Reviewing the *food v fuel* debate

Briefing prepared by Zoltán Szabó, PhD *June 2015*

Introduction

Feeding 9–10 billion people by the middle of the century and preventing dangerous climate change are two of the greatest challenges facing humanity. Viewed from a different perspective, a threefold challenge faces the world: meet the increasing demand for (transport) energy from a larger and more affluent population; do so in ways that are environmentally sustainable and climate friendly; and ensure that food security in developing countries is not compromised.

Tilman et al. (2009)[1] point out that society cannot afford to miss out on the global greenhouse-gas emission reductions and the local environmental and social benefits when biofuels are done right; however society also cannot accept the undesirable impacts of biofuels done wrong.

The two most cited "possible negative" impacts of bioethanol production are indirect land use change (iLUC) and food security impacts (food price increases leading to hunger, often called the food v fuel debate). The primary concern here is that biofuel production reduces food production, and it is assumed that this competition drives up food prices. The food v fuel debate is the focus of this briefing focusing on the EU corn ethanol pathway; with food chain impacts, price impacts and food quantity aspects considered.

1. Food chain impacts

In order to view comprehensively the food chain impacts, some technological aspects of bioethanol production (corn ethanol pathway) are presented.

Everything but sugar goes back to the feed chain

It is important to underscore that the nutrients in the corn used in ethanol plants are not removed from the food chain, but go back in the form of animal feed. Bioethanol production takes away the starch components of corn only. The protein is not taken out of the food chain, and is actually substantially increased. A modern ethanol plant produces equal quantities of ethanol and a high-protein animal feed product (distillers' grain, DGS). This co-product of bioethanol production displaces soy that would otherwise be devoted to low yield protein meal production and so frees land for food production.

Low nutritional value components are used for ethanol production

The corn ethanol pathway process uses only the starch from the corn kernel. Starch is of very low nutritional (and market) value. Corn starch does not add any sort of nutritional value to foods other than calories; no protein, fat, vitamins, minerals or fiber.

Feed corn not meant for human consumption is used

Ethanol production uses feed corn that has almost no market as food, but is instead purchased for animal feed and industrial (plastics, paper, chemicals, etc.) uses. White or sweet corn, the corn eaten by people in any quantity, is not used in ethanol plants.

[1] Tilman D, Socolow R, Foley JA, Hill J, Larson E, Lynd L, Pacala S, Reilly J, Searchinger T, Somerville C, Williams R (2009): Energy. Beneficial biofuels--the food, energy, and environment trilemma. Science. 2009 Jul 17;325(5938):270-1.

Valuable animal feed is co-produced (DGS)

DGS substitutes for a range of high value feed products, adding to the options available to livestock producers to improve feeding strategies, and the best balance of fibre, starch, energy and protein. DGS contains three times more protein, fat and fibre than corn.

The corn ethanol pathway adds more protein to the co-product animal feed through the fermentation process (i.e. brewers' yeast, 5% of DGS mass). It also makes DGS more digestible and less likely to spoil as it is cooked and dried during the process.

