Friends of the Earth Europe

Summary briefing

Timothy Searchinger paper – 'Understanding the Biofuel Trade-offs between Indirect land use change (ILUC), Hunger and Poverty'

Biofuels are forcing people to eat less food

- Though most studies on the effects of biofuels focus on land use change or food prices, a new analysis by scientist Timothy Searchinger of Princeton University highlights another important, as yet unreported dynamic: **biofuels reducing food consumption of the world's poor.**
- This new analysis of available studies, including the European Commission's own studies, shows how, buried in the data, **biofuels are taking food off people's plates to burn in cars.**
- In fact, reducing food consumption is a critical reason why some biofuels (bio-ethanol) appear to cause relatively less indirect farmland expansion e.g. into tropical forests, and therefore relatively fewer carbon emissions.
- New figures reveal that crops such as wheat or maize used to produce ethanol in Europe can only reduce greenhouse emissions if two things happen – farmers produce exceptionally high yields above and beyond the normal trajectory of yield growth, and/or **people reduce their food consumption**.
- This means that the less forest and grasslands are ploughed up, the bigger the impacts on hunger; or the lower the impacts on hunger, the more farming causes greenhouse gas (GHG) emissions from land use change.
- If EU decision makers vote to increase levels of biofuels, they will be **voting to mandate that people, probably the world's poorest consumers, eat less food**. **A vote for an increase in biofuels is a vote for hunger.**
- This is an unacceptable cost. Biofuels are fuelling hunger, land grabs and climate change. **Europe must act to stop food being burned in our fuel tanks.**

Main findings

The European Parliament and the Council of the EU are currently considering reforms that could change the course of biofuels policy – by ensuring that only biofuels that "help achieving substantial emission cuts, do not directly compete with food and are more sustainable at the same time"[1] are promoted.

However, a new analysis by Searchinger shows that the proposal being debated does not deliver this.

[1] http://europa.eu/rapid/press-release_IP-12-1112_en.htm

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Two concerns stand out: One involves the likely consequences of biofuels for greenhouse gas emissions because of the ploughing up of forests and grasslands and their release of carbon (so-called 'indirect land use change' or ILUC). The other involves the consequences for hunger and poverty. What is not broadly understood is that the two consequences closely relate: the less farmers plough up forest and grassland, the greater the impacts on hunger; but the lower the impacts on hunger, the more farmers cause greenhouse gas (GHG) emissions from land use change. A no-win situation.

Research on ILUC for the European Commission by IFPRI[2] shows that some crop-based, biofuels – mostly bio-ethanol – may succeed in reducing GHG emissions to a limited extent compared to fossil fuels. However, what is little known is that the modest GHG savings are achieved only because IFPRI also predicts large reductions in food consumption.

Searchinger's analysis makes the trade-offs between indirect land use change (ILUC), hunger and poverty clear:

- The IFPRI model predicts that of every 100 calories from wheat or maize diverted to fuel tanks, roughly 25 calories are not replaced – meaning fewer food calories are available for people.[3] This holds down the impacts on climate change, but occurs at the expense of food production and consumption – mostly in the poorest parts of the world because people in richer countries will still be able to afford enough food.
- Searchinger's analysis also shows how IFPRI predicts a large reduction in food quality. Most of the additional land needed to produce wheat or maize for ethanol displaces other crops, including vegetables. Because these other foods become more expensive, consumers (particularly the world's poorest) will eat less well.
- The analysis shows for the first time how the IFPRI study predicts that, for every hectare of maize planted for ethanol, 60% comes at the expense of using that land to produce crops for food – meaning more fuel but less food. Increased yields can help to replace some of the food lost from the supply system – but it is not clear that farmers are able to achieve crop yield improvements above and beyond normal yield gains in response to biofuels. If they cannot, people either go hungry or more land is converted.
- The IFPRI model estimates lower emissions from ILUC for ethanol from wheat and maize compared to very high emissions for biodiesel, largely because almost half of the crop area devoted to wheat ethanol and even more than half of the area for maize ethanol are not replaced. If all the land for food crops would be replaced by ploughing up new land from grassland and forest ecosystems, the ILUC land area (and corresponding emissions) would be more than five times larger. Hence, if the reductions in food consumption did not occur, ethanol from both wheat and maize would greatly increase greenhouse gas emissions.[4]

The message to decision-makers in the EU is clear: a vote for increased biofuels mandates means a vote to reduce world food supply – mandating hunger. Only by counting on people to eat less food can carbon savings be achieved: an unacceptable trade-off.

