Response to *Science* Papers by Fargione, et al., and Searchinger, et al.

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Life cycle analysis (LCA) is an internationally-recognized procedure for determining the environmental impacts of products and processes. LCA follows specific standards (e.g., ISO 14040 series) so that the both the procedure itself and the analytical results are transparent, verifiable and credible. We use LCA in combination with biophysical agroecosystem models to better understand and then improve the environmental performance of biofuels and bioproducts (refs).

The recent papers in *Science* by Searchinger, et al., and by Fargione, et al., purport to connect increased demand for corn for biofuel production with large, indirect land use changes to satisfy the demand for animal feed left unfilled because of the increased demand for corn. These indirect land use changes are in turn linked to large emissions of greenhouse gases (GHGs), thereby incurring a "carbon debt" that the authors believe may take many years to repay. Unfortunately, there is much that is speculative and uncertain in these papers.

LCA is data driven, but these two analyses are not driven by actual data at all. Instead an economic model (with all of the inherent uncertainties of economic modeling) is linked to land use decisions and these land use decisions are in turn linked to GHG emissions. In contrast, consider the following situation. Corn and ammonia are inputs used to make ethanol. One can legitimately use LCA to test the effect of different means of producing ammonia (e.g., from coal vs. natural gas) on the greenhouse gas profile of corn ethanol, but only if actual data on both ammonia production routes are available. Similarly, one can legitimately test the effects of corn produced by two different means (e.g., conventional tillage vs. conservation tillage) on the greenhouse gas profile of ethanol, but only given actual data on the GHG effects of these two tillage practices. There are no real, verifiable data in either of these papers on the land use changes that <u>actually</u> occur as more corn is processed to ethanol—hence these papers are not LCA studies. They are in fact highly speculative and uncertain <u>scenarios</u> for what <u>might</u> happen as a result of increased demand for corn grain.

Even if there were such data connecting increased corn demand for ethanol with land use changes, ethanol produced in the United States would not be "responsible," in a strict LCA sense, for anything but its own environmental profile. "New" corn produced in Brazil by clearing savannah to satisfy animal feed demand is responsible for its environmental profile as an <u>animal feed,</u> not as an ethanol feedstock. For example, plastic bottles are made from ethylene. Ethylene can also be used to make carpets. If demand for ethylene to make plastic bottles grows, then more ethylene will be needed to satisfy the unfilled demand for ethylene for carpets. But we do not make plastic bottle producers responsible for the environmental profile of carpet manufacturers. Likewise, it is unfair and unreasonable to make corn or switchgrass producers who are producing

feedstock for biofuel production responsible for the speculative land use decisions of individuals thousands of miles away who are producing corn or soy for animal feed.

This is clearly different from the situation in which tropical wet lands are converted to oil palm production for the express purpose of providing oil for biodiesel production. It is also different from the situation in which CRP grasslands are actually converted to produce additional corn for ethanol production. In both of these cases, we can and should assess the biofuel produced with the environmental impact of a specific, direct land use change. Direct land use change as a result of biofuel production is a legitimate subject for environmental analysis. In contrast, indirect land use change caused by biofuel production is tenuous, uncertain and highly speculative.