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Land use change within EU sustainability criteria for biofuels: The case of oil palm expansion in the Brazilian Amazon

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ABSTRACT

This paper discusses the oil palm expansion in the State of Pará, located in the Brazilian Amazon. It focuses on land use change aspects put in perspective with the sustainability criteria for biofuels of the European Renewable Energy Directive (RED). The study shows that palm oil production for energy purposes appears very promising in Brazil. In parallel to local targets, the mandatory European biofuel targets represent an important market potential for the country. It seems too early to know whether the export of palm oil biodiesel from Brazil to Europe will be significant or not. However, it is likely that palm oil exports for biodiesel production in Europe occur in the coming years. Although the RED includes some essential conditions for sustainable production of biofuels, we argue that the values imposed for calculating carbon stocks do not reflect diversity of pastureland where oil palm expansion occurs in the Brazilian Amazon. The use of certain land areas authorised within the RED may also represent a significant limit in terms of biodiversity protection. This study provides new insights that may be used to improve life cycle assessment of biodiesel from palm oil in order to avoid unintended policy consequences.

1. Introduction

Much controversy has been surrounding the sustainability of biofuels, notably in terms of climate change. In addition, biofuels face controversies related to food security, management of natural resources (soil, water and air pollution) and social conditions of local communities.

In the 2000s, the European Union set objectives for the development of renewables and biofuels with a European action plan for the promotion of biofuels and the release of a specific European Directive in 2003. This Directive 2003/30/EC on the promotion of the use of biofuels or other renewable fuels for transport stated that Member States should ensure that a minimum proportion of biofuels and other renewables are placed for sale on their territory. In 2009, the Directive 2009/28/EC (amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, hereafter "RED") set a minimum binding target of 10% renewable energy for the EU Member States in the final energy consumption in transport by 2020. It also added sustainability criteria for biofuels [31]. The RED requires compliance with a minimum 35% reduction of GHG emissions (rising up to 50% from 2017 to 60% from 2018) for biofuels compared to fossil fuels. Criteria related to biodiversity are also included and relate to the prohibition of the use of certain types of land representing a great value in terms of biodiversity. The marketing of "unsustainable" biofuels within the meaning of RED will not be banned in Europe, but the sustainability criteria determine which biofuels (including imports) will benefit from public incentives and contribute to achieve the 10% renewable energy target for the EU transport sector.

Palm oil biodiesel is the biofuel source presenting the greatest variation in terms of GHG balances across production systems; palm biodiesel can save 80% but may also cause 40% more GHG emissions compared to fossil fuel [80]. Recent studies on GHG balances of various biofuels showed that variations come mainly from i) methodological choices [40,45,77]; and ii) variables in the production of the biomass feedstock, which is a major contributor in palm biodiesel chain [14,67], especially land use change as well as the release of methane from palm oil mill effluent and nitrous oxide (N_2O) from the use of fertilisers [68,21,70,49,86,88]. The RED set up rules for the calculation of GHG emissions (including carbon stock changes due to direct land use change, LUC) that must be met

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for the scheme operators to gain EU recognition [31] and which allow for comparability across the supply chains. In this paper we focused on the uncertainty with respect to LUC; direct and indirect LUC factors being among the main sources of uncertainty and variability in LCA of biofuels (Ben Aoun et al., 2013).

The main objective of this study is to analyse LUC related to palm oil expansion in the Brazilian Amazon in the perspective of the Renewble Energy Directive. First, we present the reasons why new palm oil companies interested on biodiesel production are emerging in the Brazilian Amazon. In view of the current palm oil debate and the requirements of the RED, we then address more specifically the problem of land use change (LUC) in connection with deforestation and its effects on biodiversity and climate change.

2. Methods

Our analysis is based on semi-structured interviews complemented by a literature review. Two field missions were carried out in Brazil. First, a two-month mission in 2010 and then a second mission that lasted a month in 2011. The fieldwork took place in the State of Pará, in the Amazon, where oil palm cultivation is concentrated at the country level. The information was collected through participation in meetings, technical visits and interviews with twelve members of the local production chain; seven representatives of palm oil producers and associations, four from research institutes, and one from a local NGO.

3. Results

3.1. The Brazilian palm oil production in the global market

Since 1980 the global production of palm oil has increased by almost ten times. Today it is the most consumed vegetable oil in the world accounting for 31.3% of the total production of oils and fats (Oil World, 2012). About 80% of palm oil produced in the world is used as raw material by the food industry and 19% is used for the manufacture of oleo chemicals [83]. Only 1% of palm oil is used in the production of biofuels [71].