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2 http://trade.ec.europa.eu/doclib/docs/2011/october/tradoc_148289.pdf

3 This calculation treats ethanol by-products as remaining in the food supply because they remain available as animal feed.

4 Assuming that emissions would expand proportionately with area, ILUC emissions would be roughly 80g CO_2/MJ for maize ethanol, and 91g CO_2/MJ for wheat ethanol.

As part of the No Food For Fuel campaign, Friends of the Earth Europe calls upon decision makers to:

Act now to end the use of food in our fuel tanks and support genuinely clean and sustainable transport. Decision-makers in the European Parliament and national government ministries should:

- Halt and reverse the growth of harmful biofuels through the introduction of a strong and robust cap on land-based biofuels.
- Account for the full climate cost of biofuels – including CO2 from felling forests, plundering peatlands, and expanding agriculture to satisfy Europe's hunger for more biofuels – by introducing ILUC factors.
- Phase out subsidies for land-based biofuels and adopt a trajectory that will bring their consumption down to zero.
- Put our transport onto a genuinely green path by establishing new incentives and policy instruments to increase energy savings/efficiency in transport, supporting public transport and cycling, speeding up the uptake of renewable electricity for cars and trains, and encouraging the development of small quantities of truly sustainable advanced biofuels produced from waste and residues.

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UNDERSTANDING THE BIOFUEL TRADE-OFFS BETWEEN INDIRECT LAND USE CHANGE, HUNGER AND POVERTY

July 2013

Independent analysis by Timothy Searchinger produced for Friends of the Earth Europe

UNDERSTANDING THE BIOFUEL TRADE-OFFS BETWEEN INDIRECT LAND USE CHANGE, HUNGER AND POVERTY

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(July 2013)

As the European Parliament and the Council of the EU consider changes in biofuel policies, two concerns stand out. One involves the likely consequences of biofuels for greenhouse gas emissions because of the plowing up of forests and grasslands and their release of carbon. The other involves the consequences for hunger and poverty. What is not broadly understood is that the two consequences closely and inversely relate: the less farmers plow up forest and grassland, the greater the impacts on hunger; but the lower the impacts on hunger, the more farmers emit greenhouse gases from land use change. Much of the uncertainty about the consequences of biofuels relate to how much of which undesirable response the world will get.

The basic connection is one of arithmetic. When biofuels divert crops from food there are three basic alternative responses: (1) the crops are not replaced; (2) crops are replaced by land use change; and (3) crops are replaced by boosting production on existing agricultural land. The first two responses are undesirable in their own ways. If crops are not replaced, someone, somewhere is eating less (or less well), and that mostly means the world's poor. If crops are replaced by plowing up more land, the process probably releases carbon from plants and soils – or prevents abandoned land from regenerating forests – and sacrifices biodiversity. Biofuels are likely to be desirable only to the extent that farmers respond to higher prices triggered by biofuels by increasing their crop yields even more than they otherwise would – and even that response comes with its own costs in water and fertilizer. Economic theory tells us that at least some of each response is likely but the extent of each response is at least somewhat uncertain. Some biofuel supporters point to the uncertainties about each consequence as a justification for continuing to maintain support for biofuels, but much of the uncertainty only concerns which of the two bad effects is larger: increased land use change or increased hunger.

Researchers use economic models to estimate emissions from indirect land-use change (ILUC) because the precise mix of responses to the diversion of crops to biofuels depends on a range of responses by consumers, farmers and governments worldwide. Biofuel supporters can focus alternatively on ILUC models with better results for greenhouse gas emissions or on models that have better results hunger, but they cannot have it both ways. If crop-based biofuels do succeed in reducing greenhouse gas emissions a little, as some models suggest, it turns out that these models typically do so because those models also predict large reductions in food consumption.

The Role of Reduced Food Consumption in IFPRI's Analysis of Land Use Change from Ethanol

In response to requirements to analyze indirect land use change from biofuels (ILUC), the European Commission asked the Joint Research Centre (JRC) to do an analysis and comparison of the predictions of different models, and also commissioned the International Food Policy Research Institute (IFPRI) to develop a model specifically for European use. The estimates of ILUC emissions from the models analyzed by the JRC did vary, but were generally from 30 to well over 100 grams of carbon dioxide per mega joule of energy from bio-ethanol, and from 40 to well over 100 for biodiesel (Edwards 2010, p. 95 Figure 22). IFPRI's first round of modeling found emissions of 37-54 or more grams per mega joule for grain-based ethanol and around 60 for biodiesel, and when combined with the direct emissions from the production of biofuel resulted in no or only modest greenhouse gas benefits for most feedstocks (Al Rifai 2010 p. 65, Table 12). Based on all this evidence, the JRC concluded, "all the models agree that, including ILUC effects, there will be little or no GHG reduction compared to fossil fuels for ethanol from grain and biodiesel from vegetable oil" (Edwards 2010).

