Agribusiness' headlong flight to agrofuels and their impact on food security

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Agrofuels constitute the subset of liquid biofuels of the first generation, extracted from agricultural feedstocks, beside those awaited of the second generation extracted from renewable ligneous-cellulosic products (agricultural wastes, wood)[1] or algae or micro-algae, often called of the third generation. Although biogas from composting agricultural wastes (beside other organic matters) is also an agrofuel we will not discuss it as its usefulness is not disputed. We will not discuss either feedstuffs to draft animals still used extensively in the traditional sector of developing countries (DCs).

Agrofuels encompass three products: bioethanol[2], biodiesel and pure vegetable oil, of which we will hardly discuss as it is limited practically to Germany. Global biofuels production has surged exponentially since 2000 and reached 85 billion liters (Bnl) in 2008[3].

Table 1 – Agrofuels production in 2007 and 2008

	2007			2008		
Billion liters	Ethanol	Biodiesel	Total	Ethanol	Biodiesel	Total
United States	24.6	1.7	26.2	34.8	2	36
Brazil	19	0.2	19.2	27.2	1.2	28.4
EU-27	1.8	6.1	7.9	2.8	8	10.8
of which France	0.539		0.5	1.2	1.6	2.8
China	0.950	0.1	1.1	1.9	0.1	2
Canada	1	0.1	1.1	0.9	0.1	1
India	0.187	0.045	0.25	0.25	0.020	0.27
Indonesia	0	0.409	0.4			0.4
Malaysia	0	0.330	0.33			0.33
Others	1	1.186		1.2		1.2
World	49.6	10.2	59.2	72.9	12	85

Sources: FAO, The state of food and agriculture, 2008, http://www.fao.org/sof/sofa/index_en.html; http://www.ethanolrfa.org/industry/statistics/#E; and more recent sources: http://www.ethanolproducer.com/issue.jsp?issue_id=77; http://www.chinadaily.com.cn/bizchina/2008-07/09/content_6831296.htm; http://ethanolproducer.com/article.jsp?article_id=5644

However it accounted in 2007 for only 1.5% of global consumption of transportation fuels, 1% of liquid fuels for all uses or 0.4% of global energy consumption, against 10-13% for

[1] Biomass is composed of lignin (15-20 %), cellulose (35-50 %) and hemi-cellulose (20-30 %) more or less intimately linked. Two technological ways may convert them in biofuels: the biochemical (hydrolysis and fermentation) and thermochemical (thermolysis and synthesis).

[2] We will use simply the word ethanol as most specialists are doing.

[3] For comparison reasons we have converted all data in liters (l) when given in gallons or tons (t) or t of oil equivalent (toe). Main conversion factors: 1 gallon = 3.785 l; 1 t ethanol = 1262 l = 0.64 toe = 7.94 oil barrels or 1000 l of ethanol = 792 kg; 1 t biodiesel = 1140 l = 0.86 toe or 1000 l of biodiesel = 880 kg; 1 barrel of oil = 159 l = 42 gallons; 1 t of oil = 7.6 barrels; 1 bushel of corn = 25.4 kg; 1 bushel of wheat or soybean = 27.2 kg; 1 pound = 0.45359 kg; 1 acre = 0,4047 ha.

solid biofuels (mainly wood and charcoal)[4]. Yet in 2008 the 34.8 Bnl of ethanol produced in the US covered already 6.7% of total US gasoline consumption[5].

About fifty countries have medium term objectives of incorporating biofuels in transportation fuels in order to reduce their dependency from fossil fuels and their impact on greenhouse gas (GHG). Transport consumes 30% of global oil energy and accounts for 21% of global GHG emissions (26% in France). France's biofuels objective is 7% for 2010 and 10% for 2015, faster than the EU 10% for 2020, which has enlarged recently these 10% to other renewable energies (electric vehicles), on the condition that biofuels would reduce GHG by at least 50% in relation to those emitted by fossil fuels.

Agrofuels are on the hot seat in relation to food security on many grounds. First because of their imputed responsibility in the food prices explosion which has increased the number of chronically undernourished people by 115 million in 2007 and 2008, and by the risk that such a plight might carry on. Indeed 100 million tons (Mt) of grain were turned into biofuels in 2007, enough to feed 450 million people for a year, that is 47% of the 963 chronically under nourished population by end 2008. Then because their energy, economic, social and ecological record is questioned, even if it varies a lot according to feedstocks and countries. And that record conditions also the food security in the long run, the ability to feed the 9.3 billion of human beings awaited in 2050.

I – The agrofuels responsibility in the agricultural and food prices explosion since 2006

All international institutions and many governments, including from the North, have underlined the major role played by the agrofuels dramatic expansion in the agricultural prices explosion from the Autumn 2006 to the Spring 2008[6]. Thus, for OECD and FAO, "*Available data suggest that somewhat more than half of the increase in the quantity of demand for grains and vegetable oils between 2005 and 2007 was due to biofuels*"[7]. And OECD adds: "*The cure is worse than the disease*". For the World Bank the biofuels expansion would explain 65% of the prices hike[8]. For the IMF it is responsible for 70% of the rise in the corn price and for 40% of the increased soybean price[9]. If Jean Ziegler, Special Rapporteur of the United Nations on the right to food, has qualified the agrofuels production "*a crime against humanity*", his successor from 2008, Olivier de Schutter, has judged investments on biofuels to be irresponsible and has called for their freeze[10] in order to assess their ecological and social impact, particularly on the right to food.

It is therefore necessary to specify the role they have been playing within all the mechanisms having contributed to the hikes in agricultural prices, distinguishing the two large leading producers, the US for ethanol and the EU for biodiesel (see also tables 8-9 pages 11-12).

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[4] Robert W. Howarth et al., *Rapid Assessment on Biofuels and the Environment: Overview and Key Findings*, Scientific Committee on Problems of the Environment (SCOPE) of the International Council for Science (ICSU), http://cip.cornell.edu/biofuels/

[5] *Implications for US Corn Availability under a Higher Blending Rate for Ethanol: How Much Corn Will Be Needed?* http://www.bloomberg.com/apps/news?pid=newsarchive&sid=abLddZtUVXj8

[6] J. Berthelot, *Les causes de l'essor et de l'éclatement de la bulle des prix agricoles*, Revue OCL (Oléagineux, Corps gras, Lipides), Vol. 15, n° 6, Novembre-Décembre 2008, pp. 351-363.

[7] *OECD-FAO agricultural outlook 2008-2017*: www.fao.org/es/ESC/common/ecg/550/en/AgOut2017E.pdf

[8] http://www.fao.org/fileadmin/user_upload/foodclimate/HLCdocs/HLC08-inf-1-E.pdf

[9] http://www.imf.org/external/np/speeches/2008/050808.htm

[10] http://news.bbc.co.uk/1/low/world/7381392.stm

Brazil has no direct responsibility in the cereals and oilseeds prices explosion as ethanol is extracted from sugar cane and as its biodiesel production from soybean was still low in 2007. It has nevertheless an indirect responsibility on food security in the long run – we will go back over it in the second and third sections – because President Lula's global crusade to promote them and conclude rapidly the Doha Round at the WTO stems from the large benefits that Brazil has drawn from the agricultural prices explosion, which has inflated its agricultural trade surplus, by far the largest in the world ($35.2 Bn in 2007). Agricultural incomes have also risen by 13.4% in 2007 and again by 15.9% in 2008. Which, however did not prevent Brazil to face the highest deficit of its balance of payments in 2008[11], at $28.2 Bn, this level having only been exceeded twice, in 1997 an 1998, but the surplus had already collapsed from $13.6 Bn in 2006 to 1.6 Bn in 2007[12].

As for China and India, their agrofuels production has collapsed from 2006 to 2008: that of ethanol from 3.8 Bnl to 950 Ml in China[13] – after the interdiction in 2007 to use corn as feedstock following the pork price spike in 2006 – and from 1.8 Bnl to 250 Ml in India, from cane molasses, hence without impact on cereals price. And their biodiesel production is insignificant, mostly because the resort to jatropha has proved to be a blunder everywhere in the world[14] and the other DCs should better learn from that failure[15].

Above all these two countries have remained net exporters of food products[16] from 2005-06 to 2007-08 – contrary to the US and EU – and of cereals as well, whereas the EU has been a net importer of 10 Mt in 2007-08. They are held responsible for the collapse of their huge cereals stocks from 2000, forgetting that these stocks were for their domestic food security and that they remained net exporters of cereals along that period. Furthermore their stocks have increased significantly from 2005-06 to 2007-08, whilst the drop in the EU and US cereals stocks have accounted for 94% of the drop in global stocks. Now there is a reverse general correlation between the levels of commodities stocks and prices, including for agricultural ones.

The major role of the US corn ethanol expansion

Unquestionably it is the upsurge of US corn production converted to ethanol which has played the engine role in the explosion of 'grains'[17] global prices. The more so as the US is 'price maker' of the global prices of grains, on the one hand because it accounts for about two thirds of global corn exports, one third of global wheat exports and 40% of global soybeans exports (plus 15% of global soy meals and 8% of global soy oil), and, on the other hand, because these prices are quoted in the Boards of trade of Chicago, Kansas City and Minneapolis. Furthermore, as corn and soybean are mainly used as feed, the explosion of their prices has

[11] Renaud Lambert, *Le Brésil, ce géant entravé*, Le Monde Diplomatique, juin 2009.

[12] http://www.bcb.gov.br/?SERIETEMP

[13] The rise displayed for 2008 (1.9 Bnl) by F.O. Licht data and taken back by FAO is questionable because they displayed already a production level in 2007 twice those of the Indian government. The same could be said for India. Conversely the data displayed for the US, EU and Brazil in 2008 are lower than national data.

