Response from Winrock International to the EU consultation on indirect land use change.

Introduction to Winrock International

Winrock is dedicated to improving the lives of disadvantaged men, women, and youth around the world. Winrock's staff of more than 800 are located at corporate offices in Arkansas and Washington, DC, as well as in field presence in more than 68 countries. Our present clients include the World Bank, Organization of American States, the Asian Development Bank, International Fund for Agricultural Development, UN Development Programme, Food and Agriculture Organization (FAO), UK Department for International Development (DFID), US Agency for International Development (USAID), US Department of Agriculture, the Packard, Rockefeller, Starr, Kellogg and Ford foundations and numerous private clients. Winrock and is currently collaborating with Ecofys as part of an EU tender for developing a biofuels monitoring methodology.

Winrock activities in bioenergy (direct biomass to energy and indirectly via biofuels) cover more than two decades. Winrock has developed expertise, established connections, monitored innovations, and facilitated technology transfer throughout the world, playing roles in bioenergy development in Brazil, China, the Dominican Republic, Egypt, El Salvador, Haiti, India, the Philippines, the US, and regionally in South and Southeast Asia and Eastern Europe. Winrock is a world leader in terrestrial carbon measurement and monitoring, three-dimensional aerial digital imagery for ecological analysis, and the evaluation of land and climate change. Winrock is not a lobbying organization and bases its work on sound science.

Background

Biofuels present real opportunities for greenhouse gas (GHG) emission reduction and economic and social development but, if developed inappropriately, can result in negative impacts. The promotion of large volumes of biofuel through EU policy could induce a series of land use changes that has greater net GHG emissions than a situation where less biofuels were produced. This could negate any GHG benefits the biofuel claimed and result in an unsustainable situation.

The Renewable Energy Directive states:

"the Commission shall, by 31 December 2010, submit a report to the European Parliament and to the Council reviewing the impact of indirect land-use change on greenhouse gas emissions and addressing ways to minimise that impact. The report shall, if appropriate, be accompanied by a proposal, based on the best available scientific evidence, containing a concrete methodology for emissions from carbon stock changes caused by indirect land-use changes".

The concept of indirect land-use change requires clarification. As noted by Edwards, Mulligan & Marelli (2010), the distinction between direct- and indirect- land use change only makes sense for a particular batch of biofuels. The land-use implications of a policy or the total production of biofuel is just one land use change effect, which can be considered the sum of all the direct and indirect effects of the particular batches of biofuels. According to Edwards et al (2010), ‘if even 2.4% of the EU’s biodiesel needs are met directly or indirectly by palm oil grown in peatland all GHG savings from EU biodiesel would be cancelled out’.

Addressing indirect land use change through policy action has an important precedent. Climate policy and relevant legislation is based on results of complex climate modeling despite acknowledgement of much uncertainty within the modeling.

Winrock believes that, given the right regulatory framework, biofuels can be produced sustainably and contribute to reducing GHG emissions. However, emissions from land use change (direct or indirect) can be considerable and negate GHG savings of biofuels. Therefore, it is critical to address both direct and indirect land use change in establishing the GHG benefits of biofuels.

Response to questions

1. **Do you consider that the analytical work referred to above, and/or other analytical work in this field, provides a good basis for determining how significant indirect land use change resulting from the production of biofuels is?**

Currently models are used to assess the impacts of future biofuel scenarios and are based on economic principles. They can show us the relationships between various factors that influence land use change, but are limited by the assumptions they make and the boundaries of their analysis. For that reason, they are good at indicating how factors *may* influence indirect land use change, but cannot be considered good at determining what the exact magnitude of those indirect effects are. For purposes of this paper, we have reviewed the four studies published by the European Commission alongside the public consultation.

The response to this question is divided into two. The first section comments on the limitations of specific assumptions within current economic models. The second section identifies the limitations of economic modeling approaches in general.