IFPRI subsequently revised its modeling in ways that generally led to lower emissions and therefore more favorable ILUC results for biofuels (Laborde 2011, Laborde 2012). Although these new results continued to mean that biodiesel always increases greenhouse gas emissions, the estimate of ILUC emissions for ethanol from wheat dropped to 17 grams per mega joule and from maize to 11 grams per mega joule.[1] Those results are lower than virtually all other model estimates, and are based in part on optimistic assumptions about the extent to which biofuel demand will cause farmers to increase their crop yields more than they otherwise would. These ILUC estimates are low enough that wheat-based ethanol would probably generate a 25% greenhouse gas reduction overall, and maize-based biofuels roughly a 45% reduction compared to petrol.[2] These results mean that at least some grain-based ethanol could meet the requirement for a 35% reduction in current law although probably not the 50% reduction required in 2017 for all biofuels (or the 60% reduction required for biofuels from new facilities in 2018).

The IFPRI study has given rise to the general understanding that unlike biodiesel,

[1] In the 2011 final report, these figures were listed as 14 and 10, but subsequent model corrections changed these figures to 17 and 11 as reported to the JRC. In the results presented in the published paper in an economic journal, which were actually generated earlier, the ethanol emissions were 25. The main modelers emphasizes that the numbers differ based precisely on the scenario and the quantities of biofuels required.

[2] These figures are based on the JRC's 2012 estimates for the production and transportation emissions from typical European ethanol plants of 46 gCO2/MJ for wheat ethanol and 37 gCO2/MJ of maize ethanol, and the emissions of 83.8 gCO2/MJ for petrol set forth in the Renewable Energy Directive. When combined with the IFPRI ILUC numbers, that implies total emissions of 63 gCO2/MJ for wheat (a 25% reduction compared to petrol), and 48 gCO2/MJ for maize (a 43% reduction).

ethanol probably generates at least some greenhouse gas reductions. If that analysis is right, does that make ethanol good? Only to those who don't care about food, because these savings are achieved largely by reducing the amount of food eaten in the world. Biofuel production starts by diverting crops into energy use. If the effects stopped there, every ton of food diverted to biofuels (after subtracting by-products still used for feed) would come at the expense of food. Fortunately, much and probably most of that food is replaced as the diversion triggers higher prices that cause farmers to produce more. But the same high prices mean some people cannot afford as much food and eat less, and that means less land use change and greenhouse gas reductions in other ways. According to the IFPRI analysis, the diversion of wheat or maize to biofuel production results in substantial reductions in food consumption, which turns out to be the source of the greenhouse gas benefits for wheat or maize ethanol.

The reduction in food consumption is in part an issue of "quantity" – in other words, a reduction in food calories. According to an analysis of the IFPRI model by the EU Joint Research Center (JRC), of every 100 net calories from wheat or maize diverted to ethanol, roughly 25 are not replaced. This calculation properly treats ethanol by-products as remaining in the food supply because they remain available as animal feed. The reduction in the total calories consumed by people holds down climate change, but at the expense of food production and consumption.

Physically that reduced food consumption generates greenhouse gas savings compared to fossil fuels because people consume less food and carbon in food. That literally means they breathe out less carbon dioxide (and also emit less carbon as waste). In some model estimates, reduced consumption of crops by livestock also plays a role but not significantly in the IFPRI calculation. In effect, this reduction in carbon emitted by people and livestock offsets some of the carbon emitted by burning ethanol, giving it an advantage over petrol. Without crediting ethanol for these reductions in food calories, even in the IFPRI calculation, wheat ethanol increases greenhouse gas emissions, and the reduction in emissions for ethanol from maize declines to roughly 10%.[3]

The story does not stop there, however, because IFPRI also predicts a large reduction in food "quality", which plays a large role in holding down land use change. The food quality change occurs because IFPRI predicts that much of the additional land needed to produce wheat or maize for ethanol will not displace wheat and maize for people and livestock. Instead, it will displace other crops including vegetables and olives. And because these crops produce fewer calories than maize and wheat, the total loss in the world's food calories is only about 25% of the food energy devoted to ethanol. But the impact on economic value and nutrition is greater.