[14] *The Blunder Crop: a Biofuels Digest special report on jatropha biofuels development*, 24 Mars 2009 (http://www.biofuelsdigest.com/blog2/2009/03/24/the-blunder-crop-a-biofuels-digest-special-report-on-jatropha-biofuels-development/)

[15] http://farmlandgrab.blogspot.com/2009/05/any-lessons-for-ghana-in-indias.html

[16] It is necessary to differentiate food trade – which includes fish and exclude non food agricultural products – from agricultural trade, what most official data and media are mixing up generally. Now the surplus in fish (and shellfish) explains largely the positive food trade balance of China and to a lesser extent of India and explains about two-thirds of the food trade deficit of the EU and US (up to 2006 only for this country).

[17] 'Grain' is an extensive concept in the US, encompassing cereals, rice, oilseeds, pulses and even cotton.

strongly influenced the price hikes of animal products (meats, dairy produce, eggs, aquiculture fishes).

Thus the 52% surge in the US corn price at the farm gate from 2005-06[18] to 2006-07 is linked to the 34% fall of the US corn ending stock, but the continued price rise by 38% from 2006-07 to 2007-08 can neither be explained by the level of US corn stock which has increased by 25% nor by that of global corn stocks which have risen by 19%. The data for the marketing year 2008-09 show that the FOB price drops by 20% as the result of lower exports and higher global stocks whilst the farm price drops by only 3.6% despite a slight drop in the US corn stock.

The only explanation lies in the combined influence of the Congress mandate to incorporate an increasing share of corn ethanol in the transport fuel up to 2015 – after what its level will reach a ceiling, the following rise in ethanol production relying on second generation biofuels (table 4) – and of the strong signal thus given to index funds to take long positions in futures contracts on corn as long as the oil price and the level of subsidies and import protection will guarantee the profitability of ethanol.

Indeed the percentage of corn production devoted to ethanol has exploded since 2005-06 as shown in table 2 but would be capped at 34.5% from 2015-16. And corn accounts for 95% of feedstocks used for ethanol in the US.

Table 2 – Volume and percentage of the US corn production converted in ethanol

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
Million tons	17.9	25.3	29.7	33.6	40.7	53.8	76.9	95.3
% of production	7.4%	11.1%	11.6%	11.2%	14.4%	20.1%	23.2%	31.0

Sources: USDA, WASDE, http://www.ers.usda.gov/Data/Feedgrains/StandardReports/YBtable4.htm

Table 3 – Estimates of US corn production converted in ethanol up to 2022/23

	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2022/23
Million tons	104.1	109.2	112.4	115.6	118.1	120.7	122.6	124.5	
% production	33.9%	33.1%	33.2%	33.7%	34.0%	34.3%	34.5%	34.4%	

Sources: http://www.usda.gov/oce/commodity/wasde/; U.S. corn long-term projections, http://www.ers.usda.gov/Briefing/Corn/2009baseline.htm#US

Table 4 – US Renewable fuel standard for agrofuels and other biofuels

	2008	2009	2010	2012	2015	2016	2018	2020	2022
In billion US gallons									
Renewable fuel	9.0	11.1	12.95	15.2	20.5	22.25	26.0	30.0	36.0
Of whi. corn ethanol	9.0	10.5	12.0	13.2	15.0	15.0	15.0	15.0	15.0
" biodiesel		0.5	0.65	1.0	1.0	1.0	1.0	1.0	1.0
" cellulosic			0.1	0.5	3.0	4.25	7.0	10.5	16.0
" advanced biofuel*		0.1	0.2	0.5	1.5	2.0	3.0	3.5	4.0
In billion liters (1 gallon = 3.875 l)									
Renewable fuel	34.07	42.01	49.02	57.53	77.59	84.22	98.41	113.55	136.26
Of whi. corn ethanol	34.07	39.74	45.42	49.96	56.78	56.78	56.78	56.78	56.78
" biodiesel		1.89	2.46	3.78	3.78	3.78	3.78	3.78	3.78
" cellulosic			0.38	1.89	11.36	16.09	26.50	39.74	60.56
" advanced biofuel*		0.38	0.76	1.89	5.68	7.57	11.36	13.25	15.14

Source: Energy Independence and Security Act of 2007
frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=110_cong_bills&docid=f:h6enr.txt.pdf
* If other advanced biofuels are not available ethanol biofuel mandate would be increased by as much.

[18] The US marketing year for corn goes from September 1st to August 31.

A study commissioned by the Grocery Manufacturers Association confirms this analysis: "*The existing mandates have already had a dramatic impact upon numerous markets – corn prices remain 60% above historic norms, dramatic acreage shifts have occurred in recent years, livestock producers are incurring the largest losses in at least 25 years, and food inflation during 2008 rose to highest level since 1982*"[19].

It is the Congress' mandate – 136.26 Bnl of biofuels in 2022, of which 56.78 Bnl of corn ethanol and 3.78 Bnl of biodiesel – and the resulting investments which explain the continued increase in ethanol production in 2008-09 despite the collapse of the oil price and the borderline profitability of ethanol since the Summer 2008. As a result the corn price has decreased much less than that of wheat and has remained at 177 dollars per ton ($/t) in May 2009, a level higher by 8.8% to the average price of 2007 and by 80% to the average price of 2005. Whilst in May 2009 the price of HRW wheat was 1.1% lower than its average level of 2007 and higher by 65% to its average level of 2005 and the May 2009 price of SWR wheat was 25.6% lower than its average level of 2007 and higher by 24.3% only to that of 2005.

The speculation by index funds has considerably amplified the spike in the prices of corn and other grains and of non agricultural commodities, among which oil, from the second semester 2007 to the end of the first semester 2008. In the same way the withdrawal of those funds explains the burst of the prices bubble from the spring-early summer 2008. But it is the Congress mandate and the recent pressures by the ethanol business to raise its rate of incorporation in petroleum from 10% to 15% which explain the persistence of a high corn price. Indeed an ethanol lobby called Growth Energy says a switch to 15% ethanol would create 136,000 new jobs and inject $24 billion into the economy each year[20]. Incidentally this will first save many plants from bankruptcy! On the other hand the quoted Grocery Manufacturers Association's study concludes: "*If the blending standards are expanded, leading to significant increases in ethanol production, corn acreage will need expand to… as much as 110 million under the 15% allowable blend percentage… To attract this level of corn acreage, the largest in over 60 years, will require the price of corn to rise significantly, potentially well above the record level of $7.50 recorded during the summer of 2008… Ultimately this will translate into higher livestock and dairy prices, and eventually further upward pressure on consumer food prices*".

The decisive impact of Congress mandate on corn price is all the more obvious that the anticipated 11% rise of the corn global ending stock in 2008-09 and the anticipated 23% drop of corn exports should have lowered markedly the corn price. As FAPRI summarizes it well, "*When energy prices are high such that the RFS is exceeded, then corn ethanol expands to higher energy prices; when energy prices are low then corn ethanol production responds to corn ethanol mandates. The combination of these two supports effectively provides a price floor for ethanol and for corn*"[21].

How the corn price hike has spread to all grains and other agricultural products

The large increase in US corn price from 2005-06 to 2006-07 has prompted the farmers to sow more corn in 2006 to the detriment of soybean (whose production has dropped by 19% in 2007) and wheat so that their prices have risen more than that of corn in 2007-08, with the

[19] http://www.bloomberg.com/apps/news?pid=newsarchive&sid=abLddZtUVXj8

[20] http://www.growthenergy.org/2009/index.asp

[21] Dermot J. Hayes et al., *Biofuels: Potential Production Capacity, Effects on Grain and Livestock Sectors, and Implications for Food Prices and Consumers*, Center for Agricultural and Rural Development, Iowa State University, FAPRI, March 2009 (http://www.card.iastate.edu/publications/synopsis.aspx?id=1098).

result that more soybean and wheat were sown in 2007 and corn production has dropped by 7.2% in 2008. As for the US wheat price rise in 2007-08, although the acreage and production have increased, the main reason lies in the fall of US and EU ending stocks from 2006-07 to 2007-08. More generally the world prices of cereals, oilseeds and pulses fluctuate jointly given their substituability, particularly for animal feed, which Hervé Guyomard from INRA acknowledges[22]. Moreover the FAO-OECD prices prospects for 2008-2017 foresees increases of 40 to 60% for corn and wheat and of 80% for vegetable oils in relation to the average for 1998-2007, in the event that the biofuels mandates are not changed.

The role of the EU biodiesel expansion

The US soybean biodiesel has not shown the same early dynamism than corn ethanol, even if it has jumped from 0.9 Bnl in 2006 to 1.9 Bnl in 2007 and 2.6 Bnl in 2008, because this late expansion was more linked to exports to the EU than to domestic consumption which has dropped from 2007 to 2008. There is presently a large overcapacity and lack of profitability due the high level of soy oil price and the close of the EU market (see below).

On the other hand the EU biodiesel production, essentially from rape oil, has represented 60% of global production in 2007 and 68% in 2008, but it has also presently a high overcapacity for lack of profitability and because of the on-going cut in subsidies in Germany, the largest EU producer, since 2006: the production capacity has risen from 11.7 Bnl in July 2007 to 18.2 Bnl in July 2008, for an actual production of 6.5 Bnl in 2007 and 8 Bnl in 2008[23]. As 64% of the EU rape oil has been used for biodiesel in 2006, this has implied increased oilseeds imports, particularly vegetable oils for human consumption. Since 2007 imports of biodiesel from the US, hugely subsidized, have flooded the EU, with 792 Bnl in 2007 and 1,180 Bnl in 2008.