However, palm oil seems particularly attractive to meet the growing demand for biodiesel. This is especially due to its productivity, the highest among the oilseeds – 3.5–4 tonnes per hectare, which is about ten times higher than the yield of soybean oil [63]; Oil [66,78]. Also, the market price of palm oil is lower than the price for other oils [82]. The United Nations Food and Agriculture Organization (FAO) states that the production of palm oil will double between 1999 and 2030, which will be influenced to some extent, by the global commitment to replace a portion of fossil fuels by biofuels [37].

Today, Indonesia and Malaysia are the largest producers, producing together more than 80% of the global palm oil (Oil World, 2012). Nevertheless, the increase in palm oil production in these countries should slightly slow down in the future, especially because of the scarcity of land to expand palm oil cultivation in Malaysia and Indonesia [64].[1] Conversely, Brazil is not yet a major producer of palm oil. Its production of crude palm oil is around 270,000 tonnes, which corresponds to only 0.5% of global production (Oil World, 2012). However, Brazil is recognised, alongside with some African countries [71], as one of the countries with the greatest potential for expansion of palm plantations to meet global demand of palm oil in the coming years [79]. Villela et al., 2014 [84] indicate that Brazil is likely to become the world's fifth largest palm oil producer in 2015, behind Indonesia, Malaysia, Thailand and Nigeria.

3.2. Main drivers for the development of a Brazilian biodiesel from palm oil

3.2.1. The recent biodiesel market in Brazil

The biodiesel production and use in Brazil was developed within the "National Programme for the Production and Use of Biodiesel" (PNPB) launched by the Government in 2004 [59]. This programme has promoted the introduction of biodiesel in the domestic market with blending requirements for biodiesel[2] while addressing economic, environmental and social issues. Although the programme has failed in contributing to promote sustainability in social terms in the most deprived areas, it has successfully achieved the objective of introducing biodiesel in the national energy matrix [13].

Nowadays, Brazilian biodiesel is produced mainly from soybean oil. For now, soybean is the only oilseed crop to achieve a competitive cost for biodiesel compared to diesel made from fossil fuel [3]. However, soybean is firstly produced to meet the needs of the meat market, which requires protein meal for animal feed and has oil as a by-product. The economic viability of soybean oil is mainly driven by the demand for protein in use of animal feed concentrates [75]. In view of the growing demand for biodiesel, soybean oil is not likely to remain the principal source of biodiesel in Brazil in the long term [1]. To date, there has been considerable investment in supporting agricultural research and technology transfer to farmers for the production of biodiesel from other potential sources, including palm oil [24–27].

3.2.2. The international demand of biodiesel

In 2010, the share of biofuels in the use of biomass as an energy source in the world was 5% [50,51], consisting only of so-called first generation biofuels (e.g. biodiesel or methyl ester from vegetable oils and ethanol from sugar beet, sugarcane, and cereal crops). Despite the investments in research and development activities on second and third-generation biofuels, especially in the United States and Europe,[3] their production remain very limited [8,52]; Merlin, 2008). Moreover, Europe does not seem to be able to meet its stated goal of 10% renewables in transport without resorting to imports of biofuels, whether in the form of biofuels or biofuel feedstock. Several studies indicate that Europe is expected to import more than 50%[4] of biofuel sources to achieve its objective by 2020 [22,23,47].

In the biofuel sector, Brazil is particularly known for its ethanol production from sugar cane. The country experience in the production and use of ethanol began as early as the 1920s [38]. Biodiesel production is very recent compared to ethanol in Brazil. However, the Brazilian biodiesel has gained a foothold in the global market for liquid fuels (it is already the second largest producer after the EU before Argentina and the United States) [56] and expects to increase biodiesel exports especially to EU countries. The

[1] In Malaysia, only a further 200–300,000 ha is estimated to be available for oil palm cultivation [64]. In Indonesia, although the Government has announced plans to double its palm oil production by 2020 [71], a land moratorium (signed with the Norwegian Government) limits new expansion opportunities [64].

[2] The PNPB has set a target of 2% substitution of conventional diesel with biodiesel from 2008 to 5% from 2013. The goal is to increase this percentage by 20% until 2020 [59].

[3] In 2010, the European Commission launched a funding of 35 million Euros (M €) for the production of cellulosic ethanol; 26 partners, mostly industrial, have committed to invest an additional € 24 million [53]. According to IFP, in 2011, some 157 projects producing second-generation biofuels were underway in Europe.

[4] According to [22]; if we assume that 30% is second generation, biofuel imports (direct and indirect) are 32–39% instead to 56–64 without second generation.