

Land Use Change in the United States:

Accommodating a Growing Biofuels Market



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Outline

- Introduction to the Problem
- Current Situation
- Potential Future
- Trends
- Policy
- Sustainability
- Future Management
- Implications



Current News

Scienceexpress Report

Land Clearing and the Biofuel Carbon Debt
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Increasing energy use, climate change, and carbon dioxide (CO₂) emissions from fossil fuels make switching to low-carbon fuels a high priority. Biofuels are a potential low-carbon energy source, but whether biofuels offer carbon savings depends on how they are produced. Converting rainforests, peatlands, savannas, or grasslands to produce food-based biofuels in Brazil, Southeast Asia, and the United States creates a 'biofuel carbon debt' by releasing 17 to 420 times more CO₂ than the annual greenhouse gas (GHG) reductions these biofuels provide by displacing fossil fuels. In contrast, biofuels made from waste biomass or from biomass grown on abandoned agricultural lands

biofuels from converted lands have greater GHG impacts than the fossil fuels they displace. For crops with non-biofuel co-products (e.g., palm kernel oil and meal, soybean meal, or distillers' dry grains), we partition the carbon debt into a 'biofuel carbon debt' and a 'co-product carbon debt' based on the market values of the biofuel and its co-products (7).

Here we calculate how large biofuel carbon debts are, and how many years are required to repay them, for six different cases of native habitat conversion: Brazilian Amazon to soybean biofuel, Brazilian Cerrado to soybean biofuel, Brazilian Cerrado to sugarcane ethanol, Indonesian or Malaysian lowland tropical rainforest to palm biofuel,

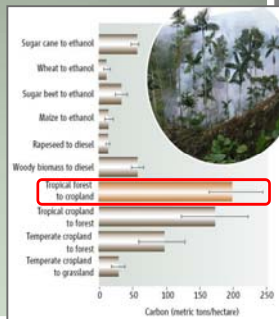
*http://www.nature.org/initiatives/climatechange/files/land_clearing_and_the_biofuel_carbon_debt.pdf

What is the Problem?

“. . . to generate greenhouse benefits, the carbon generated on land to displace fossil fuels (the carbon uptake credit) must *exceed the carbon storage and sequestration given up directly or indirectly by changing land uses.*”

Searchinger, T., R. Heimlich, R. A. Houghton, F. Dong, A. Elobeid, J. Fabiosa, S. Tokgoz, D. Hayes, and T. Yu. 2008. Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land-Use Change. *Science* 319: 1238 – 1240.

How do Biofuels Increase Carbon Output?



<http://www.alternative-energy-news.info/technology/biofuels/>

<http://environment.newscientist.com/article/dn12496>



Future Biofuel Production

- Replace 30% of our fuel consumption with biofuels by the year 2030
- Currently consume 317 billion gallons of fuel a year; 30% would be about *95 billion gallons*, which would require *1 billion tons* of biomass.
- This would require a 10-fold increase in biomass supply, . . . how much land?



Possible Scenarios

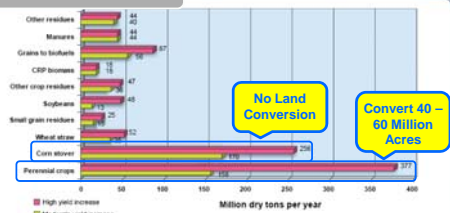


Figure 19: Availability of biomass under increased crop yields, technology changes, and inclusion of perennial crops

Perlick, R. D., L. L. Wright, A. F. Turhollow, R.L.Graham, B.J. Stokes, and D.C. Erbach, 2005. Biomass as feedstock for a bioenergy and bioproducts industry: the technical feasibility of a billion-ton annual supply. U.S. Department of Energy, U.S. Department of Agriculture. Oak Ridge National Laboratory, Oak Ridge, Tennessee, USA.

What Will Change Supply/Demand of Biofuels?

- Changes in Technology
 - Crop Hybrids
 - Harvesting Techniques
- Incorporating Non-Traditional Crops
 - Perennials
- Changing Markets
 - Higher Market Values
 → More Land Use



What Will Determine Future Land Use Change?

- Policy
 - Subsidies
 - Incentives
 - International Matters
- Sustainability as a Priority
- Time Frame
- Markets



2008 Farm Bill:

Renewable Energy Provisions

- *Section 9003*: Biorefinery Assistance Program
- *Section 9005*: Bioenergy Program for Advanced Biofuels
- *Section 9010*: Feedstock Flexibility Program for Bioenergy Producers
- *Section 9011*: Biomass Crop Assistance Program
- *Section 9012*: Forest Biomass for Energy

Presidential Candidates:

Proposed Bioenergy Plans

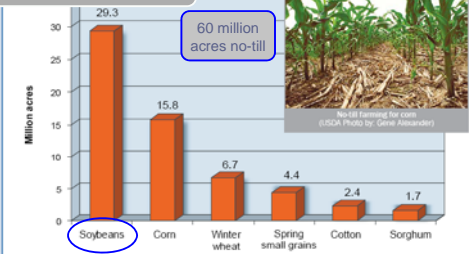
- Obama/Biden:
 - 36 Billion gallons of biofuels used annually by 2022; 60 billion gallons by 2030
- McCain/Palin:
 - Support Biofuels, but oppose any type of subsidy for biofuel production

Sustainability

- No-till Farming
- Advanced Fertilizer Technology
- Cover Crops/Riparian Plantings
- Crop Rotation
- Maintaining Unmanaged Habitat
- Improving Crop Genetics



No-Till Farming




Crop	Million acres
Soybeans	29.3
Corn	15.8
Winter wheat	6.7
Spring small grains	4.4
Cotton	2.4
Sorghum	1.7

Source: Conservation Technology Information Center (www.ctic.purdue.edu)

Figure 23: Crops under no-till cultivation

Perfick, R. D., L. L. Wright, A. F. Turhollow, R. L. Graham, B. J. Stokes, and D. C. Erbach. 2005. Biomass as feedstock for a bioenergy and bioproducts industry: the technical feasibility of a billion-ton annual supply. U.S. Department of Energy, U.S. Department of Agriculture. Oak Ridge National Laboratory, Oak Ridge, Tennessee, USA.



Improved Fertilizer Technology

Cover Crops

Riparian Plantings

Crop Rotation




Improve Crop Genetics

Maintain Unmanaged and Diverse Habitat

Future Management

- Establish Priorities
 - Energy Independence
 - Sustainable Development
 - Both?
- Weigh Impacts
 - LUC vs. Increasing Harvest
 - Improving Crop Genetics vs. Maintaining Diversity
- Hope for a better alternative energy



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Questions?