For FAO as for Keith Collins, the former Chief economist at USDA, 52% of the increase in the global use of soy oil from 2005-06 to 2007-08, which has increased more than production, are attributable to biodiesel[24].

The joint FAO-OECD prospects for 2008-17 estimate that, largely due to agrofuels, "*When the average for 2008 to 2017 is compared with that over 1998 to 2007, beef and pork prices may be some 20% higher; raw and white sugar around 30%; wheat, maize and skim milk powder 40 to 60%; butter and oilseeds more than 60% and vegetable oils over 80%*"[25].

[22] http://www.latribune.fr/info/Les-biocarburants-alimentent-ils-la-flambee-des-prix-agricoles---~-20080403U7DBR5L-$Channel=Journal-$SubChannel=La%20Tribune%20Forum

[23] http://www.ebb-eu.org/stats.php#

[24] Jean-Marc Salmon, *Agrocarburants et environnement*, Ministère de l'écologie, de l'énergie, du développement durable et de l'aménagement du territoire, décembre 2008.

[25] http://www.fao.org/es/esc/en/2/3/highlight_550.html

II – The energy, economic and social records of agrofuels

It is not easy to present an objective assessment of the energy, economic and social impacts of agrofuels, given the technical and contradictory conclusions of the existing reports. Thus the report made in 2008 by Mines ParisTech, after assessing 7 studies published in Europe, US and Brazil, concludes: "*The majority of the studies analyzed in this report are only trying to measure the impact on energy independence and greenhouse gas… The results of these works are scattered and lead to contradictory conclusions on the environmental significance of these channels*"[26].

Assessing the impacts of agrofuels for transportation implies a life-cycle or ecobalance approach, from agricultural inputs to the pump, comparing these impacts with those of fossil fuels 'from well to wheel'. To simplify, we will group together the economic and social impacts on the one hand, which weighs more directly on food security and the ecological impacts on the other hand, whose effect on food security is more indirect and in the long run. As energy impacts are closely linked to economic and ecological impacts – greenhouse gas emissions (GHG) are linked to energy consumption –, we will deal with them in the two sections.

Beside the already analyzed impact of agrofuels on agricultural prices, the production of agrofuels questions first the issue of their profitability, with their correlative trade effects, and the issue of their social impact with the risk of increased marginalization of small farmers.

Energy balance of agrofuels

The question is: does it take more fossil fuel energy to produce one liter of ethanol or biodiesel than the energy contained in the ethanol or biodiesel? Gasoline itself has a net energy balance of 0.8. Three methods can be used to assess the energy balance of agrofuels: energy value, weight value and avoided energy consumption.

Thus the energy value of rape oil biodiesel, close to that of diesel, is 1.35 toe/ha and the (food) energy value of the coproduced rape meal is 0.9 toe/ha[27]. The energy consumption of 0.75 toe (cultivation and processing) is attributed to biodiesel for 60% of energy required for cultivation and processing against 40% for meals, and for 100% for energy used in esterification. Therefore 0.53 toe/ha are attributed to biodiesel and 0.22 toe/ha to meals. The energy balance is thus of 2.5: 2.5 toe of agrofuel for 1 toe used (1.35/0.53). This balance is to be compared to that of diesel which is of 0.92: the energy efficiency of substituting biodiesel to diesel is of 2.8.

The weight value method, adopted by ADEME, allocates energy consumption according to relative weights of meals (2 t/ha) and vegetable oil (1.35 t/ha), even though the energy value of lipids (vegetable oil) is twice that of protids and glucids (meal). Thus 0.42 toe/ha of energy consumption is allocated to biodiesel, hence an energy balance of 3 (3 toe produced for 1 toe consumed). The systemic approach of CONCAWE (association of EU

[26] Anthony Benoist et al., *Analyse critique des études existantes sur la production et l'utilisation des carburants végétaux. Critique des analyses de cycle de vie et bilans énergétiques, et recommandations d'approfondissement,* Ecole Nationale Supérieure des Mines de Paris pour l'Association des Régions de France, 2008, http://www.arf.asso.fr/index.php/documents/developpement_durable/rapport_final_de_l_etude_sur_les_agrocarburants.

[27] Christian Couturier, *Biocarburants, Enjeux et polémiques*, Solagro, CLER-Infos N° 62, Janvier-février 2008, http://www.solagro.org/site/325.html

oil producers and automakers) calculates the avoided energy consumption: 1 t of rape meals is substituted to 0/6 t of soy meals, which translates in a balance of 2.3 toe produced for 1 toe consumed.

For the US corn ethanol, "*Depending on the ethanol study you read, net energy returns vary from 0.7 to 1.5 units of ethanol per unit of fossil fuel energy consumed*"[28]. But it seems that "*Most studies have concluded that the net energy balance of corn ethanol is approximately 1.3, sugar cane ethanol is 8*"[29], taking naturally into account the energy of co-products, particularly the DDGS (distillers' dry grains and solubles) feed for corn ethanol. However a study of January 2009 estimates that, due to technical improvements in ethanol plants since 2005, their net energy ratio ranges from 1.50 to 1.79[30].

According to the Climate Action Network (RAD in French), "*The energy efficiency (EE) of the French bioethanol is only of about 1.4 for wheat ethanol and 1.3 for sugarbeet ethanol, against 8 for the Brazilian sugarcane ethanol*"[31], partly because bagasse is used as an energy source to make it. Patrick Sadones adds: "*Even taking into account maritime transportation to Rotterdam, the sugarcane ethanol presents an EE of 5.82*"[32].

Mines ParisTech recommends this method of avoided impacts but underlines that "*The analyzed studies dealing with the same feedstock present results differing by a factor 5… The main source of gaps is methodological, particularly that linked to the method of allocating impacts between the agrofuel and the co-products*". It adds that the impact of the quality of agricultural data on the end result might be of 30% for ethanol and, for biodiesel, of 40% for its energy consumption and of 100% for its GHG emissions. For the dependency on fossil fuels, the most negative effect considered by the 7 studies could be increased by 45% for the sugarbeet ethanol and by 40% for whet ethanol whilst the most positive effect considered could be reduced by respectively 80% and 75%. All the same the most negative effect considered for rape oil biodiesel could be increased by 65%.

A University of Wisconsin's research of January 2009 underscores above all the large variability of biofuels yield per hectare (ha): "*Biofuel yield estimates are collected from numerous disparate sources, often with little control for the geographic location, climate, soil type or agricultural management regime of the crop in question*". Which is at stake is not so much the conversion coefficient of the agricultural feedstock in ethanol or of the vegetable oil in biodiesel – as the industrial processes do not differ that much from one country to another for the same feedstock – but the yields per hectare, highly variable from one country to the other and within each country. This research, which has analyzed thousands of surveys in 150 countries, concludes: "*For most crops, previous reports have overestimated yields by 100% or more. Barley, cassava, castor, maize, rapeseed, and sunflower all show that previous global biofuel yields were overestimated by at least 100%, with wheat–ethanol and groundnut–*

[28] http://en.wikipedia.org/wiki/Ethanol_fuel_energy_balance
[29] http://www.syntecbiofuel.com/biofuels_net_energy_debate.html
[30] http://bioenergy.checkbiotech.org/news/improvements_life_cycle_energy_efficiency_and_greenhouse_gas_emissions_corn_ethanol
[31] http://www.rac-f.org/article.php3?id_article=1211
[32] Patrick Sadones, *Agrocarburants : Limites des bilans énergétiques et écologiques de la production industrielle*, Les Cahiers de la coopération internationale, n°5, 12, 2006, www.cncd.be/IMG/pdf/cahiers_05.pdf.

biodiesel estimates having been overestimated by 150% or more"[33]. The overestimation risks concern less the agrofuels of the main present producers – US, EU and Brazil – than those of developing countries (DCs) and of the new public and private investments which rely on the yields obtained in the first and largely disseminated in literature.

Table 5 – Conversion factors of 1 ton and 1 ha of feedstock in agrofuel

	Liters of biodiesel per ton of vegetable oil					Liters of ethanol per ton of feedstock						
	Rape	Soy	Palm	Sunflower	Cotton	Corn	Wheat	Cane	Beat	Cassava	Barley	Rice
	392	183	223	418	103	410	389	81	103	180	243	430
	Liters of biodiesel per ha of oilseeds					Liters of ethanol per ha of feedstock						
World average	500	420	3600	500	180	1500	900	5400	4000	1700	510	1500
United-States	600	435		620	175	3550	910	6300	4800		700	2900
Germany	1320			920		3500	2750		5850		1350	
France	1210	465		970		3500	2750		7350		1500	
Brazil		480	1200		265	1400		5850		2020		1300
Malaysia			4400			950		6000		1700		1350
China	550	320	3100		310	1850	1580	5400		2850	730	2650
India	365	180			70	750	1000	5400		5750	400	1200
Indonesia		220	3850			1220		5500		2300		2000
Burkina Faso					120	800		8100				

Source: Matt Johnston, http://www.iop.org/EJ/article/1748-9326/4/1/014004/erl9_1_014004.html

For example a study made for the WAEMU (UEMOA) Commission in April 2006 estimates the sweet sorghum ethanol at 2,484 l/ha[34], another report made also for UEMOA in October 2008 at 2,100 l/ha in Benin[35], whereas the University of Wisconsin estimates it at 350 l/ha in Benin as in Burkina Faso, Mali, Senegal and Ivory Coast. There is also a significant yield gap for cassava ethanol between the UEMOA report of 2006 which estimates it at 2,196 l/ha in Benin against 1,700 l/ha for the University of Wisconsin in the same preceding countries. We will see further that the gap between the estimated yields for jatropha biodiesel are also highly significant. Oddly enough the UEMOA study of 2006 underestimates the yield for sugarcane ethanol, with 3,500 l/ha, against 4,000 l/ha for Wetlands international[36] and 5,300 l/ha in Burkina Faso, Ivory Coast or Mali for the University of Wisconsin.