Limitations of current model assumptions

A number of significant limiting assumptions in current indirect land use change models are described below: the types of land use changes considered by the models, how the models value land, what carbon stocks the models assign to land types, and co-products

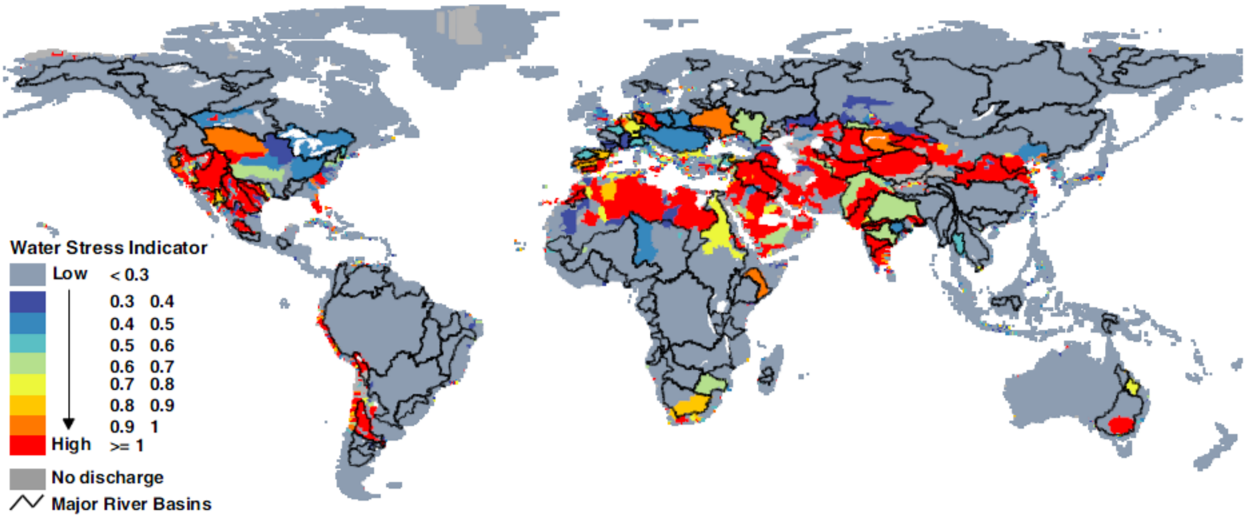
- Types of land use changes

The types of land use changes considered in models are often inadequate in their level of detail. The high level categorization of land overlooks complex land use changes that will influence the magnitude of land use change as well as associated GHG emissions. In the Modeling International Relationships in Applied General Equilibrium (MIRAGE) model for example, land use substitution takes place between 'managed' lands, (cropland, pasture, managed forest) and land use expansion in 'unmanaged'[1] lands' (primary forest, savannah, grassland, shrubland, mountains) (Al-Riffai *et al*, 2010). However, not all cropland may be in use at a given time; some cropland may be idled and brought back into production as it becomes more economic to do so. This 'buffer' capacity of cropland would reduce the substitution within or expansion into other land categories[2]. Some cropland may also be double-cropped rather than expanded or substituted. Babcock & Carriquiry (2010) state 'In the Global Trade Analysis (GTAP) model, there is no possibility of idle land which could be drawn on if the demand for cropland increases'. While GTAP has been modified and used as the basis for the MIRAGE model it is unclear if relevant modifications have been made with respect to land use categories.

The categorization of land also influences the locations of land use change. Agro-ecological zones (AEZ) have been used to determine appropriate and likely locations of land change and subsequent GHG emissions. However, The AEZ approach adopted in the modified version of GTAP assumes the availability of water. Availability and quality of water is one of the most critical parameters for agricultural expansion and without this check, the location and size of land changes are somewhat theoretical. Analysis that reviews Global Climate Change (GCC) models shows the impacts of climate change on most of the developing world are significant reductions in agricultural productivity while experiencing substantial population growth and food demand (Cline, 2007). Water availability is key to this mismatch.
A high level view of water stress indicators in basins throughout the world are illustrated in Figure 1.

[1] Without an economic value
[2] The IFPRI study discusses idle land in the context of the EU but it is not clear how this land is addressed in the rest of the world.

Figure 1: Water stress indicators including environmental water needs (closed basins in red).



Source: SIWI, 2006

Because of various limitations on rainfed land, many authorities believe that the majority of additional food production will have to come from irrigated land, and therefore the expected increase in the production and use of biofuels in the coming years would add to this requirement. Impacts will be more pronounced for local and regional water resources. Costs of irrigation will further influence decisions on land use. Modeling approaches which assume water availability at zero cost therefore are incomplete.

