through emissions from land use change. Science 10.1126/science.1151861

Simpson, T. W., R. W. Howarth, H. W. Paerl, A. Sharpley, and K. Mankin. 2007. The new gold rush: Fueling ethanol production while protecting water quality. JEQ, in press.

Tilman, D., J. Hill, and C. Lehman. 2006. Carbon-negative biofuels from low-input high-diversity grasslands. Science 314: 1598-1600.

World Watch Institute. 2006. Biofuels for transportion: Global potential and implications for sustainable agriculture and energy in the 21st Century. World Watch Institute, Washington, DC