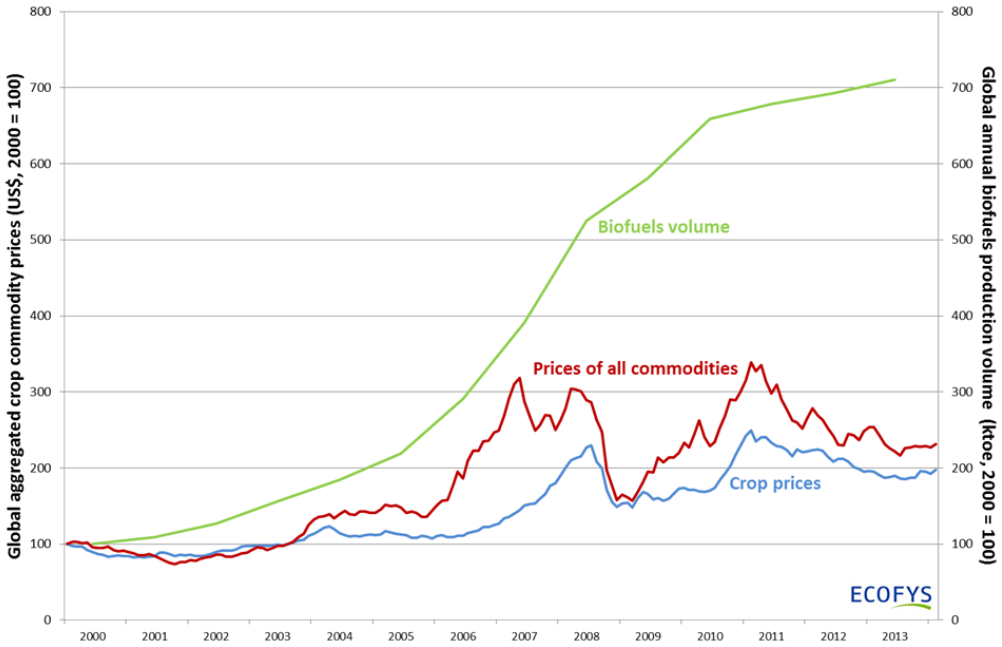
2. Price increase

The food security concern is that price increases lead to a reduction in the quantity or quality of food consumed. Patterns in global food prices are indicators of trends in the availability of food (Godfray et al., 2010[2]). In this section, the concern that biofuels reduce food security by increasing food prices will be discussed.

Relatively small share in crop production

A small share of global cereal production goes to biofuels. Global biofuel production grew exponentially between 2002 and 2008, then its growth trend slowed down, and is expected to grow only slowly until 2020. On average for the 2008-10 period, biofuels accounted for 11% of global production of coarse grains (OECD/FAO, 2011[3]). By 2023, OECD-FAO (2014)[4] projects that biofuel production will consume 12% of the total world production of coarse grains[5].

Figure 1 Global crop commodity prices and the aggregated price of all commodities, versus global biofuels production volume, both normalised



Source: Updated graph from Ecofys (2013)

[2] Godfray, H.C.J., Beddington, J.R., Crute, J.I., Haddad, L., Lawrence, D., Muir, J.F., Pretty, J., Robinson, S., Thomas, S., Toulmin, C., 2010. Food security: the challenge of feeding 9 billion people. Science 327, 812–818.

[3] OECD-FAO Agricultural Outlook 2011-2020

[4] OECD-FAO Agricultural Outlook 2014-2023

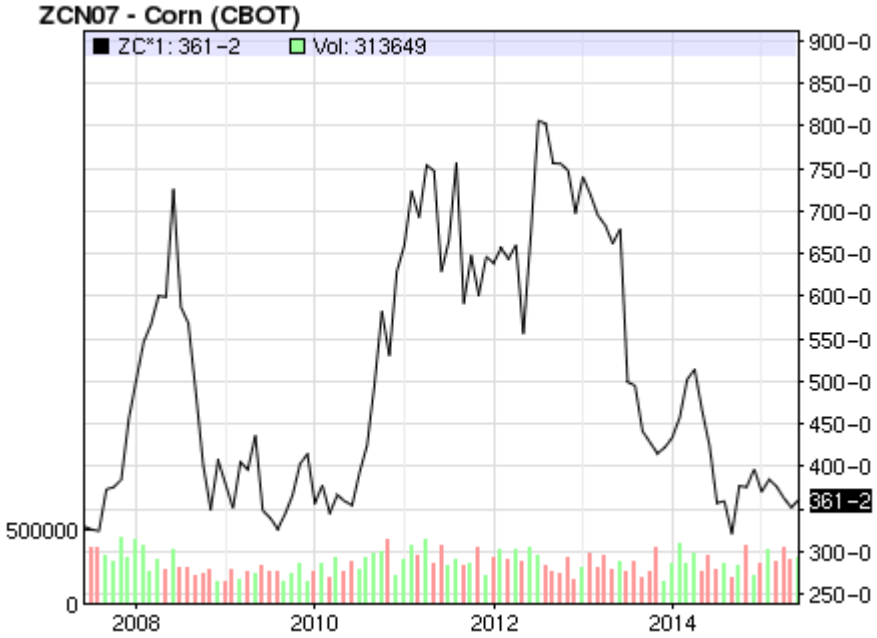
[5] FAO figures do not account for co-products. Accounting for co-products, Ecofys (2013) estimates 0.1% of global corn was used in 2010 EU bioethanol production (Ecofys, 2013: Biofuels and food security: Risks and opportunities).