- Land 'valuation'

Models forecasting land use change based on crop prices do not reflect non-market values for land:

  - In the MIRAGE model the different types of land are represented in the model in the form of economic rental values and the representative land owner can choose to allocate the land productivity between land use with different substitution levels. In models generally, fixed-rental rates are assumed to be related to productivity i.e. higher returns equals higher rental rates. This economic relationship does not capture non-market values that influence the value of land and its subsequent use. For example, a farmer on a 40-year land contract may wish to sell-up after 20 years on the contract. The terms of the contract will determine its residual value – is the farmer allowed to sell on the contract with the land? The terms of the contract as well as the actions of the farmer during the tenure will influence the access to land and the price or value of the land. If farmers are required to pay a fee, or otherwise obtain the renewal, then the security and the market value of rural land will be considerably decreased as the end of the term looms. These rental rates may not be captured or reported.

  - The Centralised Elasticity of Transformation (CET) determines the magnitude of land substitution within managed lands in the MIRAGE model. A study in 2008 (MIT[3]), stated that the CET approach does not explicitly account for conversion costs, nor for the value of the stock of timber on virgin forest land that substitutes for forest harvest on managed forest land. The magnitude of conversion may therefore be misrepresented.

[3] http://dspace.mit.edu/bitstream/handle/1721.1/41521/MITJPSPGC_Rpt155.pdf?sequence=1

- Carbon stocks and GHG emissions

Some models do not include emissions from peatland. This omission is significant as emissions from peatland can rapidly erode any GHG benefit of the biofuel. This is already identified in several of the studies released as part of this public consultation on indirect land use change. The significance of the issue is outlined by Edwards *et al* (2010) 'if even 2.4% of the EU's biodiesel needs are met directly or indirectly by palm oil grown in peatland all GHG savings from EU biodiesel would be cancelled out'.

Only land use emissions from newly converted land have been accounted for in models identified by Fonseca *et al (*2010) but additional emissions come from annual emissions from farming the newly-planted areas (Edwards *et al*, 2010). It is also likely that there are indirect benefits that have not been considered. Intensification through greater fertilizer application for example could reduce the rate of soil degradation (which would require more and more land to be cultivated to maintain yields) and therefore avoid pressure on further land conversion[4].

- Co-products

Co-products can have a significant effect on the effective land 'demand' of a biofuel. Much work has been undertaken to attempt to better reflect the impact of co-products on land use change e.g. Dried Distillers Grains with Solubles (DDGS) used as an animal feed and displacing production of a certain volume of a substitute such as soymeal.

There is a clear reference to the impact of different co-product replacement substitutes in the literature review conducted by the European Commission. While many works are cited in the document, some that is relevant is not referenced such as the work of the US National Renewable Energy Laboratory (NREL) (Arora, Wu and Wang) and Shurson (2009). A comparison of displacement ratios is identified in Table 1 and results are towards the higher end of the displacement ratios identified by the Commission's literature review (European Commission, 2010).

Table 1: Current displacement ratios in the US (kg/kg Distillers grains with solubles-DGS)

Feed type	GREET model	Shurson (2009)	California Air Resources Board (LCFS)	FASOM model	CARD/ FAPRI model
Corn	0.947	0.895	1	0.915	0.950
Soybean meal	0.303	0.334	-	0.085	0.050
Urea	0.025	0.021	-	-	-
Other	-	minimal	-	-	-
Total	**1.275**	**1.249**	**1**	**1**	**1**

Source: Shurson, 2009

While the literature review (European Commission, 2010) points out the variations in co-product displacement ratios, it is not clear within the review how regional differences in trade in animal feeds and different inclusion rates may impact model results. This variation and its impact should be accounted for within modeling approaches as co-products are a significant driver of results. Poultry consumption has not been included in the analysis used in the GREET model because feed composition and performance data available for poultry were insufficient (Arora, Wu, Wang, 2008) but increased use of DDGS for swine and poultry for example is possible (Shurson, 2009).

It is not clear within the model assumptions if any credit is given for the reduced CH_4 emissions over the lifecycle of animals fed with DDGS (except swine). They are estimated to be lower by about 258 grams per gallon of ethanol produced compared to those fed with conventional diets (Arora, Wu, Wang, Shurson, 2008) and are accounted for in the Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) Model by Argonne National Laboratory.

[4] Land degradation can also be enhanced by intensification e.g. soil erosion can result

Periods of models used in iLUC forecasting should account for future changes in the animal feed market which could change GHG emission profiles.

- Fertilizer – yield relationship

Al-Riffai *et al* (2010) assume 'The degree of crop intensification depends on the relative price between land and fertilizers' (p43). Since the relative price between land and fertilizers determines the use of fertilizers another yield-depressing effect appears: lower land prices reduce intensification and yield.

