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Viewpoint

Are biofuels a feasible option?

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ABSTRACT

Recently a number of objections have been raised against the use of ethanol produced from agricultural products such as maize, sugarcane, wheat or sugar beets as a replacement for gasoline, despite some of their advantages such as being cleaner and to some extent renewable. We address these objections in this paper. Topics discussed include the "corn connection" (which was theorized to be a cause of deforestation in the Amazonia), the rise of food prices due to ethanol production and the real possibilities of ethanol in reducing greenhouse gas emissions. It has been shown that such concerns are grossly exaggerated and that ethanol from sugarcane, as produced in Brazil, is the preferred option for the production of fuel not only in terms of cost but also as a favourable energy balance. Finally, the possibility of expanding ethanol production to other sugar-producing countries is also discussed.

1. Introduction

The present use of ethanol as a fuel is around 3.2 million GJ, accounting for 0.7% of the world's oil production and 2% of the gasoline consumption, while using less than 1% of the agricultural land in use in the world. In the year 2006, roughly 45 billion litres of ethanol were produced in the world. Three quarters of this was generated in the United States (from maize) and Brazil (from sugarcane), which each country contributing to approximately half the production (Goldemberg, 2007).

On technical grounds ethanol is a good alternative to gasoline (Moreira and Goldemberg, 1999). It is produced from agricultural products and does not have the impurities found in petroleum products, such as sulphur oxides and particulates, which are the main source of pollution in large metropolitan areas. In addition, if proper feedstock and agricultural practices are used ethanol reduces greenhouse gas emissions (Goldemberg, 2007). Despite these advantages a number of objections have recently been raised regarding the use of ethanol.

Scharlemann and Laurence (2008) argued that, on a complete life-cycle basis, biofuels might have greater aggregate environmental costs than gasoline. Laurence (2007) pointed out a possible "corn connection", linking ethanol production from maize in the United States to Amazonia deforestation. Ziegler (2007), special rapporteur on the Right to Food to the General Assembly of the United Nations 62/2007, raised the issue of the "potentially grave negative impacts of biofuels (or agro fuels) on the right to food and the serious risk of creating a battle between food and fuel". Fargione et al. (2008) and Searchinger et al. (2008), using a worldwide agricultural model to estimate emissions from land use, calculated that, as a result of the expansion of the ethanol production from maize in the United States, some 100,000 km^2 of additional land would have to come into cultivation in Brazil, China and India, leading to massive deforestation.

We argue here that such concerns are grossly exaggerated and correspond to a very simplistic interpretation of what is really happening in this field.

2. Ethanol from sugarcane and maize

To put the problem into perspective one should point out that the land in use for ethanol production 2006 in the United States (from maize) was 51 000 km^2 and in Brazil (from sugarcane) 29 000 km^2 (Table 1). Together they represent 0.55% of the agricultural area in use in the world, which has over 14 million km^2.

Despite being small, the expansion of new crops can generate regional problems; in the United States from 2006 to 2007 maize acreage grew by 19% (70 000 km^2) to almost 370 000 km^2. Most of this expansion came at the cost of soybean planting, which decreased by 17% from 310 000 to 260 000 km^2 (50 000 km^2) (HGCA, 2008). This is approximately 6% of the world's area used for that crop, and resulted in prices being driven up (FAO, 2007). For this reason, the point has been made that other countries had increased motivation to expand soybean production, possibly into the Amazonia increasing deforestation (Laurence, 2007).

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However, Fig. 1 shows the evolution of area used for grain production, soybean and sugarcane, and indicates that the area used for soybean has not increased since 2004.

The reality is that deforestation in the Amazonia has been going on for a long time at a rate of approximately 10 000 km^2 per year (INPE, 2008). Therefore, very recent increases are not due to soybean expansion, which has been very small since 2004 (FAO, 2007), but instead due to cattle grazing.

It is useful to remember that 930 000 km^2 of land are used presently for soy production around the world (FAO, 2007). As a general trend the price of food commodities has been decreasing since 1975, but fluctuations in the area planted and prices of food commodities (as well as crude oil) are frequent, as shown in Fig. 2. Such fluctuations have been taking place for many decades due to an enormous number of factors and events (Naylor et al., 2007). Moreover, not all biofuels have the same impact on food prices; in the case of Brazil, the increased production of ethanol from sugarcane did not lead to an increase in sugar prices.

Recent price increases for agricultural products following several decades of declining real prices (von Braun, 2007) are usually seen as one of the causes of famine in the some parts of the world, and give rise to the politically laden controversy of fuel "versus" food, which would affect the poor the most and cause famine in some parts of the world (FAO, 2007). In contrast, the point has been made that higher crops prices will not necessarily harm the poorest people; many of the world's 800 million undernourished people are farmers or farm labourers, who would ultimately stand to benefit from increased prices (ICTSD, 2008).