The JRC has analyzed the effect of these declines in other crops from the

[3] The carbon in wheat or maize that becomes ethanol, rather than by-products, equals 107 grams per mega joule of ethanol, one third of which is emitted during the process of fermenting starch to ethanol, and two thirds of which are emitted by the exhaust pipes of cars. If one quarter of that energy in grain is not replaced, it translates roughly into a savings of one quarter of the carbon, or roughly 27 grams per mega joule.

standpoint of land use. For example, IFPRI predicts that 86% of the additional land area devoted to producing maize comes at the expense of area devoted to other crops. Because the hectares devoted to these other crops declines, the additional area devoted to maize or wheat can come from them and not from forest or grassland, and that displacement plays a major role in keeping the estimates of ILUC emissions low. Some of this decline in other crop areas is not due to reduced consumption: it occurs because of yield gains by farmers in producing these other crops or because ethanol by-products replace some of the need for oilseed meals. The JRC analysis accounts for these replacements. But even so the JRC has found that roughly half of the net land area devoted to maize ethanol (the area after accounting for feed byproducts) results from the reduction in area devoted to food production overall. In the case of ethanol from wheat, the figure is above 60% (See Figure 4).

If farmers were to continue to produce the same level of the different crops for food and biofuels so that grains for ethanol needed to come instead from new land area, the ILUC land area (and presumably emissions) would be more than five times larger for each form of grain ethanol. In that event, ethanol from both wheat and maize would greatly increase greenhouse gas emissions.[4]

So what does the IFPRI study imply for grain-based ethanol? It does predict that grain ethanol may modestly decrease greenhouse gas emissions but only because it finds that the primary consequences of ethanol lie in reduced availability of food. It implies that decision makers who vote in favor of increasing ethanol biofuels as a way to mitigate climate change must count on people to eat less food and less nutritious food to achieve carbon savings.

Other estimates of effects of crop-based biofuels on food consumption

Although models differ greatly in their predictions of biofuel changes to food consumption, models that predict low ILUC in general predict large reductions in food consumption. No other models appear to predict the same food quality effects, but the model for the California Air Resources Board predicts that roughly 50% of the calories in maize diverted to ethanol are not replaced because of reduced food consumption, and 44% of the calories in wheat diverted to ethanol are not replaced. The analysis used by the U.S. Environmental Protection Agency from modeling done by the Food, Agriculture and Policy Research Institute at Iowa State University also predicted that roughly 25% of the calories diverted to ethanol from maize would not be replaced in the food supply.[5] In

[4] Assuming that emissions would expand proportionately with area, ILUC emissions would be roughly 80 gCO2/MJ for maize ethanol, and 91 gCO2/MJ for wheat ethanol.

[5] These results are based on updated analysis of the output files of these models by Robert Edwards and Declan Mulligan of the JRC and calculate the loss of digestible energy from the "net feedstock" devoted to ethanol, in other words, from the amount of crop energy used for ethanol after subtracting the energy that remains in the food supply through by-products. Earlier results, based on food weight, were reported in

each case, these reductions in food consumption were therefore the critical factors that explained why maize-based ethanol could generate even small greenhouse gas reductions.

An alternative economic approach is to calculate directly the consequences of increasing crop prices on global consumption of calories from staple crops. Economists William Schlenker and Michael Roberts did exactly that (Schlenker and Roberts 2013). Their best estimate found in general that when biofuels increased demand for crop calories from the major commodity crops, after accounting for by-products, roughly 22% of the crop calories diverted to biofuels would not be replaced and would therefore come out of reduced food consumption.[6]

Relation of effects on food prices and effects on hunger

Many researchers, journalists and officials treat the impact of biofuels on hunger as equivalent to their impact on food prices. Some economic models predict that biofuel policies should eventually cause only modest food price increases – sometimes as low as a few percent (although sometimes 25-50%). These models, to some, cast doubt on the fear that biofuels will cause substantial hunger or have been a large cause of the crop price increases in the last five years. Yet this thinking confuses the meaning of these models in two basic ways.

First, it confuses the relationship between hunger and prices. When biofuels divert crops, prices rise until the supply of crops increases enough and the consumption of crops falls enough that supply and demand are in balance. If many poor people are unable to pay significantly higher prices, their purchases of food decline faster and prices do not have to rise as much. For this reason, models that predict a greater deal of hunger from biofuels will actually tend to predict smaller price increases.

