BIOdiesel Tech NOTES

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BIODIESEL AND INDIRECT LAND USE CHANGE

Synopsis:
A common claim regarding biofuel production is that increases in price and demand for oils extracted from energy crops to make biofuels results in land use changes (LUC). Simply put, demand sparks an increase in biodiesel production; and, as the market expands, food crop land is converted to grow energy crops. Food prices increase, and to ease the burden, non-crop land is converted to food crop use. This conversion is called Indirect Land Use Change (iLUC).

The EPA estimates iLUC based on the Global Trade Analysis Project (GTAP) model developed by Purdue University. The model is based on the economic principle that when the price of soy oil rises, previously uncultivated land will be converted to agricultural use. However the model asserts that the cause of iLUC is only the increased demand in crude soy oil and the coproduct, meal, does not play a role; assuming that the supply of co-product increases with no increase in demand.

This Tech Note examines this assumption, as well as the economic relationship between co-products to determine how much the demand for oil is responsible in the calculation of iLUC.

There are two primary reasons why the U.S. government passed the Energy Independence and Security Act of 2007 (EISA): to encourage development of a clean, renewable fuel and to decrease our dependence on foreign sources of fuel, thereby increasing the security of the nation.

The U.S. government currently requires obligated parties, mainly companies that market petroleum-based transportation fuels, to blend about 10% renewable fuels into their products. This percentage will gradually increase to 20% by 2020.

In order to ensure a replacement fuel can qualify as a "renewable fuel," the EPA created this definition within the Renewable Fuel Standard: A biofuel is considered a "Renewable Fuel" if it reduces harmful greenhouse gas (GHG) emissions by 20% or more, relative to the petroleum fuel it replaces, while an "Advanced Biofuel" reduces GHG by at least 50%. These reductions refer to the GHG emissions for the entire pathway of production, from field to the pump, including any significant effect of indirect land use changes due to an increased demand of oil.

Co-product Allocation

To estimate the percentage of GHG reduction of any renewable fuel, a model called Life Cycle Analysis (LCA) is used. One of the challenges in life cycle analysis is to determine just how much each of the co-products produced are responsible for the GHG emitted in the production process. In the production of seed oil, the co-products are the oil and the meal. Although imperfect, allocation based on the relative mass of co-products provides a fair and consistent way of emission allocation among co-products.

However, the allocation method is different for Indirect Land Use Change (iLUC). For the purpose of iLUC allocation, the economic model assumes that the land use change was caused by an increase in feedstock price. No division of allocation is required even though the ultimate result of the land use change produces both oil and meal. This method is commonly known as "system expansion."

Using soybean oil as an example, an increase in soybean oil demand for energy fuels may lead to an indirect land use change from forest land to a food crop. Therefore, the EPA requires that for the purpose of LCA estimation, the negative effect of removing that carbon sink should be attributed solely to the soybean oil.

Indirect Land Use Change Allocation

When soybeans are crushed, the oil constitutes about 20% of the total weight. The remaining co-product, called meal, is high in protein and used mainly as animal feed. Therefore, there are two valuable products being distributed to two different markets: oil for fuel and meal for cattle feed.

The EPA currently assumes that an indirect land use change be 100% attributed to the biofuel feedstock following the method of system expansion. This calculation would be valid if the increased supply of meal as a result of iLUC had no increased value, as assumed by the EPA. In other words, the only coproduct to increase in value was the crude oil. However, that has not been the case. The price data for oil and meal over the past ten years are shown in Figure 1.

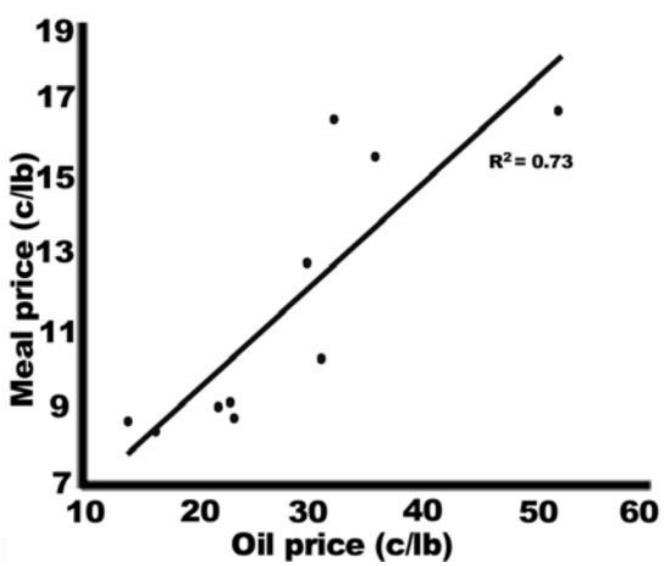

Figure 1: Annual average price of soybean oil and meal for 2000 to 2009 (source ERS, 2011)

The increase in soybean price has been broken down into meal and oil. The increase in oil price was regressed with the increase in soybean price. The regression showed that oil price increased by 94 cents for each one dollar increase in soybean price. Similarly, regression between soybean meal and soybeans showed that the meal price increased by one dollar per one dollar increase in soybean price.

This tells us that: 1) System expansion produces two marketable co-products, and should require co-product allocation; and 2) The biodiesel alone should not be held responsible for increases in food price since the soybean meal is not used to make biodiesel. If the biodiesel was the cause of a food price increase, we should have seen relatively more price increases in oil compared to meal. That is not the case.

Therefore, if demand for energy crops causes an expansion of land use to grow these crops, and non-crop land is converted to food crop use as a result, a percentage of that iLUC should be shared for both the oil and the meal. When iLUC allocation is fairly assigned, the result is a biofuel with a higher GHG reduction than previously assumed. In fact, biodiesel from soybean oil emits 76.4% less GHG than the emissions for 2005 baseline diesel.

Conclusion

In conclusion, data confirming GHG emissions as a result of iLUC is conjecture at this point. The amount of GHG emission that can be reliably attributed to iLUC is uncertain, and is based on regulatory need rather than scientific scrutiny. That does not mean iLUC is not a viable concern, or does not have merit. However, we need to be careful not to unjustly penalize the biofuel industry. Very few real world examples of indirect land use change can be attributed to energy crop production, but even if we assume this, the allocation of iLUC for the purposes of Life Cycle Assessment is clearly unbalanced and warrants further research.

For more information: S. Shrestha, J. Van Gerpen., A. McAloon, W. Yee , M. Haas, and J. A. Duffield. 2012. Reassessment of life cycle greenhouse gas emissions for soybean biodiesel. Transactions of the ASABE. 55(6):2257-2264 at http://web.cals.uidaho.edu/biodiesel/our-research