International Council for Science (ICSU) SCOPE Biofuels Project
Biofuels: Environmental Consequences and Interactions with Changing Land Use
Issued April 2, 2009

Download the full SCOPE Biofuels Project report at http://cip.cornell.edu/biofuels/

Key Passages

About SCOPE

The Scientific Committee on Problems of the Environment (SCOPE) of the International Council for Science (ICSU) established the International SCOPE Biofuels Project to provide a comprehensive, objective, science-based analysis of the effects of biofuels on the environment. More than 75 scientists from 21 countries and diverse disciplines have taken part in the SCOPE Biofuels Project's "rapid assessment" of the effects of biofuels on the environment.

Biofuels and Environmental Degradation

No matter how we use biofuels, their capacity as a sustainable energy resource is limited. Many studies conclude that it will not be possible to meet the current mandates set by several governments for liquid biofuels without severe competition for food and environmental degradation, including increased pollution and deforestation. (Ch. 1, p. 34)

The water requirements of biofuel-derived energy are 70 to 400 times larger than other energy sources such as fossil fuels, wind or solar. Roughly 45 billion cubic meters of irrigation water were used for biofuel production in 2007, or some 6 times more water than people drink globally.(Executive Summary, p. 6)

Biofuels, Nitrous Oxide, and Global Warming

Most studies on biofuels and greenhouse gas emissions have used the Intergovernmental Panel on Climate Change (IPCC) approach for estimating emissions of nitrous oxide. Recent evidence suggests that nitrous oxide emissions may well be 4-fold greater than this, with high emissions both from agricultural fields and from downstream aquatic ecosystems resulting from the use of synthetic nitrogen fertilizer. If so, the increased N_2O flux associated with producing ethanol from corn is likely to more than offset any positive advantage from reduced carbon dioxide fluxes (compared to burning fossil fuels). (Executive Summary, p. 3)

...the evidence for an increase in N_2O fluxes to the atmosphere due to human acceleration of the nitrogen cycle is indisputable, and agriculture is the major driver of the change. (Ch. 1, p. 31)

Nitrous oxide is not as abundant as carbon dioxide in the atmosphere, and is not as important as a driver of global warming. However, for an equivalent mass, it is almost 300-fold greater in its ability to warm the planet, and it is currently the third most important gas in causing global warming, after carbon dioxide and methane. (Executive Summary, p. 3)

Biofuels are often promoted as a way to reduce global warming. However, some biofuel systems can increase the release of greenhouse gases relative to the fossil fuels they replace, thus aggravating global warming. Greenhouse gas emissions from biofuels occur from farming practices, refining operations, and the conversion of ecosystems to cropland for biofuel production. (Executive Summary, p.3)

Impacts on Water Quality
Corn is an inherently nitrogen-inefficient crop, and nitrogen loads to downstream aquatic ecosystems from corn-dominated landscapes are typically…the highest of any commodity crop. (Ch. 9, p. 4)

Increased corn acreage and increased fertilizer application rates due to corn prices will increase nitrogen and phosphorus losses to streams, rivers, lakes, and coastal waters, particularly the Northern Gulf of Mexico and Atlantic coastal waters downstream of expanding production areas. (Ch. 9, p. 12)

The increase in corn to support ethanol goals in the United States is predicted to increase nitrogen inputs to the Mississippi River by 37%. This works against the national goal of reducing nitrogen inputs by at least 40% to mitigate the "dead zone." (Executive Summary, p. 7)

Biomass
A promising alternative approach, recommended but not yet tried, would require use of feedstocks that inherently avoid significant land use change; i.e., biofuels from waste products and 'idle' and 'marginal' lands. This policy recognizes that biofuel production systems that divert the productive capacity of land inherently compete with other valuable land uses (e.g. food, fiber, or timber production and carbon storage and sequestration). (Ch. 2, p. 50)

The development of efficient and competitive fermentation technologies and supporting infrastructure to allow development of a perennial grass or waste-based cellulosic ethanol industry could provide a long-term sustainable approach to ethanol production. However, it may be more feasible to use biomass directly to generate electricity and energy rather than converting it to a liquid fuel. A cellulosic renewable energy approach could provide multiple ecosystem services including energy, carbon sequestration, improved water quality and fisheries habitat, and improved soil quality and productivity. (Ch. 9, p. 13)

One Quarter Of U.S. Corn Harvest
With the Energy Independence and Security Act of 2007, the United States set a goal of producing 54 billion liters of ethanol from corn by 2022. The country is rapidly moving towards that target, with an estimated 35 billion liters produced in 2008. As of the fall of 2008, enough new ethanol plants were under construction to increase the capacity in the United States to a level of 51 billion liters per year, if all these plants are finished (Keeney 2009). (Ch. 1, p. 20)

In 2007, the United States used 24% of its national corn harvest to produce ethanol, which contributed 1.3% of national liquid fuel use. (Executive Summary, p. 2)

Global production of liquid biofuels has grown exponentially in recent years, and 2007 production was 3-fold greater than that in 2000. Despite this growth, liquid biofuels are still small contributors to the global energy supply… equivalent to 1% of the total liquid fuel use globally, or 0.4% of the total global energy consumption from all sources. (Executive Summary, p.1)