Indirect Land-Use Change – The Issues

A central controversy regarding the sustainability of bioenergy concerns the idea of indirect land-use change (iLUC). With respect to bioenergy, we can define iLUC as any land-use change caused by bioenergy production, excluding the conversion of land used directly for that production. The central hypothesis behind iLUC concerns is that when land used for a given purpose is converted to bioenergy feedstock production, then land used for the original purpose will be more scarce, increasing the value of such land and inducing people to convert other land to that purpose. For example, if an acre of land used to grow corn for livestock feed is converted to growing corn for ethanol, then it would be assumed that the price of feed corn would increase by approximately the amount required to induce someone else to convert an acre of land from some other purpose to producing corn for feed. Furthermore, if this land to be converted to feed corn production has high carbon stocks (e.g., old-growth forest), then the conversion will release CO_2 to the atmosphere, creating a carbon debt that could take decades to pay off via offset fossil fuel combustion. Under certain simple assumptions, scenarios such as this must occur. For example, attempts to quantify GHG emissions from bioenergy iLUC are guaranteed to produce positive results if researchers use models that assume that:

- all agricultural land available for conversion is fully utilized,
- all non-agricultural land available for conversion is relatively undisturbed and has high carbon stores,
- all land available for conversion is privately held,
- all landowners seek to maximize profit, and
- increases in bioenergy production occur suddenly (i.e., act as economic "shocks").

However, these assumptions do not hold in many areas of the world. Because modeling requires generalizations, assumptions will inevitably be violated to some degree. These violations are acceptable only when correcting them would not greatly affect results. In the case of iLUC, conceptual models suggest that correcting some of these assumptions in simulation models could fundamentally change conclusions about iLUC. For example, at the margins of rainforests, land-use change may be driven by multi-year cycles of shifting cultivation, including low-profit and GHG-intensive slash-and-burn techniques. In addition, new deforestation may be driven in part by the desire to claim effectively ungoverned land. Increased commodity prices could plausibly provide incentives for farmers in these areas to more sustainably and intensively manage already-cleared land instead of abandoning it to clear secondary or primary forest.

Unfortunately, data may not currently exist to allow iLUC simulations that would take such potentially crucial mechanisms into account. More research is needed to collect such data, including better resolution land-use and land-cover data throughout the world, and surveys of land managers to better understand motivations for management decisions. In addition to better data, more work is needed to integrate existing but difficult-to-reconcile data sets, such as those with high spatial but low temporal resolution and vice-versa. Techniques of causal analysis pioneered in epidemiology

hold promise for the challenge of determining whether bioenergy plays a significant market-mediated role in deforestation and other land-use change.

Researchers disagree about whether potential iLUC effects should be considered in policymaking. Because some models predict large GHG emissions from iLUC, some researchers argue that not considering iLUC effects would be an unacceptable risk. Other researchers argue that the uncertainty surrounding current estimates of iLUC, both in terms of differing estimates from current models as well as the lack of empirical validation of those models, is too large to consider their results in policymaking. In addition, some researchers argue that considering iLUC effects of bioenergy systems in policymaking is inappropriate because analogous indirect land-use change effects of fossil fuel exploration, extraction, and use are poorly understood and are not taken into account in estimates of environmental and socioeconomic effects of fossil fuels. Finally, there is philosophical debate about how to apportion “blame” (e.g., carbon penalties) among multiple causal factors leading to a given outcome. For example, if certain indirect deforestation would not have occurred in the absence of a biofuel system, then the same could also be said of the individuals or groups actually burning or cutting that forest.

Further reading:

Fritsche, U. R., Sims, R. E. H. and Monti, A., 2010. Direct and indirect land-use competition issues for energy crops and their sustainable production – an overview. Biofuels, Bioproducts and Biorefining, 4: 692–704. Online at: http://onlinelibrary.wiley.com/doi/10.1002/bbb.258/full

Kline, K., Dale, V.H., Lee, R., Leiby, P., 2009. In defense of biofuels, done right. Issues Sci. Technol. 25, 75-84. Online at: http://www.issues.org/25.3/kline.html