Findings from a Winrock report (Winrock International, 2009a) suggests that outside influences on fertilizer prices is inducing technological innovation and adaptation relevant to assumptions of intensification and yield. In Indonesia, sustaining current food production and expanding biofuels relies heavily on the availability of fertilizer and local production availability is potentially threatened[5]. Fertilizer purchase and application can account for up to 60% of the plantation maintenance costs Upward pressure on fertilizer prices has led to the focus on the use of alternative available organic sources to maintain yields. The application of empty fruit bunches (EFBs) incorporated with Palm Oil Mill Effluent (POME) are increasingly used to maintain yields. New technology under development reduces land area requirements for POME treatment lagoons and reduces retention time in the treatment process. It produces around 12m^3 of biogas from each m^3 POME that can be used as an energy source. This opens up opportunities for rural electrification, reducing kerosene and other fossil fuel use and associated GHG emissions. This may not be imminent but over the timeframe considered in the models such step-changes could be seen if the right policy framework is set.

Drivers of land use change not accounted for within current economic modelling approaches

Current models are based on economic principles only. Study 3, page 91 states that a producer in MIRAGE only reacts to prices and that no other rationality constraint is taken into account. In addition, the study chose to 'adopt a neutral normative assumption concerning elasticities across regions and crops, which means that we assume that each producer, whatever his production type or his region, reacts the same way to a price change' (Page 92). Land use conversion is consequently driven by price changes. However, there are considerable limitations in basing land use models on economic principles only.

There are several non-economic factors that also influence what land use change takes place and where it occurs. Among these drivers are politics, land use policy, location features (e.g., infrastructure, proximity to population centres), and agriculture policy and risk management. These are further described here.

- Politics

A trend identified and described in the The Economist (2009), illustrates countries that export capital but import food are outsourcing farm production to countries that need capital but have land to spare. 'Instead of buying food on world markets, governments and politically influential companies buy or lease farmland abroad, grow the crops there and ship them back. In Sudan alone, South Korea has signed deals for 690,000 hectares, the United Arab Emirates (UAE) for 400,000 hectares and Egypt has secured a similar deal to grow wheat. An official in Sudan says his country will set aside for Arab governments roughly a fifth of the cultivated land in Africa's largest country (traditionally known as the breadbasket of the Arab world)'. Export bans and taxes, such as Ukrainian and Indian wheat export bans, play a role in persuading many food-importing countries that they can no longer rely on world food markets for basic supplies.

[5] Fertilizer production requires natural gas. Other gas consumers, such as PLN, are reportedly able to purchase natural gas at higher costs and therefore potentially reduce the purchasing power and availability of domestic gas for the fertilizer industry. Based on the biofuel feedstock production estimates in the Indonesia National Plan, in 2015, fertilizer for domestic biofuel feedstock alone will require around 2.8 million tons of urea (Bahan Bakar Nabati, 2006), which is almost as much as the total consumption of fertilizer for all uses in 2002.

- Land use policy

Land use policy may dictate where land use change occurs, independent of economic or geophysical factors of the land. In Indonesia, land concessions have been granted for palm oil. It is therefore unnecessary to use models to forecast where production will occur, since concession areas for oil palm have geographical locations. Using land cover data (2004) and GIS data from Wetlands International it is clear that some concessions are located in forested areas and wetlands/peatlands (Winrock, 2009b). In Kalimantan alone, Winrock has estimated that around 1.6Mha of concessions are on forested land and over 880,00ha on wetland >50cm (Winrock calculations)[6]; See Annex A. Based on calculations stated in Edwards et al (2010), cultivation of 224,000 hectares of peatland could be significant enough to negate biofuel GHG savings[7].

- Location / infrastructure

Access to markets (e.g. distance to towns, roads etc) is key to land use change and it is not clear how this is assumed in many models. Some models that use agroecological zoning to establish a land supply curve may miss this critical issue.

- Agricultural policy and risk management

The influence of agricultural support payments on land use decisions must be considered. The extent to which support payments have been included in models for in all regions of the world is not clear. In the US for example, the majority of farm program payments have been “decoupled” from current production but marketing loan benefits, crop insurance, and disaster payments continue to depend on current prices and current production. These programs can help protect crop farmers from low prices and low yields. Farmers may still produce certain crops over others even when market price alone is used to forecast land use change. Whether yields are increased or new land is brought into production is also influenced by support payments. For example, producers in the US can increase their eligibility for these programs by converting grassland to crop production. Newly converted land is eligible for marketing loans and crop insurance.