Historical and recent price developments

The literature review findings of Oladosu and Msangi (2013)[6] suggest "initial conclusions attributing most of the spike in global food prices between 2005 and 2008 to biofuels have been revised". The authors conclude that multiple factors, in addition to biofuels, converged during the period. Figure 1 illustrates that a suggestion that corn or wheat or sugar price increases have been the result of biofuels is likely untrue.

Figure 2 shows the price of corn in the US has dropped by a half over the past two years, and it is now at 3.6 USD/bushel, the same as it was eight years ago. Bioethanol production has doubled in the same period, making the disconnection of corn price from corn ethanol production all the more salient.

Figure 2 Corn Futures Price in the US



Source: Nasdaq, http://www.nasdaq.com/markets/corn.aspx?timeframe=8y

The FAO Food Price Index in May 2015 is as low as it was in May 2007, while the FAO Cereals Price Index (wheat, maize, rice) in real terms is as low as in Oct 2006[7]. This is a clear indication for a decoupling of biofuel production growth and global food or cereal prices.
Furthermore, world inventories of coarse grains in 2014 approached their highest in nearly 30 years. FAO flagged the prospect of a "very comfortable world supply and demand balance… especially for corn"[8].

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[6] Oladosu, G.; Msangi, S. Biofuel-Food Market Interactions: A Review of Modeling Approaches and Findings. *Agriculture* 2013, *3*, 53-71.

[7] Food and Agriculture Organisation of the United Nations. http://www.fao.org/worldfoodsituation/foodpricesindex/en/

[8] http://www.agrimoney.com/news/world-coarse-grain-stocks-to-hit-28-year-high---un--7583.html, http://www.fao.org/worldfoodsituation/csdb/en/

Commodity price determinants

Agricultural commodity prices are strongly linked to the oil price. As a recent World Bank report[9] concludes that more than half of crop commodity price increases have been caused by the global crude oil price increase, and biofuels have had a very minor impact on global prices over the past decade. Ecofys (2013) concludes that "EU ethanol has had small impacts on global starch and sugar feedstock prices; the historic impact of EU biofuels demand until 2010 increased world grain prices by about 1-2% and, without any cap on crop based biofuel production may lead to another 1% increase through 2020".

Which is relevant: commodity prices or food prices?

It is far from identical to assess the impacts on agricultural commodity prices and food prices. Only the latter is relevant from a food security perspective. Most studies however focus on impacts on commodity prices, and the reason behind this is that the complexity of the analysis increases substantially as "food supply chains involve an extremely wide range of plant and animal products with varying degrees of processing of agricultural commodities and varying proportions of staple foodstuffs in the diet" (IEEP, 2012[10]). It must be kept in mind that with regard to food security food prices, not commodity prices are the meaningful indicators.

Commodity cost are small components of final food product price

Commodity costs are usually a small component of final food production costs and final food product price. OECD[11] estimates that in developed countries agricultural commodity prices usually constitute less than 35% of final food prices. Processing, packaging, distribution and marketing costs are unrelated to crop commodity prices. Thus, even though biofuel production has had a low-level impact on commodity prices, impacts on food prices are even lower.

High or low commodity or food price is desirable?

To understand the impacts on food security a broader context needs to be assessed.

