Biofuels and land-use change

A simpler approach to the problem

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Presented to the California Air Resources Board

March 27, 2009
Why care about land use change?

Land use change represents almost 1/2 the net emissions to the atmosphere. It is 1/4 the size of total fossil and cement related CO$_2$ emissions.
But it’s not easy

Accounting for cascading global economic, social and political effects of increased biofuels demand

“Consequential” Life Cycle Assessment is a new concept
Technical uncertainty

Extreme sensitivity to researchers’ input assumptions

Impact of 15 bgy corn ethanol

Source: Tyner et al (2009)
Political and ethical dilemmas

The *ceteris paribus* argument: Biofuels effects should be measured based on an assumption that all other land use factors are the same.
Political and ethical dilemmas

Should biofuels be burdened with other factors leading to unsustainable land use?
Political and ethical dilemmas

Is regulating biofuels a distraction from the more serious problems facing global sustainable land management?
A new look at land use change

I worked with Nathanael Greene at NRDC to develop a simple, commonsense system dynamics model to assess the carbon debt of biofuels when indirect land use change is included.
Overall Land Flows

A “simple” model
A look at cellulosic ethanol

We modeled the effect of the US RFS target of 16 billion gallons of cellulosic ethanol by the year 2022 with no further growth beyond that.
Tuned to FAO data

- World population projections
- Yield trends for cereal crops and oil crops
- Per capita pasture land demand trends
- Per capita cereal and oil crop demand trends
Yields held constant at 2007 levels
Model starts in 1961 and runs through 2060
History projected

Demand for ag land actually declines
Why is that important?
How can that be?
Land abandonment

• “Permanent loss of farmland due to human-induced land degradation [is] estimated to be 5–6 million ha per year.”

What have we learned?
Irrespective of who gets credit, ongoing increases in crop yields can matter.
As long as land is being lost to degradation, yield gains may not mitigate biofuels’ indirect impacts.
Land abandonment

Searchinger land mix
90 gal ethanol per ton
5 tons per acre
5 million hectares per year of land abandonment
Addressing sustainable land management changes the picture
Land abandonment

Searchinger land mix
90 gal ethanol per ton
5 tons per acre
Historical yield improvement
R&D for energy crop yields matters a lot
Energy crop yield

Searchinger land mix
90 gal ethanol per ton
Historical yield improvement
No land abandonment
What land is cleared matters
Type of land cleared

- 90 gal ethanol per ton
- 5 ton per acre
- Historical yield improvement
- No land abandonment
Some observations

• CARB’s process for implementing the LCFS is a model of openness and inclusiveness

• We are in early days for “consequential” LCA and indirect impacts

• “Background” yields can matter if they lead to land surplus
Some observations

• Land abandonment due to unsustainable farming is a (the?) critical problem

• We cannot ignore future energy crop yield improvements

• What land is displaced makes a BIG difference
Paths forward
Be flexible

• The issues behind indirect land use are fraught with political, ethical and technical concerns

• Give the scientific, business and political communities the room to work out solutions

• The science of land use change is changing fast, so be ready to adapt
Direct emissions as the bottom line

- Here the science is best understood
- Hurdle to be met by all players
Incenting sustainable global land use

- Focus on incentivizing fuel providers who offer low land-use impact feedstocks or who couple their fuel production to strategies that lead to better land management globally and restoration of degraded lands