Second, this thinking confuses timeframes. Nearly all the models that have analyzed biofuels and ILUC are focused on the long-term "equilibrium" effects of biofuels. These conditions occur when farmers have had enough time to increase their production of crops as much as the higher price of crops warrants. That is another way of saying the time at which the price of crops equals the costs of producing them. These models are in effect predicting the price that crops will settle down to some years after biofuel demand stops growing and farmers have had as much time as they need to produce more food (in part by plowing up more land.)

The more dramatic price increases experienced since 2008 are a shorter-term phenomenon driven by a market well out of balance with the long-term equilibrium

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Marelli 2011. The GTAP results presented are not precisely those used by California but were based on results using the same model by the same modelers submitted to the JRC as part of a model comparison enterprise and should therefore be extremely close to those used by California.

[6] The paper actually presents a larger percentage drop in consumption but without consideration of by-products. The 22% figure assumes that 30% of grain biofuel calories remain in the food supply through by products.

(albeit a market that can remain out of balance so long as governments continue to drive up biofuel demand). Since 2008, global crop prices have mostly been two to four times their levels from the early 2000's. [7] We can be confident these prices do not represent a long-run equilibrium because the prices of crops have increased far more than the costs of producing them today,[8] and even more than the long-term costs of producing them according to virtually all economic models.

So why are today's markets not in long-term equilibrium? Biofuels provide a big reason and probably the biggest reason (Abbott 2011; HLPE 2011; Trostle 2011). As Figure 3 shows in the case of grain, for every one ton of increased grain eaten each year by people and livestock since 2008, biofuels have consumed another 47% of a ton. Meanwhile, Figure 4 shows that, notwithstanding many unsupported claims to the contrary, global grain yields have been growing overall at roughly their historic rates. Stories for vegetable oil and sugar are similar. These facts suggest that absent the growth of biofuels, prices might have increased but would not have exploded. Perhaps more importantly, whatever other challenges world agriculture faces in meeting rising demand for food, the rapid growth in demand for biofuels must be greatly compounding them.

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[7] Price changes are shown by the FAO at http://www.fao.org/worldfoodsituation/wfs-home/foodpricesindex/en/.

[8] U.S. agriculture is generally considered to be the most energy-intensive agriculture in the world, and would therefore be the country most affected by rising energy prices. The U.S. Department of Agriculture, however, has estimated rises in prices far greater than rises in costs to produce the major commodities, including maize, and therefore rises in net returns. See data at http://www.ers.usda.gov/data-products/commodity-costs-and-returns.aspx#.UdJLLT7F2nY

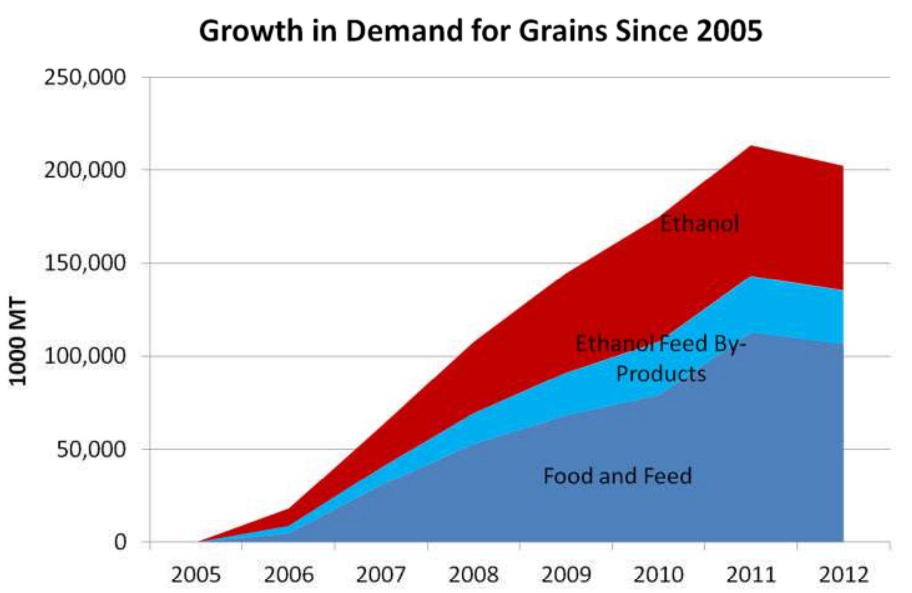

Figure 1: The rise in demand for grains for ethanol has greatly increased the growth in demand for world grains. Sources: USDA PS&D data and FAPRI.