Fundamental economics implies that there always is a response to higher crop prices resulting in more production globally and ultimately moderating high prices. In theory, an increased demand for food commodities results in higher prices in global markets in the short term. Long term impacts however are more complex as production responds to price signals and structural changes follow. For instance crop yield increases stimulated by higher prices may in the end mitigate price increases.

Likewise, extremely low global prices of corn and wheat in the past two decades disproportionately impacted cereal farmers in developing countries, like Guatemala, reducing local food production in favor of imports from Europe and the United States. That is why, prior to the advent of biofuels, there was consensus among international development NGOs that food security in poor countries required a cessation of exports of cheap grains from developed countries in order to allow for local production to be economically viable.

The evaluation of high food prices is considered ambiguous. It is clear that high food prices constitute a direct food security risk for the poor globally. However high food prices provide additional income for farmers in the developing world, who constitute a large share of the world's poor. Whether the net effects are positive or negative primarily depend on whether poor households in a country or region in question produce more food than they consume or imports are dominant. Ajanovic (2011)[12] argues that very cheap (feedstock) prices cannot be the target in any

[9] Baffes and Dennis (2013), Long-term drivers of food prices. World Bank

[10] IEEP (2012), EU biofuel use and agricultural commodity prices: a review of the evidence base. Institute for European Environmental Policy

[11] OECD, 2008: Rising Food Prices: Causes and consequences.

[12] Ajanovic, A. (2011): Biofuels versus food production: Does biofuels production increase food prices?, Energy, Volume 36, Issue 4, April 2011

market per se, and "the goal should rather be prices, which reflect the actual marginal production costs". As farmers need a certain market price level to have an incentive to grow feedstock, the author argues that "a more intensive competition due to feedstock use for biofuels could finally lead to an over-all 'healthier' market".

3. Quantity aspects

Global quantity v. distributional problem

With the global population approaching 9 billion people in the next few decades, it is often asserted that there is a need for 70–100% more food (see FAO and Godfray et al., 2010[13]). The FAO[14] calculates that the world produced over 13 quadrillion calories of food in 2010, which amounts to more than twice the recommended average dietary intake of about 2,400 kcal per person per day. It seems there is no global food quantity problem, yet, food is not available for all. Tscharntke et al. (2012)[15] argues that global food security is not directly linked to global food production but rather is determined by many important drivers, such as smallholders vs large-scale farms, distributional issues, or inefficient food usage.

Food waste concerns

Roughly 30 to 40% of food in both the developed and developing worlds is lost to waste[16]. Contemporary food usage is inefficient with one third wasted[17] and a further third used inefficiently to feed livestock. Food waste in developed countries is even higher, up to 40 percent of food in the United States goes uneaten[18].

Conclusion

Recent developments show that bioethanol production has played a very limited, perhaps negligible role in global food insecurity. Other factors, such as structural elements in the global agricultural trade system, or inadequate infrastructure and policy in the developing world play a dominant role. Moreover, global bioethanol production is well past its exponential growth trend. The world has already experienced an unexpected phenomena (i.e. the emergence of bioethanol in volume), and if major global food security problems were to ensue, facts should have reflected them by now. It just has not happened. In contrast, climate, social and economic benefits have been brought globally by bioethanol production.

[13] Godfray et al, 2010
[14] FAO, Statistical yearbook 2012 – World food and agriculture, Part 3: Feeding the world
[15] Tscharntke, T., Clough, Y., Wanger, T.C. Jackson, L., Motzke, I. *et al. (2012):* Global food security, biodiversity conservation and the future of agricultural intensification Biological Conservation, 151 (2012), pp. 53–59
[16] Godfray, H.C.J., Beddington, J.R., Crute, J.I., Haddad, L., Lawrence, D., Muir, J.F., Pretty, J., Robinson, S., Thomas, S., Toulmin, C., 2010. Food security: the challenge of feeding 9 billion people. Science 327, 812–818.
[17] http://www.unep.org/wed/quickfacts/
[18] http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0007940