# Soy oil and indirect land use change

## Biofuel crops, indirect land use change and emissions

BRIEFING | AUGUST 2010

THIS IS THE THIRD BRIEFING IN A SERIES ON INDIRECT LAND USE CHANGE AND EMISSIONS FROM BIOFUEL CROPS

Friends of the Earth Europe

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**Friends of the Earth Europe** campaigns for sustainable and just societies and for the protection of the environment, unites more than 30 national organisations with thousands of local groups and is part of the world's largest grassroots environmental network, Friends of the Earth International.

This publication was produced as part of the project "Feeding and Fuelling Europe" with financial support from the European Union and the European Climate Foundation. The contents of this publication are the exclusive responsibility of the Friends of the Earth Europe and Friends of the Earth Hungary and does not reflect the position of the funders mentioned above. The European Union and the European Climate Foundation cannot be held responsible for any use which may be made of the information this document contains.

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**Publishing date:**
August 2010

**Design:**
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www.onehemisphere.se

**Printing:**
www.beelzepub.com

**Cover image:**
Forests destroyed
to provide area for planting
in Indonesia.
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# Soy oil

## 1. Introduction

**European Union (EU) biofuel targets are leading to a rapid increase in demand for feedstock crops such as sugar cane, oil palm and soy. This creates severe pressure for more agricultural land. Where this expansion occurs at the expense of forests, peat land and other carbon rich habitats, it results in substantial increases in greenhouse gas emissions from the soil and the removed vegetation. This expansion at the expense of natural habitats is often indirect, ie. biofuel crops are not planted on forestland, but instead displace other crops or pasture land which move to the forest. This makes it impossible to address this issue through sustainability certification schemes that by definition work at a farm-scale level.**

Scientific research has now shown that emissions from indirect land use change (ILUC) have the potential to negate any greenhouse gas emission savings which might be generated from biofuel use. In fact the net-effect of biofuel targets could be an overall increase in emissions.

In this series of briefings – looking at three different displacement chains - Friends of the Earth illustrates the reality of indirect land use change, highlighting how the EU's biofuel policy could in fact be aggravating climate change. This briefing[1] looks at how demand for soy oil is contributing to ILUC through the knock-on effects on the demand for palm oil.

## 2. Soy bean and soy bean oil

Originally discovered and farmed in China more than 5,000 years ago, the soy bean has become a staple product and is now the world's most important protein source for animal feed. It is also used in food processing and increasingly for biofuel[2].

This growth in demand for soy bean oil for biofuel is expected to affect the supplies available for food processing, leading to an increase in demand for other oils.

During World War II, soybeans became a popular source of oil and protein. The United States secured tariff-free access to the European market for its soybeans in trade talks in 1960. This triggered a boom in soy in Latin America following the agricultural revolution. Latin American soy production has now overtaken production from the US.

Current global production amounts to approximately 250 million tons (Mtons) per year and is expected to rise to 300 Mtons/year in 2020[3,4]. The main producing countries are the USA, Argentina and Brazil, which provide more than 80% of total production. Soy bean provides about 65% of the world's oilseed meal supply and is a major source of vegetable oil, accounting for 28% of global production[5].

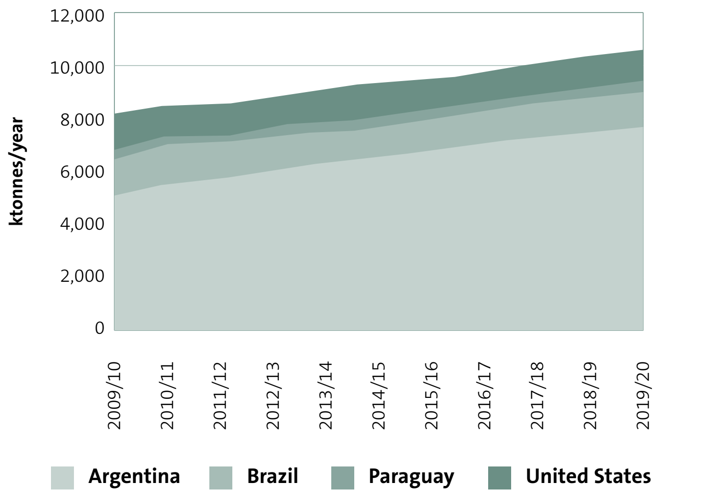
Approximately 55 – 60 MT of soy beans, 8 – 10 MT of soy oil and 42 – 45 MT of soy meal are traded annually across the world[6,7,8]. In Argentina reduced tax rates for soy biodiesel are increasingly encouraging soy producers to sell their oil for biodiesel[9].

