LIFE CYCLE ANALYSIS DEFICIENCIES IN EPA DRAFT REPORT

Several important deficiencies in the EPA Draft Report in terms of technical life cycle analysis are observed. These include sensitivity analysis, allocation and model testing. These will be discussed in turn.

Sensitivity Analysis

It is beyond argument that the system analyzed in the EPA Draft Report is extremely complex and depends on many variables. EPA has examined some variables, but not others. These are some of the important variables that apparently have not been explored:

1. Use of Standing Carbon Stock

EPA is not clear on its assumptions regarding the fate of the existing carbon stock (forest or grassland) in the analysis of indirect effects. Since any productive use of the existing carbon stock (eg, pulp and paper, furniture, etc) would displace products for which GHG emissions would otherwise be generated, this is an important omission. EPA should conduct a sensitivity analysis to determine the effect on calculated indirect emissions if the existing carbon stock on the land presumably cleared because of biofuels is put to productive use. If these effects are significant, a more in depth analysis is required to determine how to account for this effect in the final report.

Also, since the different types of land converted give such different results (grassland vs. forest), EPA needs to conduct a sensitivity analysis with regard to the effects of converting forest vs. grassland on the final result. For example, if the mix of land converted is, say, 40% forest and 60% grassland, versus 60% forest and 40% grassland, how does that change the results of GHG calculations? What is the confidence level that EPA has in the actual mix of land types supposedly converted?

It is also unclear what fraction of land supposedly converted as a result of biofuel production is predicted by EPA to occur in the United States. EPA needs to be explicit about this fraction and bring it forward in their analysis. There are two reasons for this: 1) since we maintain good information on land use and land use changes, for this fraction of the predicted land use change arising from the models, we can actually test the models quite well. EPA should do this. 2) highlighting this fraction will also serve as useful data for policy makers to see how much of our indirect land use change regulation falls within our borders and is somewhat susceptible to our influence, and how much lies outside our borders and is therefore not very susceptible to US governmental influence.

2. Management of Land

EPA has assumed full tillage (although less than half of US corn is grown this way) and medium levels of inputs. However, it is known that different land management strategies will cause different amounts of carbon to be stored in the soil. EPA should conduct a sensitivity analysis to determine the effects of different management strategies on overall GHG emissions. No till, reduced till and conventional tillage practices, plus cover crops, should all be explored as well as the effects of climate and fertilization practices. If the effects are significant, a more in depth analysis is required to determine how to properly account for this effect in the final report.

3. Probability distribution for variables

EPA states correctly that the values chosen for important variables in the analysis of indirect effects are uncertain and subject to some distribution function. Then EPA says that since the probability distribution function is unknown, it would be more scientific not to assume a distribution function. Apparently EPA relies on point estimates for the different variables.

But this is not an adequate response and contradicts LCA principles. It also contradicts EPA's own statements in the draft report. For example, on Page 286 EPA states:

"Although there are uncertainties associated with these estimates, it would be far less scientifically credible to ignore the effects of land use changes altogether than it is to use the best approach available to assess these known emissions sources."

If this is correct, then EPA does not seem to be justified when is states on pg. 304

"While this may be the most intellectually pleasing approach in theory, there are several significant barriers to this approach. Most significantly, it is difficult to determine scientifically-defensible probability distribution functions for all (or even the most significant) input variables. Applying functions that are not well understood may serve to misstate uncertainty."

We do not understand why it is scientifically credible to use the best approach available to estimate GHG emissions (given the uncertainties in the modeling approach) on page 286 and then on page 304 to ignore the uncertainties in input variables.

It seems that a better approach, more scientific and more in keeping with LCA principles, would be to assume various distribution functions and determine the effects of these functions on the estimated GHG emissions. For example, EPA could assume Poisson distribution and normal distribution and compare the results. But it is unacceptable scientifically not to deal with the fact of uncertainty and determine its potential effects on the conclusions of the EPA study. This is especially true since the calculated indirect effect GHG emission is by far the largest factor in assessing the GHG burden of biofuels. Thus the confidence interval around this number is critical and deserves to be estimated.

4. Effect of Abandoned Land

It is well known that nearly a billion acres of abandoned land, formerly in agricultural production, exists around the world. Surely some of this land will be brought into production as a result of the mechanisms explored by EPA in their draft report and will thereby reduce the amount of virgin land supposedly cleared as a result of biofuel production. It is not clear if EPA has considered this abandoned land in their analysis. If so, it should be considered as the allocation issue becomes critical here.   Any GHG release from these lands was incurred long ago for other purposes and cannot reasonably be attributed to biofuel production today.

5. Sensitivity to Allocation

A key LCA issue is how to allocate environmental burdens between different products in a multiproduct system. Both corn ethanol and soy biodiesel are multiproduct systems. EPA is not clear on how it handles the allocation between biofuels and coproducts in these systems. A separate sensitivity analysis should be done to show the effects of different allocation methods on the results. In the event these are important, EPA should solicit external input as to the most valid ways of allocating GHG emissions.