For Patrick Sadones, "*If the acreage spared owing to the use of coproducts as feed is taken into account, rape oil presents a net productivity per hectare larger than that of sugarbeet ethanol. Indeed one hectare of rapeseed intended to produce raw oil allows to spare around two thirds of one hectare of soybean, whereas one hectare of sugarbeet for ethanol spares only half an hectare of wheat. Thus the net productivity per hectare of rapeseed reaches 1.95 TOE/ha, whereas one hectare of sugarbeet-ethanol does not exceed 1.46 TOE/ha*". However raw vegetable oil is for the time being only used in Germany on a significant scale.

Table 6 – Compared energy efficiency of agrofuels

Agrofuel	Gross production/ha	Net energy efficiency	Net production in toe/ha
Sugarcane ethanol	4727 kg	5.82	2.72
Wheat ethanol	2550 kg	1.35	0.42*
Sugarbeet ethanol	5780 kg	1.25	0.73*
Pure rape oil	1000 kg	3.80	0.65*
Rape oil biodiesel	1370 kg	2.23	0.67*

Source: www.cncd.be/IMG/pdf/cahiers_05.pdf; * with co-products used in feed.

[33] Matt Johnston, *Resetting global expectations from agricultural biofuels*, University of Wisconsin, January 2009, http://www.iop.org/EJ/article/1748-9326/4/1/014004/erl9_1_014004.html

[34] http://www.uemoa.int/PRBE/PRBE_publication.htm

[35] *Sustainable Bioenergy Development in UEMOA Member Countries*, Hub Rural, UN Foundation, ICTSD, www.globalproblems-globalsolutions-files.org/gpgs_files/pdf/UNF_Bioenergy/UNF_Bioenergy_full_report.pdf

[36] http://afrique.wetlands.org/LIBRARY/tabid/978/mod/3861/articleType/ArticleView/articleId/2162/Les-biocarburants-en-Afrique.aspx

Tereos Group, first French sugar producer and large wheat producer and whose subsidiary Guarani is the third producer of sugar and ethanol in Brazil, is well placed to compare the energy and economic yields of sugarcane, sugarbeet and wheat:

Table 7 – Net energy and gross margin per hectare of ethanol from sugarcane, sugarbeet and wheat

	Sugarcane	Sugarbeet	Wheat
Net energy per ha: MWh/ha	101	38	31
Gross margin per ha: € /1000 l	245	70	105

Source : www.iar-pole.com/presentationbresil/Duval.pdf

The highly differentiated production costs of agrofuels according to countries
Brazil sugarcane ethanol is by far the most competitive as it remains so without subsidies for an oil price of 30-40 $ per barrel, whereas that from US corn become competitive for an oil price of 50-60 $/barrel and that of wheat requires a barrel at 70 $. And the EU biodiesel from rape oil becomes competitive only when the oil barrel is at 135 $. Among the reasons why the production cost of Brazil sugarcane ethanol is so low are the low price of land and manpower, the fact that the sugarcane is harvested 5 times before being replanted and the use of bagasse as energy source for processing, allowing even to sell part of the electricity produced from it.

Developed countries' agrofuels are not profitable without subsidies and import protection
If the production of agrofuels has been launched in the US and EU owing to large subsidies and import protection before the explosion of 2006-08bin the prices of cereals and oilseeds, the more so the persistency of high prices for these feedstocks together with an oil price relatively low linked to the global recession implies that these supports be maintained to ensure a minimum profitability to processors.

Berthelot has calculated that the EU's agrofuels have received €4.5 Bn of subsidies in 2006, of which €1.448 Bn of direct payments to farmers and €3.051 Bn to processors as reductions on excise duties paid by oil fuels[37]. But he questions the methodology used by the International Institute for Sustainable Development (IISD) of Geneva to assess the subsidies to agrofuels in producing countries, particularly in the EU[38]. Indeed not only it does not take into account the subsidies of the Single Payment Scheme (SPS) to farmers under the pretext that they are alleged to be 'decoupled', but also it considers as a subsidy from consumers to farmers the gap between the world prices and the domestic prices of agrofuels. This position is in line with the liberal thought considering the world prices as the 'true prices' although they are dumping prices, and this denies also the right to food sovereignty. And the EU mandate to incorporate 10% of biofuels in transportation fuels in 2020 would imply €13.8 Bn of subsidies, of which €4.2 Bn of direct aids of the SPS to farmers and €9.6 Bn to processors as reductions on excise duties and aids to research. However, as Germany has began in 2006 to lower the reductions on excise tax and planned to eliminate them at the end of 2012, and as France has begun the same process from 2009, the subsidies to processors would be much lower.

However the EU ethanol is protected by a tariff of 0.192 €/l, equivalent to about 40% *ad valorem*, including against ordinary DCs exports which can avail only of the GSP (Generalized System of Preferences) since 2006 (previously they benefitted of a 15%

[37] J. Berthelot, *The EU's main agrofuels subsidies in 2006 and 2020*, Solidarité, 11-10-08, http://solidarite.asso.fr/home/textes2008eng.htm
[38] www.gem.sciences-po.fr/content/research_topics/trade/ebp_pdf/GSI-European_Report_on_support_to_Biofuels-oct07

reduction on this tariff). But the other DCs can export ethanol duty free, which has already prompted several LDCs and ACPs to initiate agrofuels projects for export to the EU. But the import protection on other ordinary DCs will inevitably fall also in case of finalization of the Doha Round and above all if a free-trade agreement is concluded with Mercosur. Moreover the EU trade Commissioner Peter Mandelson has offered to Brazil in December 2008 to import 6% of the EU domestic ethanol consumption duty free if Brazil opens more its domestic market to the EU exports of industrial products and services, and this in ordr to finalize the Doha Round[39]. On the other hand EU tariff on biodiesel, which contrary to ethanol is not considered as an agricultural product, is only of 6.5%. Which can be explained by the fact that the EU has been importing its vegetable oils duty free since the start of the CAP in 1962 as the result of the US pressures during the Dillon Round of GATT. The EU has imported 8.6 Mt of vegetable oil in 2008, of which 4.6 Mt of palm oil, essentially for human consumption and very little directly for biodiesel. It is nevertheless a fact that it is because the major part of EU rape oil has been processed to biodiesel that the EU has been obliged to cover its food needs through larger imports of other vegetable oils. It is clear that the large openness of the EU market for biodiesel can only prompt DCs to invest for export.

Given those subsidies the cost to the French taxpayers of the ton of CO^2 avoided is very high, of about 130 € per ton of CO^2 avoided for biodiesel and of 400 € per ton of CO^2 avoided for wheat ethanol, as against 40 € per ton of CO^2 avoided for the thermal use of biomass.

In the US the maximum price of corn and minimum price of ethanol avoiding a loss for processors are respectively of 98.4 $/t and 0.41 $/l[40], without reducing the supports of 0.135 $/l of tax credit to blenders (reduced at 0.12 $/l since January 2009) and the tariff of 2.5% plus 0.14 $/l. The tax credit to blenders is of 0.26 $/l for biodiesel. Beside these federal supports, additional subsidies are provided in several States. The federal tax credit to blenders alone has cost $3 Bn to taxpayers in 2006 for a domestic consumption of 22 Bnl but would cost on the same bases $19 Bn in 2022 if the Congress mandate of 136 Bnl is reached[41]. Additional subsidies have been adopted by the Energy Independence and Security Act of December 2007 (about $1 Bn), the Farm Bill (Food, Conservation, and Energy Act) of 22 May 2008 (about $1 Bn), all these subsidies being integrated in the National Biofuels Action Plan of October 2008[42] co-managed by USDA and DOE (Department of energy). Since 2007, USDA spends $1.6 Bn per year for research on biofuels, of which $210 M in 2008 on cellulosic ethanol[43]. And DOE will allocate $1 Bn till 2012 to private firms investing in research on biofuels, particularly cellulosic ethanol. The fiscal package (American Recovery and Reinvestment Act) of 17 February 2009 has extended the partial tax reduction to oil companies blending ethanol with petroleum until 2013 instead of 2010 and granted new subsidies for research on second generation biofuels[44], to flex-fuel vehicles and to filling stations to put in pumps for E85 ethanol (85% ethanol and 15% petroleum)[45].

Above all we should not forget the large subsidies to farmers growing corn and soybean. Even if some subsidies disappear when their prices are high (marketing loans and counter-

[39] http://www.portaldoagronegocio.com.br/conteudo.php?id=27251
[40] Antonio M. Bento, *Biofuels: Economic and Public Policy Considerations*, Cornell University, SCOPE, 2008 (http://cip.cornell.edu/biofuels/)
[41] IISD, *Biofuels – At what Cost? Government support for ethanol and biodiesel in selected OCDE countries*, September 2007.
[42] www1.eere.energy.gov/biomass/pdfs/nbap.pdf
[43] http://www.bulletins-electroniques.com/actualites/56352.htm
[44] http://news.tnanytime.org/energy/node/2058
[45] http://www.bulletins-electroniques.com/actualites/56352.htm

cyclical payments), there remain several others: the fixed direct payments for which corn and soybean get close to half of them, i.e. around $2.5 Bn; the subsidies to crop insurance, for which those on farmers' premium alone (without taking into account those to insurance companies) have reached $2.1 Bn for corn in 2008; the subsidies to irrigation (16.5% of corn and 8.7% of soybean were irrigated in 2007), to agricultural loans and agricultural fuel. For the 2002-05 period, before the agricultural prices explosion, total direct and indirect subsidies to corn have reached an annual average of $6.2 Bn and those to soybean $1.8 Bn[46]. But IISD does not take into account the major part of these subsidies to farmers.