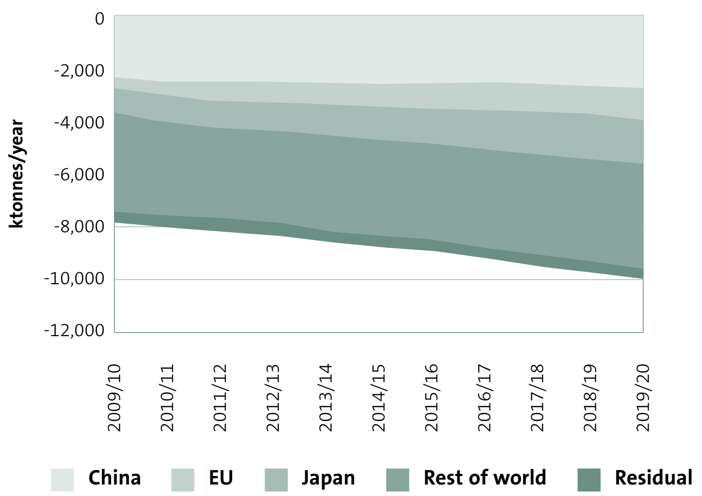
The main export markets for soy for cooking oil are China and India, which are supplied primarily by Argentina and to a lesser extent by Brazil.

The growing demand for soybean oil for use as biodiesel threatens the supply of soybean oil for cooking oil imported by China. If supplies for cooking oil for China and India are diverted to biodiesel, these countries will need to find a replacement for their current supplies from Argentina.

**Figure 1. Overview of current and forecasted soy oil trade**

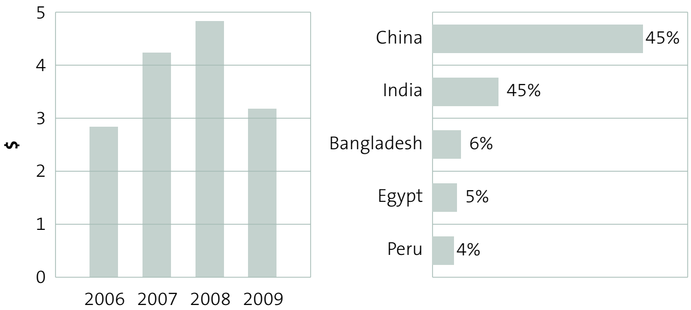
The upper part of the graph shows current and forecasted export volumes, broken down into the main exporting countries;
The lower part of the graph shows current and forecasted imports, broken down into the main importing countries.



# Soy oil

**Figure 2. Illustration of current destination of traded Argentine soy-oil**[10]




***Source:*** *ABECED consultants*

*Close up of a soy plant.*

*Forests destroyed to provide area for planting.*

## 3. Soy bean biodiesel

Soy bean oil has become a major feedstock for biodiesel in both the Americas and Europe, where legal targets have been introduced to stimulate the use of biofuels. Soy bean oil accounted for 50% - 90% of all biofuel feedstocks in the USA[11].

Rapeseed oil is currently the major feedstock in the EU, the biggest biodiesel market in the world. Soy bean biodiesel is produced in the EU from oil produced at domestic crushing mills and also imported directly from the USA and Latin America. Imports of Argentine biodiesel are expected to increase significantly in the next few years[12].

Soy oil based biodiesel currently makes up approximately 15% of total EU biodiesel production[13], but this may be as high as 40% in some individual member states as for example in the UK[14].

Argentine biodiesel capacity is expected to increase over the course of 2009 to 2.4 million metric tons (from 1.4 MMT at the end of 2008), with production aimed at the export market[15]. The competitiveness of Argentine biodiesel in the EU market is enhanced under the Argentine differential export tax (DET) system, which makes it more attractive for EU customers to buy the finished biodiesel than to buy Argentine soy bean oil and convert it into biodiesel in the EU[16].