Other issues that impact land use and land cover change include:

- Business models. For example, if a soybean farmer has financial interest in a crushing plant he won’t just change crops as modelling would suggest.
- Currency and exchange rates. Devaluation of a currency can lead to an attractive investment potential in that country from other regions and a weak currency assists in export competitiveness.
- Labour availability
- Exchange rates
- Technological innovation

2. **On the basis of the available evidence, do you think that EU action is needed to address indirect land use change?**

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[6] These areas may overlap and therefore are not additive

[7] 2.4% (Edward’s estimate) of the EU biofuel demand of 27Mtoe results in 648,000toe biodiesel. If this all came from CPO from peatland, the area of peatland converted would be 224,000 ha. This assumes the ratio of tonne biodiesel; to toe is 1.07 that 1ha produces 3.5tonne CPO and 2.7tonne biodiesel Winrock. (2009a)

While land use change will happen with or without biofuels demand, EU action is needed to ensure that substantial demand for new products does not indirectly increase emissions. Although the models indicate a wide variation in potential indirect land use change impacts from biofuels, a majority indicate that the potential impacts are too large to ignore. The potential impact of taking no action to address iLUC would at best cancel out any GHG benefits of biofuels, and at worst would counteract any actions to address climate change in the transport sector.

3. If action is to be taken, and if it is to have the effect of encouraging greater use of some categories of biofuel and/or less use of other categories of biofuel than would otherwise be the case, it would be necessary to identify these categories of biofuel on the basis of the analytical work. As such, do you think it is possible to draw sufficiently reliable conclusions on whether indirect land use change impacts of biofuels vary according to: Biofuel feedstock; geographical location; land management?

Land management can play a significant role in reducing risk of indirect land use change through improving total yields on cultivated land for example.

As part of a study commissioned by the UK Renewable Fuels Agency (Dehue, van de Staiij, Chalmers, 2010), Winrock provided case studies and assisted in the development of a methodology that identifies biofuels that could be considered 'additional' which ensures that indirect emissions caused by displacement do not occur.

Three ILUC mitigation options are identified (that produce additional feedstock for biofuels and do not cause displacement): These could also be identified at a regional level or through individual project-type approaches (similar to CDM)

1. Expanding production without displacement of current production by expanding onto currently "unused land"
2. Expanding production without displacement of current production by increasing the productivity of non-bioenergy systems

    - Rotating annual crops with Zero Tillage into degraded pastures allows intensification of land use and increased productivity per hectare. One case study illustrated in Landers (2007) illustrates the potential indirect land use change mitigation potential: In a 4-year rotation an Integrated Crop and Livestock Zero Tillage (ICLZT) system[8] on 4 hectares has been shown to:
    - Produce 3 hectares of arable crops including *soybean* and
    - Carry 5 animal units

    To achieve the same production without integration of crops and livestock:
    - 3 hectares would be needed to produce the same annual crops
    - An additional 10 hectares to maintain 0.5 AU per hectare in the customary grazing system on degraded pasture cleared from forest. Assuming a direct comparison is made with the 4ha rotation above, 1 ha remains in addition to that used for arable crops. This could support 0.5 AU therefore 9ha would be needed for the additional 4.5 AU.

    The calculated deforestation mitigation potential illustrates four (4) hectares of this intensive integrated crop–livestock system 'saves' 9 hectares of forest from clearance and land degradation. Therefore, 2.25 hectares of forest is 'saved' per hectare of ICLZT which could be cited as displacement mitigation potential. In other words, the ICLZT leads to an improved land productivity of 225%. This implies that, compared to

[8] The total system was 800 ha with mechanized operation and beef cattle. Cropping pattern is a 1 year pasture ley in rotation with 3 years of annual cropping: soybeans-cotton-maize.

a normal system without integration, production can be more than doubled without increasing land requirements[9].

3. Expanding production without displacement of current production by increasing the productivity of existing bioenergy systems (e.g. yield improvements)

    - The San Carlos Bioenergy Project in the Philippines illustrates large yield increases that could be considered to minimize the risk of displacement. Yields increased from an average of 70t/ha to 136t/ha in the trial area through installing drip-irrigation and improving management practice. The bioenergy project addressed and overcame existing barriers to yield increases such as access to capital, technology support, existing agricultural practice and business models for cane supply.

