GLOBIOM 2016
CRITICAL ANALYSIS

1. An original but very complex model and a non-transparent and not peer-reviewed study

- The GLOBIOM model is built on **a very different structure than the models commonly used for ILUC assessment (General Equilibrium models)**.
  GLOBIOM is a **partial** equilibrium model which **only** incorporates **agricultural products and forestry** - (**but not** other very significant soil uses such as **urbanisation**).

- The land-use representation of the model is derived from agronomic data which itself is issued from a great number of biophysical databases processed by other models (EPIC and SPAM) for operating a distribution of the various crop productions through the 212,000 regional cells individualised by GLOBIOM.
  A first simulation process has led to setting an initial database for the year 2000 – the many assumptions necessary at this stage are nevertheless not explained in the report.
  The 2000 database is used in a next stage to make projections in 2010, 2020 and 2030, and simulate the biofuel policy.
  The projections require the introduction of a set of economic data (production costs, cost of land conversion etc.). Unfortunately, the study reveals v**ery little information on this economic data** as well as how they are introduced in the model. In particular, there is a **great opacity on essential supply elasticities** such as the yield/price elasticities, which are crucial for the determination of additional needs of farmland and therefore for assessing the ILUC impact.

2. GLOBIOM 2016: much higher figures than other recent modelling results

- **IFPRI 2011 (Mirage model)**
  - According to the GLOBIOM study, the area subject to ILUC is 5 times greater than in IFPRI study: 8.8 million ha in GLOBIOM against 1.7 million ha in Mirage.
  - The product-specific ILUC is as well much higher for all crops: for wheat (+70%), rapeseed and sunflower (+20%), and especially for palm (+400%) and soybean (+ 150%).

- **Previous simulations of the GLOBIOM model**

The GLOBIOM model was used for 3 previous studies:

- A simulation of the world biofuel production in 2011;
- A study on ethanol in the USA in 2013;
- A study on biodiesel in the EU in 2013 as well.

The results found ILUC figures in the range of 40gCO2e/MJ both for biodiesel and ethanol in Europe and in the USA.

- **California Air Resources Board (CARB)**

The results of GLOBIOM are 3 to 5 times higher than those of CARB:

Biofuel	GLOBIOM	IFPRI	CARB	*ILUC directive*
Wheat ethanol	34	17-23		*12*
Corn Ethanol	14	10-13	19.8	*12*
Sugar Beet ethanol	15	5-9		*13*
Cane ethanol	17	13-16	11.8	*13*
Rapeseed Biodiesel	65	53-56	14.5	*55*
Sunflower biodiesel	63	50-62		*55*
Soy biodiesel	150	55-72	29.1	*55*
Palm biodiesel	231	54-63	71.4	*55*

3. Some yield data don't fit with public statistics

It is very difficult to interpret and verify the work behind the GLOBIOM report since only partial figures are available and, for many findings, only delivered under the form of graphs.
Nevertheless, from what is available in the report, some key figures raise questions and especially yield figures whose impact on final findings could be significant.

- The **palm oil yield** is reported at 2.6 T/ha, when widely published and accessible average yields figures in the range of 4 T/ha. (P 63);
- Another question surfaces from the difference of price variation between palm oil and palm fruit which are respectively: +3.1% and +4.2%. Considering the oil ratio in the fruit, such a difference suggests that an excessive high value is given for the co-products (palm kernel oil and meal).
- Regarding **rapeseed**, the oil ratio in the seed seems to be excessive. From the figures reported page 65 of the study, 1.9 million tonnes of additional oil would be processed from 6.2 million tonnes of seeds leading to a ratio of 54% when the actual ratio is 40% to 44%.

4. Surprising price variations on the European oilseed markets: GLOBIOM seems to consider the European oilseed market as isolated from the world market

Results for biodiesel from rapeseed and sunflower indicate that the model isolates the European market from the world market. Indeed, for the same oil, the price variations that are reported show huge differences between the European market and the world market.

- **Rapeseed**
  Seed: price variation of + 25% in the EU against only + 5.3% on the world market
  Oil: price variation + 28% in the EU against + 7% on the world market
- **Sunflower**
  Seed: price variation of + 8.1% in the EU against 5.2% on the world market
  Oil: price variation of + 16.7% in the EU and + 8.3 on the world market

Such differences of price developments are totally unlikely to happen: the European oilseed markets are indeed connected to the world price, the import duties being non-existent for the seed and the meal and very low for the oil (-6%).

- **European market - sunflower and rapeseed oils: the difference in price variation is difficult to understand**

On the European oilseed market, the difference in the price variations observed in GLOBIOM between sunflower and rapeseed is not explained.
The initial demand shock is the same, +3.5 million tonnes of oil, and the production increases are similar, although differently distributed:

- *Rapeseed: +6.2 million tonnes of additional production divided between 3MT in the EU (15% of EU production) and 3MT elsewhere in the world (10% of world production);*
- *Sunflower: +6.1 million tonnes of additional production including 1.7 million tonnes in the EU (the shock accounting for 20% of European production and 15% of world production).*

Regarding price variations, world price effects are almost identical (around 5%). However, on the **European market, contrary to what might be expected, the price variations are very different for the 2 products**:

- *Rapeseed: the oil price increases by 25% for a shock that represents 15% of the production*
- *Sunflower: the oil price oil increases by 8% for a shock of 20% of the production.*

Such a difference is difficult to understand and is not explained by the report.