**Figure 3. Europe: biofuel targets increase demand for soy oil**

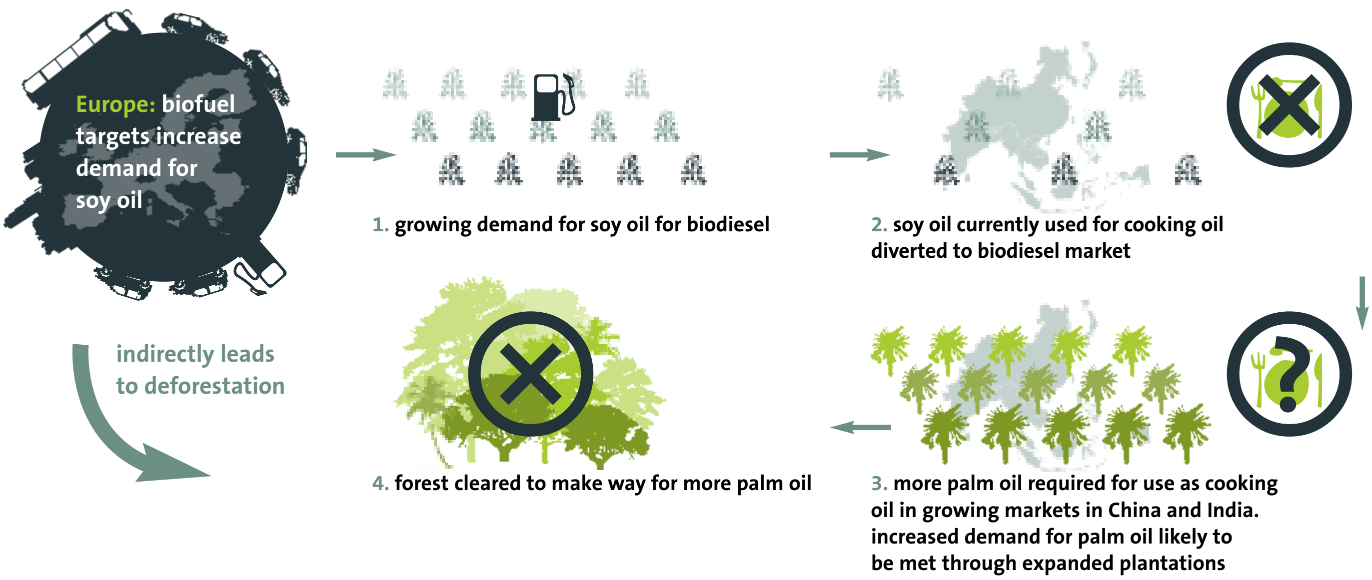


**Figure 4. Biodiesel feedstocks applied in the UK in 2009/2010**

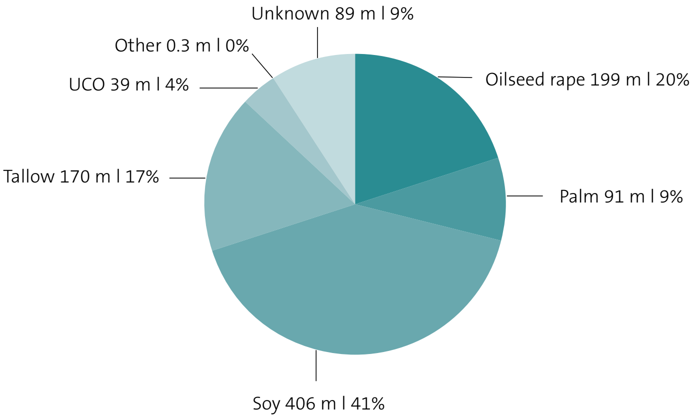
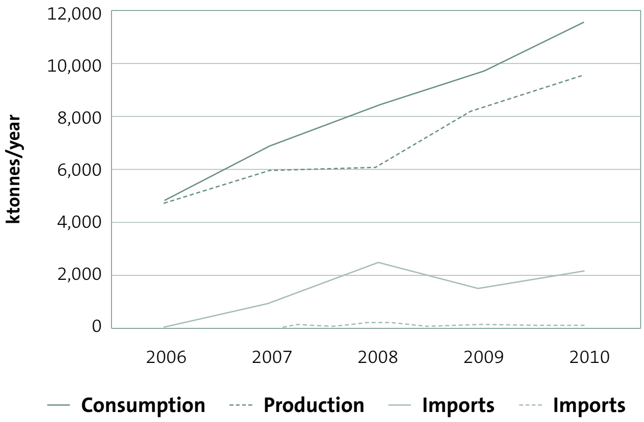



**Figure 5. Supplying EU biodiesel demand[25]**




***Source:*** *EU FAS Posts*

## 4. Soy bean biodiesel and (I)LUC

Using soy oil as biodiesel feedstock is likely to cause both direct and indirect land use change.