While of benefit to avoiding risk of indirect land use change, the study also highlighted potential negative social and environmental consequences of approaches to production of 'additional' biofuels.

4. Based on your responses to the above questions, what course of action do you think appropriate?

One approach to minimize the GHG impacts of biofuels from iLUC would be to define a risk profile for biofuels. Biofuels classed as 'low risk' or 'no risk' for iLUC could be counted towards the 2020 target. Guidance on the evidence required to prove certain biofuels could be classed as 'low risk' or 'no risk' would be required.

The 'low risk' category would provide a high confidence level that iLUC has been avoided by defining biofuel production that is 'additional' i.e. biofuel feedstock production is increased without displacing current provisioning services. This could be achieved by (Dehue, van de Staiij & Chalmers, 2009):

- Expanding production without displacement of current production by expanding onto currently "unused land"
- Expanding production without displacement of current production by increasing the productivity of non-bioenergy supply chain. e.g., crop-livestock integration such as sugarcane or soy with cattle, or integration of biofuel crops with other crops. Biofuel crops are essentially 'new' in this system and have not reduced productivity of the existing crop;
- Expanding production without displacement of current production by increasing the productivity of existing bioenergy supply chains (e.g. yield improvement through improved fertilization and irrigation techniques, crop rotations, double-cropping, etc.);
- Expanding production from waste feedstock.

Indicators would be required to assist the provision of evidence. A regional approach to risk assessments would utilize a combination of remotely sensed imagery combined with statistical information as evidence for designation of biofuels from certain regions into specific risk categories. A baseline for each region must be developed in order that effective monitoring takes place. Provided the region illustrates a low risk of iLUC, subject to demonstration of compliance to other sustainability criteria, biofuel and biofuel feedstock from that region would be allowed to count towards the 10% by 2020 target in the EU for a specified period of time (e.g. until the next reporting period).

[9] Note that the climate will affect the carrying capacity of the land and therefore the land productivity. Dry season pasture production determines a farm's year-round carrying capacity (animal stocking rate). Rainfall intensity increases to the northwest and this better winter rainfall in the Amazon region than in the Cerrado allows higher dry season stocking rates. Cattle enterprises give a higher average return per hectare in the Amazon region than in the degraded areas in the Cerrado. For example, the large cattle-growing area of South Pará has a dry season of only 2–3 months compared to 4–6 months in the Cerrado (Landers, 2007).

A stricter approach would require companies supplying biofuels into the EU market to produce this information from their specific supply chain. However, project-based compliance requirements would be more expensive than those conducted at a regional level. This approach could be used within a broader framework, for example, if the regional risk assessment highlights biofuel production has a 'medium risk' or 'high risk' of iLUC, then more specific information on supply chains can be provided to prove the biofuel is in the 'low risk' or 'no risk' category.

Despite the higher confidence level in this approach there remain risks to indirect land use change and wider environmental and social issues. For example, there are likely to be increases in water consumption for example in yield changes and cultivating "unused" land. Delivering additional biofuel yields in one watershed entirely through yield increases for example could deliver water availability problems for other users and trigger land use change elsewhere as a result. On social side, the "unused" or marginal land is usually where the poor and disadvantaged people of society are likely to concentrate. As these lands may be put into cultivation of biofuels feedstocks, land use changes elsewhere as a result of use of these marginal lands may arise. In developing a more holistic look at the impacts of biofuels and addressing them appropriately it would be necessary to differentiate on the basis of risk.

A true 'no risk biofuel' would have to show that, in addition to one of the three routes above, there has been no negative impact of biofuel production on other parameters such as water use, soil quality or water quality for example. This is because, should these parameters be negatively affected, this could result in land use change elsewhere.

A true 'low risk biofuel' could be produced through one of the routes above but would take place in areas where there is a low risk of resource scarcity e.g. production takes place in an open watershed[10] or are produced from by-products[11]. Sugarcane bioethanol from yield increases in open basins of Brazil could for example be included in this category.

Parameters would have to be defined for the risk categories and once this approach has been developed it could supercede that identified above.

The policy solution chosen should fit the objective. However, given the inevitable trade-offs such as reduced water availability as a result of improving yield to reduce GHG emissions through iLUC, it appears unwise focus solely on the GHG impacts of iLUC. Approaches such as applying ever higher GHG thresholds without addressing other parameters is likely to have other negative impacts.