Allocation Issues

It is obvious that we use land for many purposes and that most human use of land is actually to provide feed for our livestock. EPA has interpreted EISA as requiring that all incremental land demand supposedly caused by biofuel production be assessed against biofuels. Another way of interpreting EISA is that biofuels should be assessed their fractional total of all human use of land. This would allow policy makers to weigh other human uses of land and to decide how and if to allocate GHG releases due to these other land uses. Or this analysis could also be done quite easily as a sensitivity analysis wherein the different uses of land were each assessed their appropriate weighted fractions of GHG release. For example, we could as a society decide to curtail use of some animal products so as to have more land available for biofuels. Unless these policy choices are illuminated by the appropriate analysis, however, we cannot make the choices.

Specifically regarding the modeling of the animal feeding system, it is not clear how EPA has done the carbon mass balance around the cow. It is true that cows emit methane, but that methane is supposedly from plant derived carbon. Or is it? The details of the GHG accounting and allocation for the ruminant animal system are not clear and they need to be. Likewise, the allocation of GHG burdens between soy meal and soy oil for the soy biodiesel system are not clear. Allocation is a critical issue and clarity about assumptions is needed if these are to be properly evaluated.

Baseline Comparisons

On Page 332 EPA states.

"In addition to direct N2O emissions from croplands, there are several additional sources of indirect emissions, including emissions from volatilization, leaching, crop residues, and residue burning. Some of the N applied to agricultural soils as fertilizer volatilizes, entering the atmosphere as ammonia and other oxides of nitrogen. The volatilized N subsequently returns to soils through N deposition and then contributes to N2O emissions. After fertilizer application or heavy rain, large amounts of N may leach from the soil into drainage ditches, streams, rivers and eventually estuaries. Some of this N is emitted as nitrous oxide when the leached nitrogen fertilizer undergoes the process of nitrification or denitrification. There are also N2O emissions from crop residues that are incorporated into agricultural soils. Following IPCC guidance, N2O emissions are calculated as 1% of the N from crop residues that is incorporated into the soil. FASOM

also assumes that a certain fraction of fields are burned each year, which results in N2O (and methane) emissions. These emissions are calculated using the IPCC default value, which assumes that on average 0.7% of N contained in the burned residue is emitted as N2O. In addition, methane emissions are calculated based on the average methane emissions per acre, but these emissions are typically quite small relative to the other emissions tracked in FASOM. All FASOM calculations of N2O emissions are based on IPCC guidance (See DRIA Chapter 5 for more details). "

This is a reasonable approach given EPA's mandate to consider indirect effects. But if this approach is valid for biofuels, then it is also valid for gasoline and diesel. What are the indirect GHG effects of gasoline and diesel production? It is not scientifically justified to consider indirect effects in one analysis and to ignore them in another.

Tests of Modeling System

As EPA is well aware, the modeling system they have constructed is the "first of a kind". In order to have confidence in the results, especially given the critical nature of the analysis to the future of biofuels, it is important to test the model. It seems that EPA could test its modeling construct by determining if it predicts the changes actually observed in land clearing and world agriculture during the first phase of the expansion of the corn ethanol industry, for example between 2001 and 2005. If the model is able to backcast with acceptable accuracy, then we can have some confidence in its ability to forecast. If not, then the whole scientific basis for the regulation is undermined.

For example, here is one way that we have tested the model. Apparently, at least in this instance, the model is unable to backcast.

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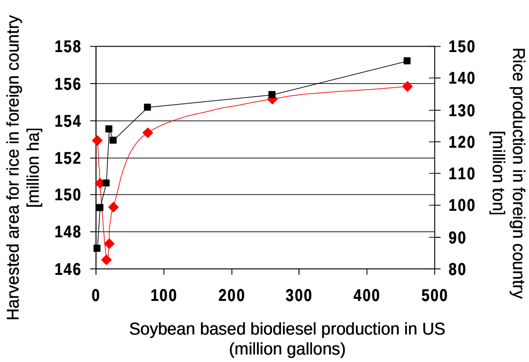
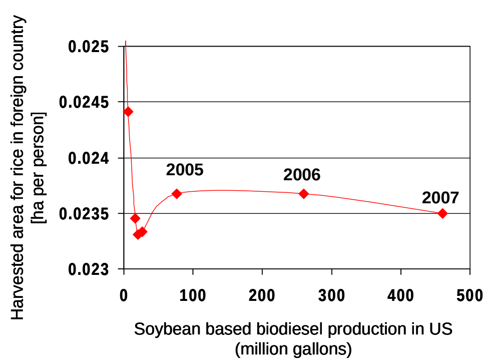
"… the FASOM model projects that increasing the production of soy-based biodiesel will reduce domestic livestock and rice production, which reduces methane emissions from those sectors. To compensate for this decrease in domestic rice and livestock production, the FAPRI models project that foreign countries will expand their rice and livestock production."





This prediction has not actually occurred according to the figures above. Soy biodiesel production has expanded by 5 fold between 2005 and 2007, while harvested rice area per person has actually declined (in other words, factoring out increased human food demand from the overall picture).

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