Soy bean production is currently mainly driven by demand for animal feed, with oil produced as a by-product. As a result the intensity and amount of cultivation are determined primarily by the soy meal price.

But increased demand for vegetable oil to meet EU biodiesel targets is expected to increase prices for vegetable oil – making it more likely that the soy oil price will also drive production, with increases in production expected in Brazil and Argentina[17,18,19]. This could create a further 900 million hectares of soy bean and a potential 0.5Mton increase in soy oil production[20].

However, total contribution of soy oil to the EU demand for biodiesel feedstock is anticipated to be significantly higher than 0.5 Mton. Most forecasts predict exports of soy oil or derived biodiesel to the EU as in excess of 3 Mtons/year[21,22,23]. This means soy oil is likely to be diverted from the cooking oil market to biodiesel production[24].

At the same time demand for vegetable cooking oil is expected to keep rising in Asian countries, most notably in India and China. The expected future rise in demand will be partially met by increased vegetable oil and oilseed imports, as India and especially China have limited opportunities for increasing the area for oilseed because of competition with other crops, particularly cereals[26,27]. As a result, the expected increase is expected to be met partially by imports of soy and palm vegetable oils (with some increase in yield also possible).

The increased demand could be met partly with soy oil, but this is likely to be diverted at least partly to biodiesel production. Instead extra oil palm will probably have to be imported, triggering demand for increased production in the main palm oil producer countries, Indonesia and Malaysia. Experts from the vegetable oil industry and NGOs expect this to be the case – supported by industry and independent forecasts[28,29].

Oil palm expansion is considered to be a major driver of deforestation, especially in Indonesia[30]:

- An evaluation of FAO land cover data suggests that between 1990 and 2005, some 55–59% of oil palm expansion in Malaysia (that is 834 000–1 109 000 ha of a total of 1 874 000 ha), and over 56% of that in Indonesia (1 313 000–1 707 000 ha of a total of 3 017 000 ha) occurred at the expense of natural forest cover.
- According to some estimates more than 80% of arable land extension in South East Asia takes place at the expense of natural forests and savannahs and grasslands. In the case of palm oil plantations the converted natural areas will be primarily forests, not savannah, because of the need for high precipitation for oil palm cultivation.
- Estimates made by Winrock International on the basis of satellite images for the US Environmental Protection Agency also indicate that more than 80% of extra oil palm plantation area is created at the expense of primary forests and savannah (see Table 1).

The creation of oil palm plantations is also used as a smoke screen for illegal logging for tropical wood[31].

# Soy oil

### Table 1. Proportion of different land uses converted in case of arable land expansion in specific countries and regions[32]

| | Forest Managed | Forest Primary | Other | Pasture | Savannah |
|---|---|---|---|---|---|
| Argentina | 16.4% | 0.0% | 24.7% | 35.6% | 23.3% |
| Brazil | 0.5% | 16.3% | 11.2% | 23.5% | 48.5% |
| Canada | 1.4% | 7.8% | 42.5% | 32.2% | 16.1% |
| China | 5.6% | 2.2% | 27.3% | 39.0% | 26.0% |
| CIS | 3.7% | 5.6% | 33.3% | 30.7% | 26.7% |
| EU27 | 8.4% | 0.4% | 23.5% | 36.8% | 30.9% |
| Indonesia and Malaysia | 3.2% | 51.7% | 7.0% | 7.0% | 31.0% |
| Oceania | 9.0% | 0.0% | 32.6% | 36.0% | 22.5% |
| Rest of OECD | 14.6% | 0.0% | 18.8% | 20.8% | 45.8% |
| Other South East Asia | 1.1% | 20.4% | 21.5% | 23.1% | 33.8% |
| South Africa | 1.1% | 5.1% | 28.4% | 43.2% | 22.2% |
| South Asia | 12.7% | 0.0% | 32.4% | 31.0% | 23.9% |
| USA | 5.4% | 2.5% | 21.1% | 47.4% | 23.7% |