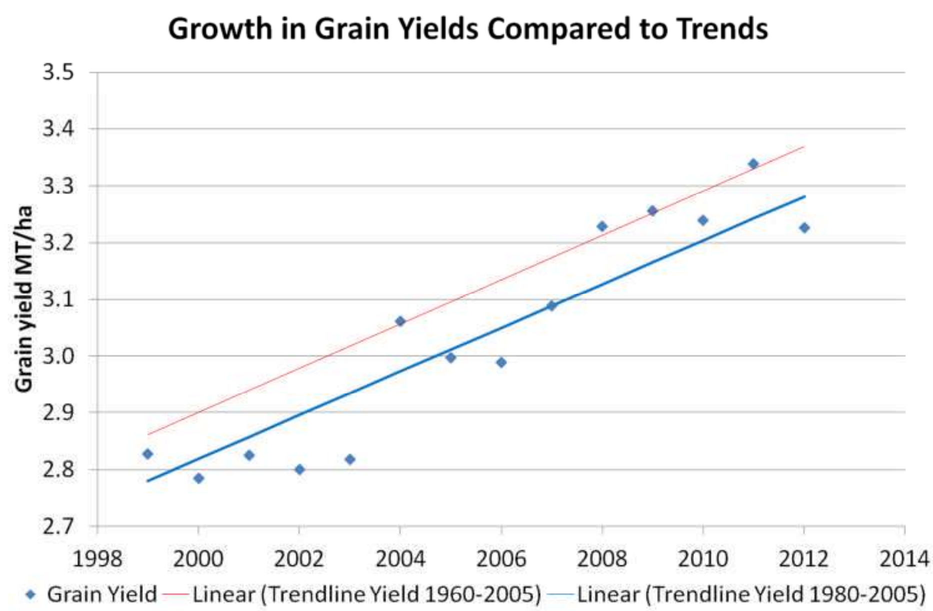

Figure 3: Since 2006 global grain yields have been growing above their trend line from 1980 to 2005 in all years except 2012, and have even been mostly matching the slightly faster growing trend line using data back to 1960. Source: USDA PS&D data

So what do these analyses mean for biofuels and hunger? Many models, such as the IFPRI model, are predicting that even in the long run, much of the food diverted to biofuels will not be replaced. Although food prices should come down if governments slow down their push for biofuels, that still means many people will be eating less. Yet in the shorter run, the situation is probably worse. In the short-term, farmers have less ability to boost food production, so more of the crops diverted to biofuels must come from the food eaten by people. These even greater impacts on hunger are likely to continue if governments continue to demand that biofuel production grow at a rate faster than farmers can fully match.

Consequences for People

Who eats less when food prices rise? Long-time evidence has shown that wealthier people barely change their total food consumption when prices rise, but poor people in poor countries, who devote half or more of their incomes to food production, often must reduce their food consumption out of sheer necessity (HLPE 2011). (Technically, the price elasticity of demand for food among the poor is much greater than among the rich.)

The impacts on the poor are not the same everywhere. Increases in global crop prices do tend to translate into local prices in poor countries in Africa, Asia and Latin America, but the transmission is uneven and sometimes delayed (HLPE 2011). Some of the world's poor are net food producers and may therefore benefit from higher crop prices on balance. But roughly half of the world's hungry people are urban, and therefore net consumers; and even most of the rural poor are net food purchasers (Ahmed 2007; Filipiski 2010). The hungry therefore suffer from higher prices either by reducing their food consumption or by reducing their consumption of other necessities. Several studies have analyzed the impact of the recent rise in food prices on hunger, nutrition and related health effects in specific developing countries, and many such studies have found harsh impacts (Compton 2011; Dorward 2012).

The Implications of the IFPRI Modeling for Uncertainty

As the European Union considers whether to cap food-based biofuels and other biofuels that can compete with cropland and forests, biofuel advocates argue that the uncertainties about indirect land use change are too great to restrict biofuels based on such concerns. The IFPRI study provides a good illustration of why that is not the case. The reason: it represents an extremely favorable estimate of land use change for biofuels. But those greenhouse gas reductions are due to in part to reduced food consumption, rely heavily on large additional yield increases by farmers, and even so do not predict large greenhouse gas reductions from biofuels.