And we should not forget the major support represented by Congress' mandate of an increased incorporation of agrofuels in transportation fuel, otherwise oil companies can be fined up to $32,500 a day[47]. Indeed the follow-up of the mandate is very strict: "*Any party that produces gasoline for use in the 48 contiguous states, including refiners, importers, and blenders, is considered an obligated party under the RFS program*"[48] and have "*to meet the Renewable Volume Obligation ("RVO")*". A RIN (Renewable Identification Number) is "*a unique number that represents a volume of renewable fuel*" and which is assigned to each batch of ethanol and follows it along the ethanol chain. Every obligated party can sell or buy RINs and "*Although obligated parties are required by the EPA to have a proof of purchase of a certain percentage of renewable fuels and therefore RINs, they aren't required to possess the fuel. Theoretically, [a company] can be in compliance with the EPA without bringing in any fuel at all, as long as they buy the RINs*"[49]. In other words "*The RIN is the currency for the RFS program*". Indeed to meet their RFS obligation, blenders can buy RINs on the RINs market exchange (www.RINmark.com): RINs have become tradable commodities, with RIN brokers – such as Clean Fuels Clearinghouse, which runs a clearinghouse for RINs, called RINSTAR[50] – but hardly yet pure speculators. Under the current RFS law, cellulosic biofuels get 2.5 RIN credits per gallon (3.785 l), whereas conventional biofuels get just one RIN credit. RIN prices have seen a dramatic increase from when the RFS program originally started on September 1, 2007: they traded initially at $0.25, primarily because industry did not understand the program but they have reached $0.13 in mid January 2009. Besides "*The RIN system may also be the foundation of a carbon cap-and-trade system. RINs could act as the currency for carbon credit trading and compliance, just as they do now for renewable fuels*"[51]. On the RINs market demand is rigid, being determined by the RFS for the year and supply depends on the ethanol production itself related to the ethanol prices, itself related to the prices of oil, corn, DDGS feed, etc. To conclude let us say that this RINs business is rather complex and you can get more information on the EPA (Environmental Protection Agency) website[52], in the Educational Briefing Series of Clean Fuels Clearinghouse[53] and in some other papers[54].

FAPRI has shown that, if all supports to ethanol would be eliminated – blender's tax credit of $0.45/gallon ($0.119/l), ethanol tariff of $0.54/gallon ($0.143/l) and no mandate to use corn

[46] Jacques Berthelot, *The huge lies in the US notification of its agricultural trade-distorting domestic supports from 2002 to 2005*, Solidarité, 3 January 2008.
[47] http://www.renewableenergyworld.com/rea/partner/stoel-rives-6442/news/article/2007/11/rfs-deadline-november-30-50659
[48] http://www.ethanoltoday.com/index.php?option=com_content&task=view&id=5&Itemid=6&fid=7
[49] http://www.ethanolproducer.com/article.jsp?article_id=3657
[50] http://cleanfuelsclearinghouse.com/2009/01/dj-trading-of-rin-credits-increases-as-ethanol-production-slows/
[51] http://www.ethanolproducer.com/article.jsp?article_id=3989&q=&page=all
[52] http://www.epa.gov/oms/renewablefuels/
[53] http://cleanfuelsclearinghouse.com/category/educational-briefing-series/
[54] http://www.jonesday.com/pubs/pubs_detail.aspx?pubID=S4345

ethanol – ethanol production would drop by 20.8 Bnl and would come only from second generation feedstocks, and the corn price would drop by 13% in relation to its anticipated level[55].

For OECD, if the supports granted to agrofuels in 2007 would not change, they would use 12.4% of global production of cereals during the 2013-17 period as against 8.4% in 2007 and 14% of global production of vegetable oils against 8.7% in 2007[56].

The growing agrofuels imports of the EU and US
Both the EU and US are net importers of ethanol, essentially from Brazil. The EU imported almost no biodiesel before 2006 and statistics are missing because it has no specific customs code.

However EU-27 vegetable oil imports keep increasing, from 6.972 Mt in 2005 to 8.637 Mt in 2008, those of palm oil having risen from 4.028 Mt to 4.555 Mt, not only to satisfy domestic food needs to replace rape oil mainly devoted to biodiesel but also to produce allegedly 'green' electricity in hundreds of cogeneration plants with significant EU subsidies[57].

But imports of biodiesel B99 from the US have exploded since 2007, having jumped from 0.1 Mt (79 Ml) in 2006 to 1 Mt (792 Ml) in 2007 and 1.5 Mt (1.190 Bnl) in 2008, representing 46% of national production (table 8)[58]. Because this biodiesel – a small part of which was already imported by the US until October 2008 ("splash and dash" system) – is subsidized at 0.79 $/l, whether sold on the domestic market or exported, as it suffices to add a drop (0.01%) of diesel to B100 biodiesel to get the subsidy. And indeed 80% of the US produced biodiesel has been exported to the EU in 2008. Moreover, once imported in the EU, this US biodiesel enjoys the same subsidies granted to the EU biodiesel, according to the GATT national treatment provision.

Table 8 – EU-27 production, trade and consumption of ethanol and biodiesel

Million liters	2001	2002	2003	2004	2005	2006	2007	2008
Ethanol								
Production	366	490	536	620	921	1593	1771	2800
Imports	126	161	228	286	551	551	985	1254
Exports	107	68	110	76	58	55	60	52
Balance Exports-Imports	19	93	118	210	493	496	925	1202
Consumption						1855	2650	
Biodiesel*								
Production	912	1466	1715	2204	3630	5000	6967	
Imports						79	792	1190
Consumption						5293	6932	

Source : COMEXT, http://nui.epp.eurostat.ec.europa.eu/nui/setupModifyTableLayout.do
* We must add to production and consumption of biodiesel 712 Ml of pure vegetable oil in Germany in 2006, a volume still holding for 2007 and 2008.

[55] FAPRI, *Impact of selected US ethanol policy options*, May 2009, http://www.fapri.missouri.edu/.
[56] OECD, *Economic Assessment of Biofuel Support Policies*, ppt in pdf, 2008, http://www.oecd.org/document/28/0,3343,fr_2649_33717_41013916_1_1_1_1,00.html
[57] "Le Mensonge vert": http://www.dailymotion.com/video/x8xokx_documentaire-le-mensonge-vert-2_news
[58] European Biodiesel Board, *Subsidized and dumped biodiesel from the USA ("B99"). Mechanism and impact for EU industry*, 12-03-09 www.ebb-eu.org/EBBpressreleases/EBB%20PR%20B99%20claims%20recognised%20Backgro...

The result: 15 EU biodiesel plants have gone bankrupt, about forty are close to bankrupt and, although production has increased from 2006 and 2008, the production capacity has increased much more so that plants were working at 40-45% capacity in 2008 against at 80% in 2006. Eventually the EU has decided to apply from the 13 March 2009 for 6 months, with a possible extension to 5 years, countervailing duties of 221.2 €/t to 237 €/t according to exporters plus antidumping duties of 23.6 €/t to 208.2 €/t[59], which should stop imports as this corresponds to about 70% of the biodiesel value[60].

In 2007 the agrofuels consumed in the EU, pure vegetable oil included, have represented 2.6% of fuels for road transportation[61], that is less than half the objective of 5.75% for 2010, and this despite net imports representing 9.3% of production for biodiesel and 52.2% for ethanol.

In the US table 9 shows that biodiesel imports have exploded, accounting for 46.2% of production in 2008 against 17.9% en 2006, as well as exports which were almost equal to production (97.9%) in 2008, and domestic consumption has decreased by 10.6% in 2008 after having been multiplied by 3.9% between 2005 and 2007.

Table 9 – US production, trade and consumption of ethanol and biodiesel

Million liters	2001	2002	2003	2004	2005	2006	2007	2008
Ethanol								
Production	6681	8100	10613	12884	14777	18486	24546	34875
Imports	558	710	879	583	2088	2604	1322	
Exports	182	213	217	216	187	375	665	
Balance Ex-Im	-376	-497	-662	-367	-1901	-2228	-657	
Consumption	6590	7846	10696	13444	15363	20746	25912	
Biodiesel								
Production	32	40	54	106	344	948	1854	2583
Imports	12	30	15	15	33	170	531	1193
Exports	6	9	17	19	33	132	1030	2526
Balance Ex-Im	-6	-21	2	4	0	-38	499	1333
Consumption	39	61	51	102	344	986	1356	1212

Source: http://www.ers.usda.gov/Briefing/bioenergy/biofueldata.htm#eth1;
http://www.afdc.energy.gov/afdc/data/fuels.html

According to FAO, "*In energy equivalence, the 2008 ethanol share of the gasoline transport fuel market in these countries is estimated at 4.5 percent for the USA, 40 percent for Brazil and 2.2 percent for the EU. The biodiesel share of the diesel transport fuel market is estimated at 0.5 percent for the USA, 1.1 percent for Brazil and 3.0 percent for the EU*"[62].