There are clearly ways in which to identify biofuels with positive impacts. The European Commission should seek to minimize unsustainable approaches to producing biofuels and should begin immediately with implementing a risk-based approach to minimize the impact of indirect land use change on GHG emissions. This solution should only be a starting point and the Commission should develop a more comprehensive approach to biofuel sustainability within the policy framework to address the complex trade-offs outlined in this response.

[10] Open watersheds have consistent outflows of usable water in the dry season. More water could be developed for dry season use and beneficially depleted upstream without diminishing existing uses. This could be considered 'low risk' owing to chance of dry seasons that may change this situation periodically and temporarily.

[11] By-product demand would have to be monitored to ensure use of the by-product itself does not deliver a risk of iLUC through product substitution for example.

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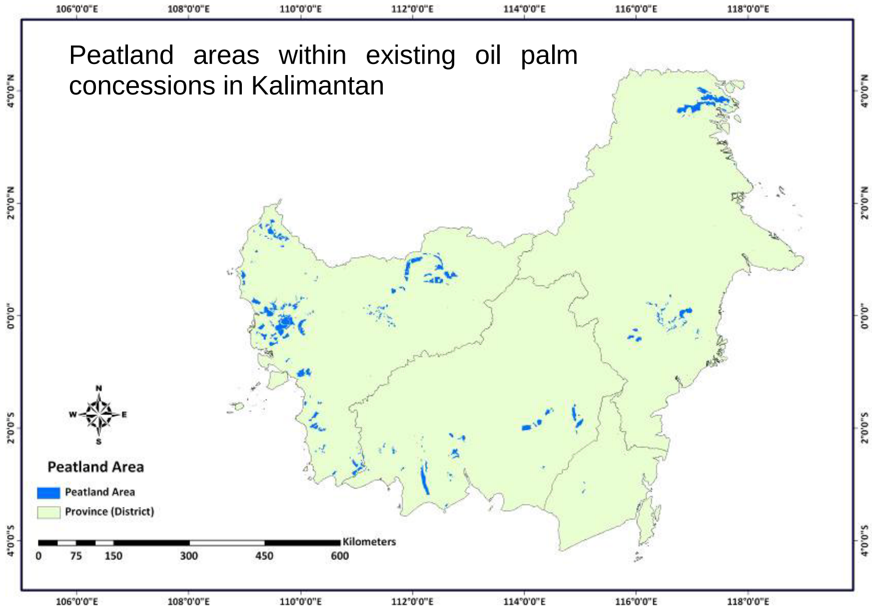
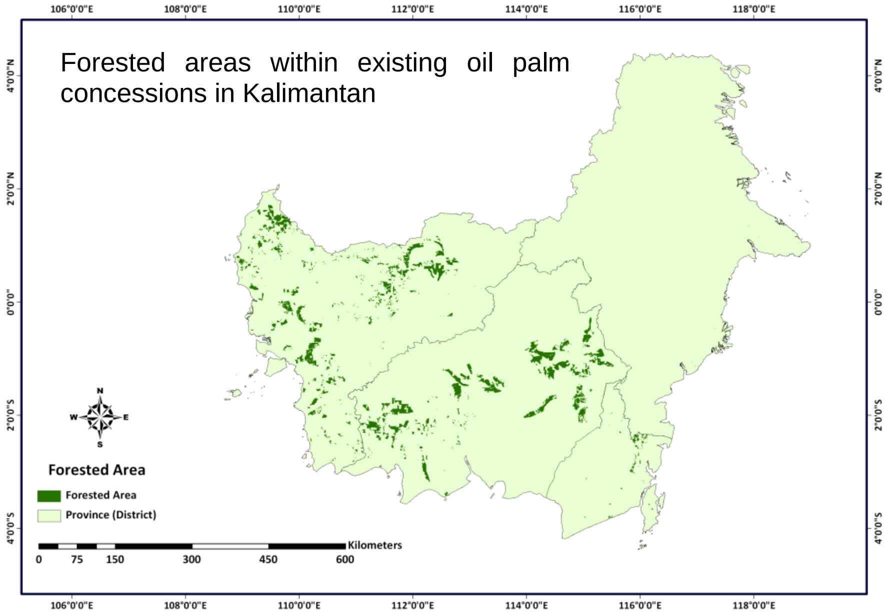
Annex A

Peatland areas within existing oil palm concessions in Kalimantan and Forested areas within existing oil palm concessions





Source: Winrock, 2009b