Robert Edwards of the Joint Research Center (JRC) has carefully analyzed the IFPRI results for grain-based biofuels. His analysis, reproduced in Figure 4 below, illustrates why the IFPRI model estimates such low emissions from ILUC for ethanol from wheat and maize. The analysis first calculates a *ne*t land area devoted to biofuel production. That is the total land area needed to produce the ethanol but subtracting the land area saved by the ethanol feed by-products, which are roughly 35%.   That is the true land area devoted to ethanol production. The IFPRI analysis then predicts first that almost half of this net land area devoted to wheat ethanol, and 60% of the net land area devoted to maize ethanol, come at the expense of using that land to produce crops for food – meaning less food. These results are described above. Of the food that is replaced, IFPRI predicts that the vast majority comes into being because farmers respond to the higher prices triggered by biofuels to increase their yields on the same cropland. In effect, for every ten hectares of cropland devoted to biofuel production on a net basis, only around one hectare is replaced by expanding cropland area.

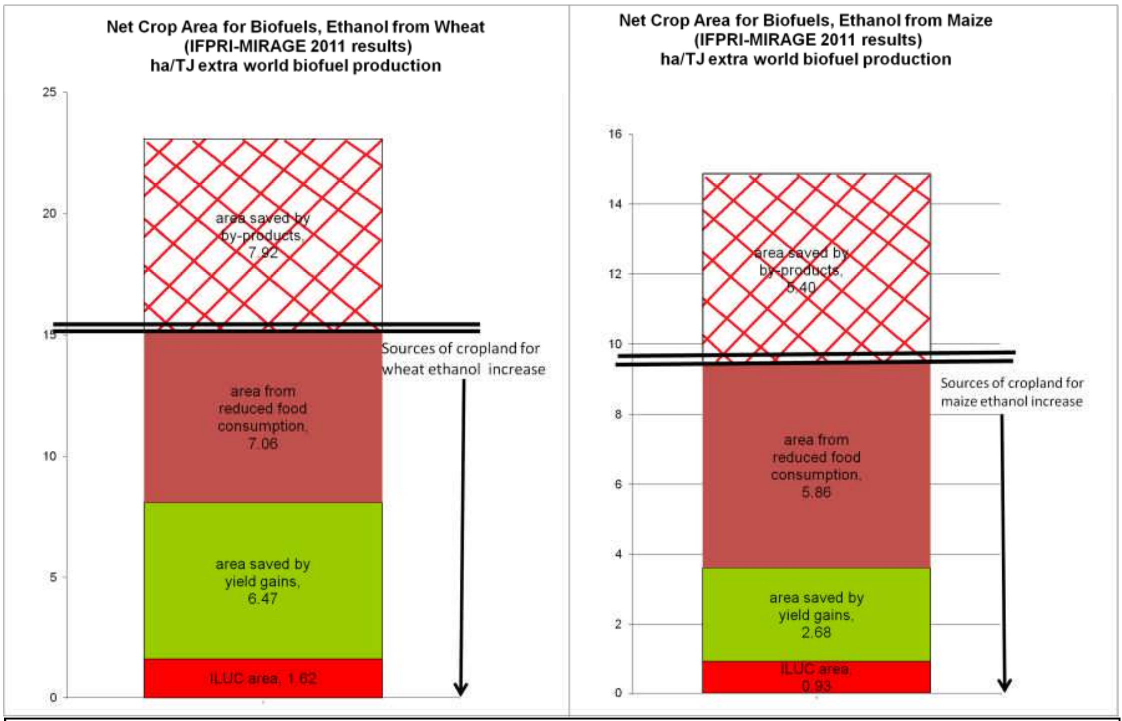

Figure 4: According to the IFPRI calculations, to produce a terajoule of ethanol (roughly 42,000 liters) requires roughly 23 hectares of wheat and 15 hectares of maize.   Some of those hectares of food are effectively replaced by ethanol by-products, which generate an animal feed, so the net area diverted to ethanol is roughly 35% less. Where does this net area come from according to the model? Much of the land becomes available for ethanol because of reduced food consumption.   Another part also occurs because of reduced cropland devoted to food but is effectively replaced by increases in yields on existing cropland by farmers responding to higher prices. (These yield gains must be in addition to those the farmers would achieve without biofuels). Finally, approximately one tenth is replaced by the expansion of cropland area (ILUC). Source: EU JRC Analysis of IFPRI Output

In addition to the large reduction in food consumption, the small ILUC results heavily from an assumption built into the model that when prices increase, farmers will replace food primarily by increasing yields rather than by expanding cropland area. These assumptions are highly disputed. For example, the California Air Resources Board hired the chairman of the economics department at Yale University to review the precise yield estimates used in the GTAP model used by California, which were then borrowed by IFPRI. Berry's analysis determined that the studies underlying the GTAP estimates actually found that price increases would not result in increased yields (Berry 2011). In other words, yields would continue to grow but would not grow any faster because of biofuels. Most models estimate that expansion of land area provides a greater share of additional crops than suggested by the IFPRI analysis. If IFPRI were to run its model with less of a yield response and more of an area response, ILUC from grain ethanol would be higher, and with even relatively modest changes, such ethanol would probably increase greenhouse gas emissions.