The International Energy Agency estimates that biofuels will cover 2.3% of global demand for road transportation in 2015 and 3.2% in 2030. For D. de la Torre Ugarte, replacing by agrofuels the 21 M barrels of petroleum and 21 M barrels of diesel used daily globally in 2006, or 7 Bnl, would require 30 M barrels of ethanol (4.8 Bnl) and 23 M barrels of biodiesel (3.7 Bnl)[63]. With feedstocks of high yields this would require for ethanol 300 Mha of

[59] http://www.biodieselmagazine.com/article.jsp?article_id=3463
[60] http://www.biodieselmagazine.com/article.jsp?article_id=3482
[61] http://www.energies-renouvelables.org/observ-er/html/barosom.asp#baro
[62] FAO, *Bioenergy, food security and sustainability – towards an international framework*, Rome, 3-5 June 2008, www.fao.org/fileadmin/user_upload/foodclimate/HLCdocs/HLC08-inf-3-F.pdf.
[63] Daniel de la Torre Ugarte, *Developing Bioenergy: Economic and Social Issues*, in Peter Hazell and R. K. Pachauri, IFPRI, Bioenergy and agriculture: promises and challenges for food, agriculture and the environment.

sugarcane or 590 Mha of corn, that is respectively 15 or 5 times the present global acreage. And biodiesel would require 264 Mha of palm oil, 20 times the present acreage. For FAO, if the 600 Mha presently cultivated globally in cereals, sugarcane, sugarbeet and cassava were affected only to ethanol, the 940 Bnl produced would satisfy only 57% of the present global oil consumption[64].

For the European Commission's Joint Research Center, of which it has refused to agree on the conclusions, "*If 2nd generation biofuels do not make a significant contribution by 2020, these figures would rise to 56-64% overall, and 80% of biodiesel… The DG-AGRI projection assumes that EU ethanol industry is protected from cheaper imports from Brazil by tariff barriers. If WTO stops this, the % of imports would rise even further*"[65].

The EU target of 10% ethanol in gasoline for 2020, and in fact of 13% given the lower energy content of ethanol, corresponds to 15.6 Bnl of ethanol which would use 40 Mt of wheat, or 30% of the 2005 production[66]. All the same, using 10% of biodiesel, and in fact 11% given its lower energy content than diesel, would require 18 Mt of biodiesel or 40 Mt of rapeseed, 2.6 times the present production!

For the Congressional Research Service "*If only corn is used, expanding ethanol production to 35 billion gallons would require more corn than the United States currently produces, which would be infeasible. Corn (and other grains) have myriad other uses, and such a shift would have drastic consequences for most agricultural markets, including grains (since corn would compete with other grains for land), livestock (since the cost of animal feed would likely increase), and land (since total harvested acreage would likely increase)*"[67].

Clearly international institutions and DCs are complaining about the EU and US high import protection on agrofuels, particularly ethanol, and say that their objectives of reducing GHG would be much more efficiently reached if they rather imported from DCs sugarcane ethanol and palm oil biodiesel. However that position presupposes that the environmental and social effects of these products are as positive as their energy and economic impacts calculated without incorporating these effects.

The agrofuels status at the WTO

Developed countries would like that the WTO confers the status of 'environmental goods' to agrofuels, which would place their agricultural subsidies in the 'green box' non subject to reduction, at least for ethanol as biodiesel is considered as an industrial product. But this would assume that subsidies limit themselves to make up for the environmental damage avoided by agrofuels, and we should prove it. Besides this contradicts to the WTO case law on the concept of '*similar product*' or '*substantial* e*quivalence*': products are considered according to their end use, not according to their 'production process and method', because there are products which are traded, not the production processes and methods, otherwise this would foster protectionist abuses.

Cité par D.J. Connor and C.G. Hernandez, *Crops for Biofuel: Current Status and Prospects for the Future*, in SCOPE, 2008 (http://cip.cornell.edu/biofuels/)

[64] FAO, *The state of food and agriculture, 2008. Biofuels: prospects, roisks and opportunities,* http://www.fao.org./sof/sofa/index_en.html.

[65] Giovanni de Santi et al., *Biofuels in the European Context: Facts and Uncertainties*, Joint Research Center, European Commission, 2008 http://www.jrc.ec.europa.eu/

[66] www.idfkorea.or.kr/brief/file/Yelto%20Zimmer.pdf

[67] Brent D. Yacobucci and Randy Schnepf, *Selected Issues Related to an Expansion of the Renewable Fuel Standard (RFS)*, CRS, December 3, 2007.

GATT article XX authorizes each country to restrict imports "*necessary to protect… plant life*", (XX.b) and to guarantee "*the conservation of exhaustible natural resources*" (XX.g), on the condition that "*such measures are made effective in conjunction with restrictions on domestic production or consumption*", that there would not be any discrimination according to the exporting country and that trade restriction would be the only means to reach the objective. On the other hand the WTO forbids limiting imports of products when their production is harming the environment in the exporting country or at the global level, regardless of the multilateral Conventions on the environment. Thus the US has been condemned at the WTO in 1997 to have refused imports of Mexican tuna because Mexican fishermen were using fishing methods catching at the same time dolphins, a protected species. And it has also been condemned in 1999 to have refused imports of Indonesian shrimps as their fishing methods caught at the same time tortoises, themselves protected.

As long as WTO rules would not be changed, the EU and US subsidies to agrofuels could thus be prosecuted, at least those to farmers. This is clear for the EU SPS direct payments as they are not decoupled given the WTO case law in the cotton case of March 2005, and as they benefit largely to feedstuffs co-produced with agrofuels, which are input subsidies. One can say the same for subsidies to pure vegetable oil which are also input subsidies at least when it is used by farmers.

The agrofuels are grabbing agricultural lands and excluding small farmers
Agrofuels will not only grab agricultural lands in the EU and US but above all in DCs given the massive imports needed to abide by their mandates, either as agrofuels or as feedstocks to process them, particularly for the EU.

Thus, not only the agrofuels boom bears already the main responsibility in triggering the agricultural and food prices explosion and their persistence at a high level despite the drop in the oil price, but it bears also a huge responsibility in the correlative course to agricultural land grabs in DCs by food deficit Northern and Southern countries to secure in the long run their food and fuel needs.

Already USDA has acknowledged that the surge in the acreage of agricultural feedstocks converted to biofuels from 2004 to 2007, that is 4.5 M ha, has represented 24% of the global supplementary agricultural area in the period[68]. In the United Kingdom "*The value of farmland rose by 28 per cent during the second half of 2007*" and again "*by more than 10 per cent in the first quarter of 2008*"[69]. The average price of arable lands has increased by 13% in the US in 2007 and by more than 10.5% in 2008[70] but, in Iowa, first State for corn and ethanol production, it has risen faster since 2002 (+ 8%) up to 22% in 2007 and again by 14% in 2008[71].

In DCs the eviction of small farmers take at the same time the form of land price increases which are no longer within their means and a more or less violent grab of lands they are already farming. Everything happens as if, after the burst of the oil price bubble since Summer 2008, the scramble for the grab of DCs' most productive lands by powerful public or private operators with the backing of their public Authorities has replaced the financial

[68] www.ers.usda.gov/Publications/WRS0801/
[69] http://www.independent.co.uk/news/uk/this-britain/fields-of-gold-investors-discover-lucrative-haven-inbritains-farmland-810376.html
[70] http://www.farmpolicy.com/?p=854
[71] http://www.extension.iastate.edu/agdm/wholefarm/html/c2-70.html

speculation which had amplified the bubble of agricultural prices from the second semester of 2007 till the end of the first semester of 2008.

In Brazil, the price of agricultural lands has increased by 18% in 2007, notably because of the expansion of the sugarcane area which has increased by 43% from 2005 (6.1 Mha) to 2008 (8.7 Mha), an average annual increase of 13%[72]. And that large increase in agricultural land price, despite the recurrent claim that the country avails of huge reserves of cultivable land, has also contributed, beside huge food exports, to increase the production cost of all food consumed in Brazil. Thus the index of basic foods little processed has surged by 20.5% from February 2007 to January 2008 and again by 8.2% from February 2008 to January 2009, much more than the 4.7% and 5.9% respectively of the general index of consumer prices[73].

Several recent inventories on land grabbing in DCs[74] have been published by the NGO GRAIN (180 contracts) and the research center IFPRI (57 contracts), essentially from informations having circulated in the media. Other analyses more substantial come from IISD[75], IBON[76], IIED-FAO[77], the Brazil's Pastoral Commission on Land[78] and international institutions are working on the issue. The main buyers or renters on very long term leases (50 or 99 years) are governments or private investors from the Persian Gulf or China, Korea, Japan and even India which are investing mainly in Africa and South-East Asia. Which should not hide that more than 30 Mha belong already to foreigners in Brazil[79]. IISD specifies: "*It is impossible to determine the precise amount of investment in land and water for food, feed or fuel… There is plenty of information circulating in the media about such land deals, but there remains a lack of concrete evidence, data and statistics on the nature and extent of such deals. It is especially unclear whether contracts exist for those deals that have been confirmed by government officials… There are enormous economic, social and political risks that are associated with foreign ownership of land and water rights. This was demonstrated most strikingly in the South Korea Daewoo-Madagascar deal, where civil opposition to a range of government policies, including sale of farmland, eventually contributed to the overthrow of the government*".

IIED has analyzed in details the situation in 5 African countries – Ethiopia, Ghana, Madagascar, Mali and Sudan – where projects concluded since 2004 concern 2.5 Mha for investments commitments of $920 M and, in a more qualitative way, Mozambique and Tanzania, two countries where the share of agrofuels projects is prevailing and mainly for export.