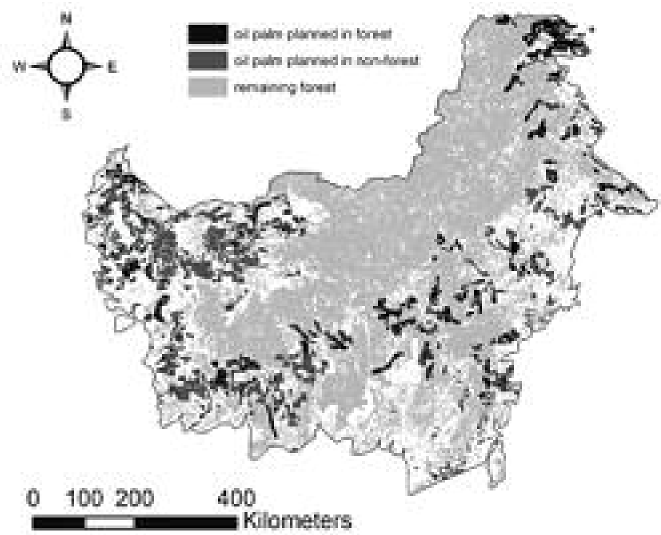
What is more, oil palm is increasingly being planted on peat lands because most mineral soil areas in the primary oil palm regions in Malaysia and Indonesia are already in use[33].

The conversion of natural forests into oil palm plantations results in significant greenhouse gas emissions as the carbon assimilated in the natural vegetation is released as $CO_2$. Where oil palm plantations are on peat land extra $CO_2$ is emitted from oxidation of the drained peat.

Replacing primary rainforest with oil palm results in a net release of 160 tonnes per hectare (544 tonnes of $CO_2$) per hectare. Partially drained and well-drained peat land releases 4 - 16 tonnes of carbon per hectare per year (13 - 55 tonnes of $CO_2$/ha per year) or up to 1,650 tonnes of $CO_2$/ha over the (maximum) life cycle of the plantation[34].

In comparison, a (very) good average yield of palm oil (4 tonnes/ha/year) would result in 60 g/MJ of greenhouse gas emissions per unit of palm oil, assuming 50% of the oil palm plantation comes from the conversion of primary rainforest[35].

### Figure 6. The extent of forest and planned oil palm plantations within forest habitat and in non-forest in Kalimantan, Indonesia[36]




## 5. Conclusion and recommendations

As a result of the large emissions per unit of oil palm, the greenhouse gas emissions per unit of soy oil based biodiesel related to indirect land use change are estimated as being very significant, with a potential ILUC factor of 75g $CO_2$-eq/MJ. This means the ILUC emissions would be expected to completely mitigate any direct emission savings and the net effect of replacing conventional diesel with biodiesel would be a net increase in GHG emissions of approximately 35g $CO_2$-eq/MJ[37].

**Friends of the Earth is calling for:**

- Strong ILUC factors, based on the precautionary principle, to be used to calculate the impact of ILUC emissions in the life cycle analysis of biofuel emissions.
- An urgent review of EU biofuel targets in the light of findings that ILUC emissions increase disproportionally with the size of the overall target.