Regarding cost, the production of biofuels such as ethanol from maize could indeed disturb the price of cereals; however, it is still too early to attribute that cause to recent price variations, and in the process raise new objections to the idea of using biofuels. Table 2 compares the cost of the production of ethanol from maize, wheat, sugar beets and sugarcane in the US, Germany and Brazil.

Only ethanol produced from sugarcane in Brazil, which has no subsidies, is competitive as a replacement for gasoline (Henniges and Zeddies, 2004).

The reduction in greenhouse gases can be assessed by a life-cycle analysis of the energy balance involved in the preparation of the ethanol. The results are sensitive to assumptions about

Table 1
Yields and areas of maize and sugarcane for ethanol production (2006)

	Maize (US)[a]	Sugarcane (Brazil)[b]
Harvested area (thousand km^2)	286[c]	62[c]
Area used for ethanol production (thousand km^2)	18% or 51[d]	47% or 29[c]
Average yield (2003–2006) (metric tons/km^2)	936[c]	7400[c]
Total production (2006) (million metric tons)	268[c]	455[c]
Present production of ethanol (million m^3/year)	18.6	17.8[e]
Ethanol yield (m^3/km^2)	365	614
World total agricultural arable land	14 million km^2[c]	

[a] Naylor et al. (2007).
[b] Moreira and Goldemberg (1999).
[c] FAO (2007).
[d] Larson (2007).
[e] Unica (2008).

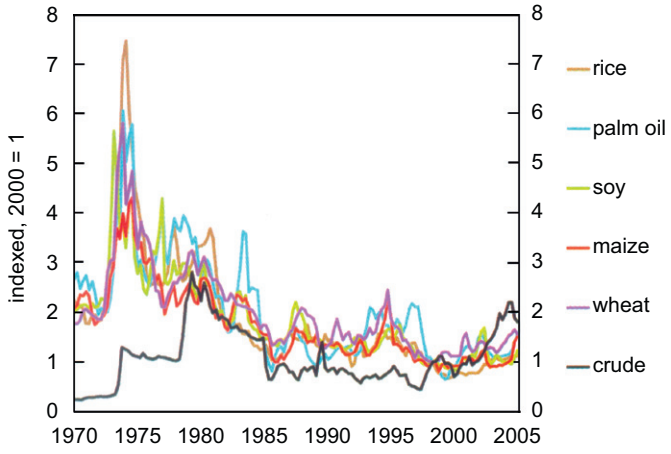

Fig. 2. Global trends in process of food commodities and crude oil 1970–2007. *Source*: Naylor et al. (2007).

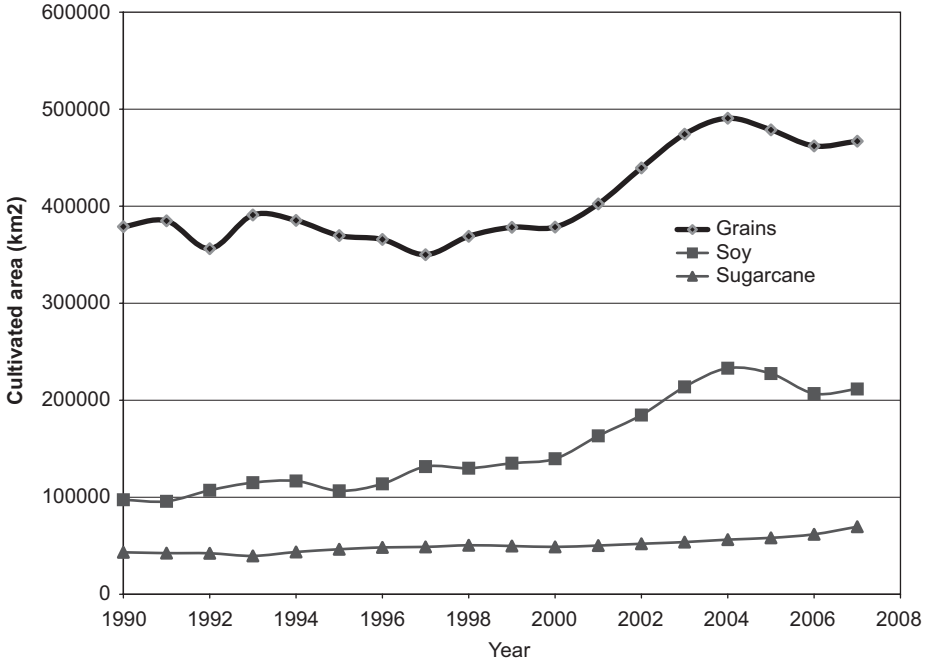

Fig. 1. Cultivated area in Brazil (1990–2007). *Source*: CONAB (2006) and IBGE (2006).