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[72] André M. Nassar et al., *Prospects of the sugar cane expansion in Brazil: impacts on land use allocations and change*, 2009, www.iddri.org/Activites/Ateliers/081009_Conf-Ethanol_Executive_Summary_Andre_Nassar.pdf
[73] http://www.dieese.org.br/rel/icv/icv.xml#
[74] http://farmlandgrab.blogspot.com/2009/05/iisd-thirst-for-distant-lands.html;
[75] Carin Smaller and Howard Mann, *A thirst for distant lands: foreign investment in agricultural lands and water*, IISD, May 2009, http://farmlandgrab.blogspot.com/2009/05/iisd-thirst-for-distant-lands.html
[76] Arnold Padilla, *Biofuels: a new wave of imperialist plunder of Third World resources*, IBON, www.foodsov.org/html/resources.htm
[77] Lorenzo Cotula et al., *Land grab or development opportunity? Agricultural investment and international land deals in Africa*, IIED-FAO-IFAD, 2009, http://www.reliefweb.int/rw/rwb.nsf/db900SID/KHII-7SE4R4?OpenDocument&RSS20=02-P; Lorenzo Cotula, Nat Dyer and Sonja Vermeulen, *Fuelling exclusionn? The biofuels boom and poor people's access to land*, IIED-FAO-IFAD 2008, www.iied.org/pubs/display.php?o=12551IIED
[78] Comissão Pastoral da Terra, *Os impactos da produção de cana no Cerrado e Amazônia*, www.agroambiente.org.br/arquivo/biblioteca/os_impactos_da_producao_de_cana_no_cerrado_e_amazonia.icv
[79] http://www.mst.org.br/mst/pagina.php?cd=6579

Among the long term leases, let us mention the 91,000 ha leased for 50 years and renewable in Mozambique by the sugar plant Sena whose majority of capital is owned by the French cooperative Group Tereos and its Brazilian subsidiary Guarani. Sena has produced 61,000 t of sugar in 2007-08 and intends to export more and more to the EU, availing of the EU Decision "Everything But Arms" of 2001 allowing imports duty free and quota free for LDCs[80].

All these projects to buy or lease for a very long time agricultural lands constitute a heavy threat for small farmers whose lands will be confiscated and who will be reduced to unemployment as the new landlords will manage these lands in large single crop agro-industrial farms. But it is also a heavy threat for the food security of the whole population of the countries thus colonized as these food or biofuels products exported to the investing countries will diminish the food available locally as was already acknowledged in Brazil.

More broadly all these holdups on the land traditionally owned by peasant communities of DCs constitute for them a true sacrilege as their relation with the "Mother Land" goes well beyond a simple means of material livelihood since it is a gift of God, a sacred link with the Ancestors, and as "*Land belongs to a large family of which some are living, a large number is dead and the largest number is still to be born*" (definition of a Nigerian traditional chief according to the sociologist Denise Paulme, definition close to others to be found in Indian tribes of North and South America). For the anthropologist Karl Polanyi, "*What we call land is an element of nature inextricably intermingled with human institutions. Isolating and marketing it was likely the strangest of all the undertakings of our ancestors... It guarantees its stability to human life, it is the setting of its dwelling place, it is the condition of its physical security, it is landscape and seasons*". Hence the importance of ritual ceremonies of offerings to land and, inextricably united with it, to ancestors, which punctuate still to-day the main farming works, particularly sowing, in many Southern traditional societies.

Of course history will show once more, above all if agricultural prices do not stabilize at a high level, that these agrobusiness farms will rapidly turn non profitable and will require large subsidies, independently of their highly detrimental social and environmental impacts. Moreover these agrobusiness farms are powerful levers to increase free trade and prevent to rebuild agricultural policies at national and multilateral levels on food sovereignty. And they undermine all the efforts of regional integration between neighboring Southern countries.

The eviction of small farmers and violation of human rights

The eviction of small farmers and violation of human rights are without any doubt the most obvious in South America countries, particularly in Brazil and Columbia, even if they are also very high in South-East Asia. In Brazil 2,553 slaves, or 48% of the 5,266 slaves set free in 2008 after prosecutions, were working in 18 sugarcane farms, knowing that 54% of the sugarcane national production has been processed into ethanol[81]. Father Tiago, a Scottish Catholic monk who has for many years been helping the abused workers, told Der Spiegel, "*The promise of biofuel is a lie. Anyone who buys ethanol is pumping blood into his tank. Ethanol is produced by slaves*"[82]. However this slavery is only the tip of the iceberg of a more general exploitation of cane cutters because, even if they are not the worst paid agricultural workers, the competition of the growing rate of harvest mechanization has increased the demands of a higher productivity, which has jumped from 4-6 t a day in the 1980s to 12 t a

[80] http://www.aguarani.com.br/ri/

[81] http://www.cptnac.com.br/?system=news&action=read&id=3163&eid=277

[82] http://biofuelsdigest.com/blog2/2009/06/02/debt-slavery-on-the-rise-in-brazilian-sugarcane-plantations-report/

day in 2007[83]. François Houtart specifies that a study of 2008 has shown that "*The cane cutters cut down every ten minutes 400 kg of cane, making 131 machete strokes, requiring 138 chest bendings… Serious risks for the health are created and life expectancy of workers is seriously affected*"[84]. Moreover, beside 14 million of Brazilians chronically undernourished, a total of 72 million, or 40% of the population, are in a state of food insecurity[85] and 4.5 million of landless families are awaiting a true agrarian reform.

In Columbia, only between 2001 and 2005, 263,000 peasant families have been expropriated of 2.6 Mha by agrobusiness companies and paramilitars to grow mainly oil palm to be processed into biodiesel. François Houtart has visited in 2007 a peasant community in the North-East of Choco where "*They were told: If you disagree to sell your lands, we will buy them to your widows". Unfortunately the facts have followed. In the community we are visiting, 113 people have been assassinated, first by the army then by the paramilitary. The same thing has happened in many other places*".

The scope of this study does not allow to quote the same types of perverse effects brought about by oil palm, particularly for biodiesel, in Indonesia and Malaysia and more largely in South-East Asia. And we cannot quote all the reports of NGOs and farmers associations such as by Biofuelwatch, Via Campesina[86] and its member associations such as the MST in Brazil.

The absurdity of jatropha projects

Beyond the marginalization of small farmers or ranchers deprived from their lands, the most absurd is the non profitability of a great many projects, the most exemplary being those of jatropha, the alleged miracle plant. For instance, despite its bitter failure in India and Myanmar, more than 20 projects are negotiated or on-going in Ghana to buy lands or lease them for a very long term to produce jatropha biodiesel for export. These projects come from Brazil, China, India (50,000 ha), Norway (10,000 ha but its Ghana subsidiary would have contracted for 400,000 ha, 60% of which for agrofuels), Italy, Germany, the Netherlands, Belgium, Israel (100,000 ha). The largest project would be that of Gold Star Biofuels, which has begun the cultivation in 2005 and which claims to have signed contracts of 50 years lease on 2 million ha. But the most criminal jatropha project is that of the forced labour to which the military ruling Myanmar has condemned all farmers and even all countryside schools[87]. See also on internet the third part of Inge Altemeier's excellent film "Le mensonge vert" (The green lie) on oil palm in Indonesia and jatropha in India, broadcasted by Arte the 9 April 2009[88].

The lack of realism of these projects is also to be found in the Regional program of energy biomass of WAEMU (UEMOA) of April 2006, based on estimates by researchers of Louvain University claiming an average yield of jatropha biodiesel of 3,400 l/ha (from 2,600 l to 4,200 l)[89], a yield confirmed in another report of October 2008 which gives 3513 l/ha for

[83] en.wikipedia.org/wiki/Ethanol_fuel_in_Brazil

[84] François Houtart, *L'agroénergie. Solution pour le climat ou sortie de crise pour le capital?* Couleur Livres, Bruxelles, 2009.

[85] http://noticias.uol.com.br/economia/ultnot/2006/05/17/ult82u5901.jhtm

[86] http://bio-fuel-watch.blogspot.com/2009/04/biofuelwatch-action-against-agrofuels.html

[87] Biofuels by Decree. Unmasking Burma's bio-energy fiasco, WRM's bulletin Nº 137, December 2008,

[88] http://www.dailymotion.com/video/x8xkid_documentaire-le-mensonge-vert-1_news;
http://www.dailymotion.com/video/x8xokx_documentaire-le-mensonge-vert-2_news;
http://www.dailymotion.com/video/x8xpiu_documentaire-le-mensonge-vert-3-fin_news

[89] http://www.uemoa.int/PRBE/PRBE_publication.htm

UEMOA[90], but also by UNIDO which gives 3,500 l/ha for Sub-Saharan Africa[91]. Yet a Wetlands international's report of 2008 gives a jatropha oil yield between 400 l and 2,200 l/ha for Sub-Saharan Africa[92] and the company D1-BP Fuel Crops Limited, which is facing large setbacks with jatropha in India and tries desperately and in vain to find new investors to save the project, confesses that yields are between 1,000 to 2,000 l/ha[93]. A report ordered by the United Kindom ministry of agriculture estimates that 1 ton of jatropha seeds gives 250 l of oil (and biodiesel) and that the yield observed in Mali goes from 3.5 to 5 t of seeds per ha, that is of 875 to 1,250 l/ha of biodiesel, in other words of 1 t/ha on average. The report states also that the jatropha oil yield oberved in India without irrigation goes from 1 to 2.75 t of seeds per ha, that is from 250 to 688 l/ha of biodiesel[94]. Finally Maurice Oudet mentions in March 2009 the testimony of a farmer from Boni in Burkina Baso who, having followed the government recommendations to plant jatropha, told him: "*Don't tell me any longer of jatropha, all my plants are dying*"[95].

That being said, this should not condemn all the small scale agrofuels projects, including of jatropha as those allowing small isolated villages of Mali to have access to electricity[96].

