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PERSPECTIVE

Oil palm deserves government attention in Brazil

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Abstract

Englund *et al* (2015 *Environ. Res. Lett.* **10** 044002) have recently analyzed biodiesel production from oil palm plantations as one possible way to mitigate climate change while providing cost effective results. They show that data for detailed quantification of biological carbon sequestration is available allowing a high confidence evaluation of positive impacts when oil palm plantation for food and biodiesel production is carried out in degraded, cultivated soil, and also with some varieties of natural vegetation in the Amazon. Nevertheless, economic risk associated with the future price of fossil fuels and uncertainties related with carbon subsidy are barriers. Here we discuss the assumptions under which such controversial proposal is based and suggest further analysis for Brazilian decision makers.

The paper 'Oil palm for biodiesel in Brazil—risks and opportunities' by Englund *et al* (2015) presents a superb 100 meter resolution analysis of the Amazon soil. In the process, they identified large areas with native vegetation suitable for palm oil production. However to conclude that 'oil palm was found to be profitable and environmentally sound on extensive areas including areas under native vegetation where establishment would cause large land use change (LUC) emissions' is quite another matter and involves innumerous controversial assumptions, some of which politically sensitive.

It is highly desirable to reduce fossil fuel emissions by displacing gasoline and diesel oil with low carbon (C) fuels such as ethanol and biodiesel (IPCC 2011). The production of ethanol from sugarcane in Brazil and from corn in the US proved to be economically competitive, and objections based on indirect land use effects from such fuels proved the indirect land use change (ILUC) emissions are most likely an order of magnitude smaller than first estimated 6 years ago (Macedo *et al* 2015). Biodiesel, however, is expensive even if produced from palm oil (approximately US\$ 700 t^{-1}) and therefore requires government subsidies. Presently, petroleum is at US\$ 300–400 t^{-1} and most of the palm oil production in Indonesia (21 million t yr^{-1}) and Malaysia (17 million t yr^{-1}) in 2013 was used for food or cosmetics. Rapeseed and soybean were the main crops used for biodiesel production in Europe and America (FAO 2015).

The Brazilian biodiesel program initially started not as an energy program but a social program to promote family farms and cooperative agriculture in the Northeast of the country using local crops such as babaçu and other native products (Mattei 2010). It failed due to the lack of agricultural experience and poor human qualification in the region even with heavy governmental subsidies. The program only survived by using a large share of commercial-scale soybean production in the Centerwest and Southeast of Brazil, to which the subsidy 'social seal' was applied in the name of a small share of feedstock produced by family farms (Mattei 2010). The cost of production is shared with the production of soya meal used for cattle feeding and even so—after a decade of production—is not competitive. The assumptions used by the authors to presume that palm oil will be competitive in the future can be equally challenged.

Production of biodiesel from palm oil in the Amazon raises several other problems that the paper discusses, such as transportation costs and small scale production. In the case of ethanol, experience shows that the small-scale processing units are not economically competitive and very likely the same will happen with biodiesel. In order to be a large-scale competitor for diesel oil, biodiesel must be sold at almost the same price of diesel. This, according to the paper, may occur at the scale of a few million ha, without any subsidy, or at hundreds of thousands of ha if some subsidy, like carbon tax, is added. Such expectation is well described elsewhere (IPCC 2007), but Englund *et al* (2015) were able to present economic figures well supported by extensive technical data on the Amazon soil and vegetation. Such conclusion is based on reasonable assumptions, like future high palm oil yield (twice higher than presently achievable in Brazil (FAO 2015), which can be supported by intense and continuous precipitation and small rebound from the oil industry (Creutzig *et al* 2014) since biodiesel is mostly used as a blend backed by government mandate. Nevertheless, other assumptions like the future price of oil, which, in the paper is taken from the forecast done on the IEA Energy Technology Perspectives study (IEA 2012) are less convincing. Many other forecasts are available (e.g., World Bank 2015, IMF 2015, EIU 2015) showing more than 30% value disagreement for as early as 2018. Thus, there is no strong technical reason for entrepreneurs to trust the accuracy of these forecasts. Another important uncertainty comes from the oil palm productivity assumed. It is well known that soils are usually classified for some agricultural activity according with their degree of suitability and this is not considered in the paper, where a maximum average yield, during the 25-year crop life, of 5.7 t ha^{-1} is assumed

Since mainly pastures and degraded soil are replaced by oil palm, the authors' comment regarding the important aspect of C mitigation throughout displacement of high C fuel and biological carbon sequestration is positive, but the temporal factor was not included. When existent above ground vegetation is removed, C emission due to CO_2 and CH_4 from below ground biomass occurs immediately. Biological carbon sequestration occurs over many years, mainly the recovery of C on the soil, which is driven by below ground biomass availability and litter associated with the new plantation (van Minnen *et al* 2008). Nevertheless, C mitigation due to fossil fuel displacement occurs continuously, but in small amounts, as soon as biodiesel is produced around 5 years after seeding. Since climate change (CC) mitigation asks for actions that reduce C emission immediately, and considering that plantation of tens of millions of hectares in the Amazon is a long-term project, this can reduce the interest on the proposed action.

Initial oil palm production, as the paper claims, can be addressed to the food market. In the next five years, there is room in the food market for additional oil palm if past growth trend is preserved and future price confirms its present competitive behavior with other vegetable oil feedstocks (Index Mundi 2015). Indonesia and Malaysia alone increased their production by 26% in 5 years (2013–2009) over the 2008 production of 173 Mt of palm oil fruit (FAO 2015, Index Mundi 2015). Nevertheless, for larger areas such as the 29 Mha available for oil palm plantation in Brazil, in accordance with the Brazilian agro-ecological zoning (Villela *et al* 2014), most of the oil has to be allocated to biodiesel production and used to displace diesel in the transport sector, an option that is not commercially viable.

In conclusion, the paper deals technically with an important and quite interesting potential solution to recover degraded soil in the Amazon and to generate profit to farmers, enterprises and the country, while mitigating CC. But it is not enough to attract investors due to future uncertainties that cannot be properly addressed. Rather, as pointed out by the authors, the decision relies on proper policies, which must be addressed under a risk framework. Further analysis is required and the political decision has to consider economic risks and, once adopted, must be performed in small steps to collect real data and to continuously adapt to the globally evolving traditional and modern renewable energy markets. Palm oil plantation in degraded and deforested areas in the Amazon seems reasonable, but displacing natural vegetation requires better analysis for Brazilian decision makers.

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