*Deforestation in Indonesia.*



*Soy bean pods.*




1 Based on Soy-oil biodiesel and Indirect Land Use Change (ILUC), H.J.Croezen, CE Delft, July 2010.
2 Levin Institute, 2009 (was Globalization), Globalization 101 project, Case study: Soy beans' impact on the world, New York.
3 FAPRI, 2009, M. Carriquiry, et al. FAPRI 2009 :U.S and World Agricultural 2009, Ames : Iowa State University & University of Missouri-Columbia, Food and Agricultural Policy Research Institute.
4 OECD-FAO, 2009, Agricultural Outlook 2009-2018, Paris ; Rome : OECD/FAO, 2009.
5 USB, 2006, LMC International Ltd. Soybean Meal Evaluation to 2020, Chesterfield United Soybean Board (USB), 2006.
6 FAPRI, 2009, M. Carriquiry, et al. FAPRI 2009 :U.S and World Agricultural 2009, Ames : Iowa State University & University of Missouri-Columbia, Food and Agricultural Policy Research Institute.
7 OECD-FAO, 2009, Agricultural Outlook 2009-2018, Paris ; Rome : OECD/FAO, 2009.
8 MCXIndia, 2010, Multi Commodity Exchage of Inda Limited, At: www.mcxindia.com/home.aspx.
9 USDA, 2009, Bob Flach, et al. EU-27 Biofuels Annual : Annual Report 2009, S. l. : United States Department of Agriculture (USDA), 2009.
10 WSJ, 2010, M. Moffett, S. Romig, China squeezes key argentine export, The Wall Street Journal, April 13, 2010.
11 See: www1.eere.energy.gov/biomass/abcs_biofuels.html#biodfeed, www.mvo.nl/Portals/0/statistiek/nieuws/2009/MVO_Factsheet_Soy_2009.pdf and www.biodieselmagazine.com/article.jsp?article_id=3875
12 USDA, 2009, Bob Flach, et al. EU-27 Biofuels Annual : Annual Report 2009, S. l. : United States Department of Agriculture (USDA), 2009.
13 Ibid.
14 See: www.renewablefuelsagency.gov.uk/sites/rfa/files/23_RFA_monthly_report_Apr_2009_Mar_2010.pdf.
15 USDA, 2009, Bob Flach, et al. EU-27 Biofuels Annual : Annual Report 2009, S. l. : United States Department of Agriculture (USDA), 2009.
16 Rapoza, 2007, Kenneth Rapoza, Brazil soy industry prepares for biodiesel war with Argentina, In: Market Watch, march 25, 2007, www.marketwatch.com/story/brazil-soy-industryprepares-for-biodiesel-war-with-argentina.
17 EC, 2010, María Blanco Fonseca, Alison Burrell (ed.), Hubertus Gay, Martin Henseler, Aikaterini Kavallari, Robert M'Barek, Ignácio Pérez Domínguez, Axel Tonini, Impacts of the EU biofuel target on agricultural markets and land use: a comparative modeling assessment , Sevilla : European Commission, Joint Research Centre, Institute for Prospective Technological, 2010.
18 OECD-FAO, 2009, Agricultural Outlook 2009-2018, Paris ; Rome : OECD/FAO, 2009.
19 FAPRI, 2009, M. Carriquiry, et al. FAPRI 2009 :U.S and World Agricultural 2009, Ames : Iowa State University & University of Missouri-Columbia, Food and Agricultural Policy Research Institute.
20 See 17.
21 FAPRI, 2009, M. Carriquiry, et al. FAPRI 2009 :U.S and World Agricultural 2009, Ames : Iowa State University & University of Missouri-Columbia, Food and Agricultural Policy Research Institute.
22 OECD-FAO, 2009, Agricultural Outlook 2009-2018, Paris ; Rome : OECD/FAO, 2009.
23 IFPRI, 2010 P. Al-Riffai, B. Dimaranan, D. Laborde (IFPRI), Global Trade and Environmental Impact Study of the EU Biofuels Mandate, Brussels : Directorate General for Trade of the European Commission, 2010.
24 See e.g. www.mvo.nl/Portals/0/statistiek/nieuws/2009/MVO_Factsheet_Soy_2009.pdf
25 USDA, 2009, Bob Flach, et al. EU-27 Biofuels Annual : Annual Report 2009, S. l. : United States Department of Agriculture (USDA), 2009
26 FAPRI, 2009, M. Carriquiry, et al. FAPRI 2009 :U.S and World Agricultural 2009, Ames : Iowa State University & University of Missouri-Columbia, Food and Agricultural Policy Research Institute.
27 USDA, 2009, Bob Flach, et al. EU-27 Biofuels Annual : Annual Report 2009, S. l. : United States Department of Agriculture (USDA), 2009.
28 See e.g. www.mvo.nl/Portals/0/statistiek/nieuws/2009/MVO_Factsheet_Soy_2009.pdf
29 MVO = productschap Margarine, Vetten en Oiën, the Dutch product board of Margarine, Fats and Oils FAPRI = Food and Agricultural Policy Research Institute, OECD-FAO = Organisation for Economic Cooperation and Development - Food and Agriculture Organisation.
30 CIFOR, 2009, D. Sheil, A. Casson, E. Meijaard, M. van Nordwijk, J. Gaskell, J. Sunderland-Groves, K. Wertz. and M. Kanninen, The impacts and opportunities of oil palm in Southeast Asia : What do we know and what do we need to know? Bogor : CIFOR, 2009.
31 Ibid.
32 E4tech, 2010, Indirect Land Use Change (ILUC) impacts of soybean oil for biodiesel (stakeholder workshop – working draft) S.l. : E4tech, 24 March 2010.
33 Ibid.
34 Ibid.
35 (550 tonnes $CO_2$ + (4 * 30) tonnes palm oil ÷ 37 GJ/tonne oil).
36 Venter, O., Meijaard, E., Possingham, H.P., Dennis, R., Sheil, D., Wich, S. and Wilson, K. 2009. Confronting the carbon crisis—a safeguard for tropical forest wildlife. In press. Conservation Letters.
37 IFPRI, 2010 P. Al-Riffai, B. Dimaranan, D. Laborde (IFPRI), Global Trade and Environmental Impact Study of the EU Biofuels Mandate, Brussels : Directorate General for Trade of the European Commission, 2010.

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