- **World prices – the price variations between oils are too different for an identical demand shock**

The demand shock is identical for all biodiesel: 3.5 million tonnes of oil.
Product-specific simulations result on the following price variations on the word market:

Palm: 2.1%
Soybean: 10.8%
Rapeseed: 7%
Sunflower: 8.3%

There again, the differences in variation seem difficult to understand, especially when looking at the low impact on the price of palm oil (2.1%) compared to other oils whose variations are between 7% and 11%.
It is reported that the model has improved its representation of substitution patterns between oils. However, the report does not give enough precise indications to answer this question.

5. The paradoxical effect of protein co-product increases ILUC figures in the GLOBIOM study, when it reduced them in the other models

In most models, the co-production of protein meal reduces the ILUC. This intuitive result comes from 2 phenomena:

- Protein co-products from biofuel feedstock partly replace other feedstocks in animal feed – grain or other protein-meals.
- Moreover, the shock of a new demand for biofuel generates a general price increase of agricultural products, except for the protein meal whose co-production leads to a price decline. Globally the **overall price increase results in a decrease of the end human consumption**. In the IFPRI model, in the case of soybean biodiesel, the human consumption decline was in the order of - 0.15%.

The **GLOBIOM model finds the reverse phenomenon:**

- For soybean biodiesel as well as for rapeseed and sunflower, the demand shock results in an increase of the consumption of meat and milk. Indeed, for soybean biodiesel, the consumption of animal products increases by 0.15%, while for rapeseed and sunflower biodiesel, there is an increase in the consumption of animal product as well as an increase of consumption of cereals by 1 million tonnes.

These findings suggest that the model leads to extreme and unrealistic price decreases for protein meal; however, the report gives no indication on this point.

6. Yield/price elasticities must be very low

The yields/price elasticity is fundamental for the ILUC: it determines the allocation between additional land and yield increases in order to supply the additional production needed to supply an additional demand of biofuel.

Clearly, the yield/price elasticity in the GLOBIOM model is low and leads the model to favour an increase of surfaces rather than yields.
When the figures available in the report allow the reader to calculate it, one can only see that a large (and excessive) majority of the effort (more than 80%) is taken by surface increases:

- Soybean: +82% surface, +18% yields;
- Rapeseed: +80% surface, +20% performance;
- Wheat: +83% surface, +17% yield.

This is in contradiction with the reference scenario of GLOBIOM (cf. pages 21 and 22 of the report), where the evolution of the production (+70% between 2000 and 2030) causes only an 11.1% land use increase. This means that 84.3% of the additional production was provided through productivity improvement and 15.7% through additional land – exactly the opposite of what the model simulates when it comes to biofuels.

7. The sensitivity analysis is unclear

Overall, the sensitivity analysis is not very explicit, but the case of the sensitivity analysis of the yield/price elasticity is particularly opaque. This is regrettable because this elasticity is fundamental for the evaluation of the land use change.

It may be noted that the value of the yield/price elasticity is not indicated, and that the range of sensitivity is not indicated in % as it is the case for the other parameters, but only in absolute terms: -0.05 to +0.2. This is quite unusual and certainly not the way sensitivity analysis are conducted and reported.
The range of the analysis (–0.05 to +0.2) is surprisingly unbalanced. The fact that sensitivity test is unbalanced to the upper limit seems to indicate that the elasticity is particularly low.

8. The concept of "foregone carbon sequestration" – a GLOBIOM singularity which increases the ILUC in a questionable manner

GLOBIOM innovates by including in the simulation a source which was not taken into account in previous simulations: "forgone carbon sequestration".

> *"A **modest** (for most feedstocks) but **interesting emission source** is foregone sequestration, which is the effect that, without demand for biofuels, cropland area might decrease and partly revert into grassland or forest".*
> *(GLOBIOM report, page XIII Executive Summary)*

The concept is based on the existence of a global trend of abandonment of land that can be observed in the European Union. It seems that Europe is an exception in this matter: in the model database, it is the only region which has a trend of land abandonment.

> *"**Natural vegetation reversion (foregone sequestration)**: avoided emission savings due to reduced afforestation or reduced return of cropland to other natural land due to increased use of cropland. This effect takes place in particular in Europe where a trend exists of cropland abandonment.*
> *On the abandoned land, there would be a resumption of the wild vegetation, and gradually the establishment of the forest."*
> *(GLOBIOM report, page IV Executive Summary)*

While in general, the abandonment of land is considered as a negative phenomenon arising from rural desertification, the authors of the GLOBIOM study only describe it as an "interesting" carbon emission source, recognising that it may be debated.

> *"We acknowledge that this topic can be debated, as the extent to which the effect occurs in reality is not well documented".*
> *(GLOBIOM report, page XIII Executive Summary)*

Nevertheless, the final results incorporate this effect which evaluation is everything but "*modest"*:

- Rapeseed: 15g CO2/MJ (23% of the total ILUC);

- Sunflower: 7g CO2/MJ (10% of the total ILUC);
- Wheat: 13g CO2/MJ;
- Corn: 5g CO2/MJ.

On the other hand, it is regrettable that GLOBIOM does not take into account the urbanisation of farmland. Urbanisation is a major phenomenon of land use change and loss of carbon. It would be of great interest to simulate the positive effect of biofuels on the slowdown of this phenomenon.

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