Researchers have also found that global crop yields are not growing sufficiently to meet future food demands without clearing more forest and savanna (Ray 2013). Ultimately, for biofuels to truly contribute to solving climate change, those yield gains must be additional to whatever is needed to meet growing food demand alone. The IFPRI analysis does not attempt to analyze whether or how yields could grow for biofuels above this rate needed for food alone.

Economists and modelers disagree about the relative responses of food consumption and yield versus expansion of crop area, but the IFPRI results are informative precisely because the model is built in such a way as to produce such a low ILUC. Even with estimates that additional cropland (ILUC) replaces only around 10% of the net cropland diverted to biofuel production, grain-based ethanol would probably still not be able to reduce greenhouse gas emissions enough to satisfy EU goals. Although it is true that ILUC estimates are somewhat uncertain, the IFPRI results indicate that even with favorable assumptions to biofuels, greenhouse gas reductions are likely to result only from reductions in food consumption, and even so, are not likely to be large.

References

Abbott, P. Hurt , and C. Tyner, W. (2011). What's Driving Food Prices in 2011? Farm Foundation Issue Report.

Alexandratos, N. (2008), "Food Price Surges: Possible Causes, Past Experience, and Long-Term Relevance". Population and Development Review, 34 (4): 599-629.

Al-Riffai P., B. Dimaranan, D. Laborde (2010), Global trade and environmental impact study of the EU biofuels mandate (IFPRI, Washington, DC)

Ahmed U. et al. (2007), The World's Most Deprived: Characteristics and Causes of Extreme Poverty and Hunger, (Food Policy Report, IFPRI, Washington) .

Berry S (2011) Biofuels policy and empirical inputs to GTAP models. Report to the California Air Resources Board. Available at: http://www.arb.ca.gov/fuels/lcfs/workgroups/ewg/010511-berry-rpt.pdf (accessed 16 May 2012).

Compton, J. et al. (2010). Impact of the global food crisis on the poor: What is the evidence (Overseas Development Institute, London)

Dorward, Andrew (2012), The short- and medium- term impacts of rises in staple food prices, Food Security 4:633-645

Edwards R. D. Mulligan, L. Marelli (2010), Indirect land use change from increased biofuels demand: Comparison of models and results for marginal biofuels production from different feedstocks (EU Joint Research Centre, Ispra, Italy)

FAO, The State of Food Insecurity in the World: How Does International Price Volatility Affect Domestic Economies and Food Security (Rome: FAO, 2011)

Filipski, M., and K. Covarrubia. 2010. "Distributional Impacts of Commodity Prices in Developing Countries." In J. Brooks (ed). Agricultural Policies for Poverty Reduction. Paris: OECD.

Headey D. and S. Fan (2010), Reflections on the global food crisis: How did it happen? How has it hurt? And how can we prevent the next one? (Research Monograph 165, IFPRI, Washington DC)

HLPE, High Level Panel of Experts on Food Security (2011) Price Volatility and Food Security (FAO, Rome)

Laborde D. (2011), Assessing the land use change consequences of European biofuels policies: Final report (IFPRI, Washington, D.C.)

Laborde D., H. Valin (2012), “Modeling land-use changes ina a global CGE: Assessing the EU biofuel mandates with the MIRAGE-BioF Model,” Climate Change Econ. 3:1250017

Marelli L, Mulligan D, Edwards R (2011) Critical issues in estimating ILUC emissions: Outcomes of an expert consultation 9–10 November, Ispra, Italy. Report EUR 24816 EN, EU Publications Office, Luxembourg.

Oxfam International, “Double-Edged Prices: Lessons from the Food Price Crisis: 10 Actions Developing Countries Should Take,” Oxfam International Briefing Paper 121 2008: 1-46. /data

Ray D., Mueller N., Foley J. (2013), Yield trends are insufficient to double crop production by 2050, PLUS One http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0066428

Trostle R., D. Marti, S. Rosen, P. Westcott (2011). Why have commodity prices risen again? WRS-1103, Economic Research Service, USDA, Washington, D.C.