Precisely another aspect of land grabbing is the claim that some agrofuels – like jatropha and to-morrow the ligneous-cellulosic second generation biofuels – will not harm farmers as they can grow on marginal lands not usable for cultivation. This claim is totally unfounded as they provide the livelihood to tens of millions of marginalized small farmers, indigenous and tribal populations, particularly in India[97].

To conclude this overview of the social impact of agrofuels expansion, let us stress that social impact is never included in the overall life-cycle assessment analyses, contrary to their environmental record. As if only their environmental impacts mattered and had global effects from which the developed countries cannot escape, including the indirect effects on their long term living standards, whereas they think they could always prevent massive immigration of DCs population marginalized by the agrofuels expansion.

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[90] *Sustainable Bioenergy Development in UEMOA Member Countries*, Hub Rural, UN Foundation, ICTSD, www.globalproblems-globalsolutions-files.org/gpgs_files/pdf/UNF_Bioenergy/UNF_Bioenergy_full_report.pdf

[91] www.unctad.org/sections/wcmu/docs/ditc_comb_Jatropha001_en.pdf

[92] http://afrique.wetlands.org/LIBRARY/tabid/978/mod/3861/articleType/ArticleView/articleId/2162/Les-biocarburants-en-Afrique.aspx

[93] http://www.d1bpfuelcrops.com/

[94] randd.defra.gov.uk/Document.aspx?Document=GA01105_7190_ABS.pdf

[95] http://www.pambazuka.org/fr/category/comment/55220

[96] http://www.malifolkecenter.org

[97] African Biodiversity Network, Biofuelwatch, EcoNexus, the Gaia Foundation, Salva La Selva and Watch Indonesia, *Agrofuels and the Myth of the Marginal Lands*, September 2008, http://www.econexus.info/

III – The environmental record of agrofuels

The main reason displayed by the EU and US to develop agrofuels is the reduction of GHG emissions of fossil fuels. However the impact of agrofuels on the environment goes much beyond GHG as it affects also water resources, the quality of soils and biodiversity.

The agrofuels impact on GHG emissions

The impact of agrofuels on GHG, already significant in the EU and US, is and will be even more in DCs from which they will import the large volumes of feedstocks or directly of agrofuels required, particularly in the EU. The main method to be used here is that of the avoided impacts, which must take into account the changes in land use, which may be direct – a forest is replaced by a land affected to an agrofuel feedstock – or indirect: a feedstock replaces a food crop which is moved on a meadow or forest, not only in the producing country but also in the rest of the world. It is that question of land use changes which has been the central focus of harsh debates and pressures in the US Congress in May and June 2009.

Most lawmakers (Democrats and Republicans alike) of Middle West States growing corn – and particularly the democrat from Minnesota Collin C. Peterson, Chairman of the House of Representatives' Agriculture Committee – have been openly hostile to incorporate the impact on GHG of land uses changes in the rest of the world. These changes are linked to the higher world agricultural prices resulting from the series of effects of the higher US corn price in response to the US mandate on agrofuels. And this contrary to the law that has charged the Environmental Protection Agency (EPA) to take into account the indirect land uses changes throughout the world or of the State of California which has adopted a low-carbon fuel standard (LCFS) to reduce GHG emissions from motor fuels by 10% in 2020 compared to present levels [98].

It is interesting to underline that Collin Peterson is a member of the Farm Bureau and of the Renewable Energy Caucus, a powerful bipartisan pro-ethanol lobby within the House of Representatives which assembles 218 Members (138 Democrats and 79 Republicans), that is a little more than 50% of the 435 Members[99]. According to Wikipedia "*Representative Peterson has been among the largest recipients of campaign contributions from farm interests*"[100] and the Center for Responsive Politics adds that, during his political career from 1989 to March 2009, he has raised $5.843 Mn of which $1.597 M from agribusiness[101]. For the election campaign 2007-08, he has raised $1.218 M, being the fourth largest Representatives receivers but the first for the donations from agribusiness ($542 M). He has also received the "Golden Plow" award of the American Farm Bureau Federation in 2006, knowing that "*The objectives of the Golden Plow award are to identify, select and award those members of Congress, regardless of their party affiliation, whose philosophies or records demonstrate their commitment to the private enterprise system; sound agricultural policies supported by Farm Bureau; fiscal conservatism; and reduced federal regulations on businesses and individuals*"[102].

[98] See the daily follow-up of these debates on www.farmpolicy.com/

[99] http://www.renewableenergyworld.com/rea/news/article/2006/07/membership-in-congressional-renewable-energy-caucus-grows-45541

[100] http://en.wikipedia.org/wiki/Collin_Peterson

[101] http://www.opensecrets.org/politicians/summary.php?cycle=Career&cid=N00004558&type=I

[102] http://www.fb.org/index.php?fuseaction=legislative.gp

Moreover EPA legislation requires that, for biorefineries built since 2007, the GHG emissions relative to gasoline be reduced by 20% for corn-ethanol, 50% for biodiesel and 60% for cellulosic ethanol.

Already if France would have to reach by itself its mandate of 10% agrofuels in transportation fuel in 2015, it would have to mobilize additional 1 to 2 Mha of non cultivated agricultural lands, the area of which would drop by 4/5 and that of meadows by 1/10, which would provoke important releases of carbon stocked in the soil and nitrogen gas, even if the record would be less negative for sugarbeet ethanol. Moreover cultivating fallow lands would impede the objective of biodiversity protection.

For FAO, "*While maize produced for ethanol can generate greenhouse gas savings of about 1.8 tonnes of carbon dioxide per hectare per year… the conversion of grassland to produce those crops can release 300 tonnes per hectare, and conversion of forest land can release 600–1 000 tonnes per hectare (Fargione et al., 2008; The Royal Society, 2008; Searchinger, 2008* "[103]. A study in Science magazine stated that when you take deforestation into account, ethanol and biodiesel produce twice as much CO^2 emissions as regular gasoline.

In Brazil, sugarcane for ethanol claims to avoid 2 t of carbon emission per hectare and per year whereas the cultivation of a tropical forest destocks 156 to 305 t/ha[104].

The deforestation of tropical forests is responsible for about 20% of global GHG emissions, about the same as the transportation sector. Amazon stocks from 80 to 120 Bnt of carbon and if all its forest would disappear this would correspond to 50 times the annual US emissions which accounted in 2007 for 21% of the global emissions, second after China with 24[105],[106]. From August 2007 to July 2008, Brazil's National Institute of Spatial Research has acknowledged a 64% jump in the deforestation of the Amazon, with 8,138 km^2, knowing that 1 ha of Brazilian forest has vanished every 10 seconds for the last 20 years. Moreover 20% of the Amazon deforestation in 2007 has concerned indigenous reserves or areas of environmental protection.

Now the increased production of sugarcane ethanol contributes, directly and above all indirectly, to the deforestation of the Amazon and Cerrado. During the FAO Head of States summit of June 2008 on the food crisis President Lula has stated that there is no sugarcane production in the Amazon. Yet CONAB, affiliated to the Ministry of agriculture, has registered a production increase of sugarcane production from 17.6 Mt in 2007 to 19.3 Mt in 2008 in the North Region only, which does not cover the whole geo-economic Amazon (which includes also the Matto Grosso and the West of Maranhao).

On the other hand soybean production – increasingly processed into biodiesel –, has jumped by 18% a year in the Amazon since 1990. It covered 1.2 Mha (5% of national total) in 2004-05 and has risen by 20% from 2006-07 to 2007-08 against 2.9% for the national average[107]. Greenpeace has shown that the evolution of the rate of Amazon deforestation has been

[103] http://www.fao.org./sof/sofa/index_fr.html.

[104] If estimates of carbon destocking linked to deforestation vary strongly according to authors, in any case this destocking is incommensurate with that linked to agrofuels production.

[105] http://www.ecodebate.com.br/2008/06/18/minc-quer-estender-moratoria-da-soja-para-madeireiras-e-frigorificos/

[106] http://www.elrst.com/2008/06/16/world-co2-emissions-rose-by-31-percent-last-year/

[107] Reporter Brasil, *O Brasil dos biocombustiveis. Os impactos das lavouras sobre a terra, o meio e a sociedade : soja, mamona*, 2008, www.reporterbrasil.org.br/agrocombustiveis/relatorio.php

parallel to that of soybean and bovine meat prices[108]. This is confirmed by Martins of IPAM (Research Institute on the Amazon environment): "*If one compares the deforestation curve in the Amazon with the soybean price, one follows the other. The more expensive soybean gets, the more deforestation grows*"[109]. For WWF also "*In the Amazon, since 2000, the price of soybean is very tightly linked to deforestation. This correlation is continuously verified, the recent hike in soybean price has gone with a significant upsurge of deforestation in 2008 (INPE, FMI). 13.5 million hectares of Amazon forest have disappeared to the benefit of soybean cultivation since 1998. Furthermore, those deforestations are responsible of most other environmental problems*". And the Amazon is not alone involved as "*Every year, 3.7 million hectares are deforested in Brazil, Argentina, Bolivia and Paraguay for soybean production… Brazil is the most affected country (2.4 million ha per year, half of which in Matto Grosso State alone)*"[110].

Nevertheless researchers from ICONE claim that *"The area used for soybeans in Brazil (mainly in the Amazonia) has not increased since 2004*" and that "*Even recognizing that sugarcane expansion contributes to the displacement of other crops and pasture, there is no evidence that deforestation caused by indirect land use effect is a consequence of sugarcane expansion*"[111]. Maybe but if we take into account that sugarcane expansion has displaced at least partially soybean and that soybean has displaced pastures to the Amazon and Cerrado implying deforestation, the end result is the same. Maybe also ICONE's researchers do not enjoy a full freedom of expression since ICONE – Institute for International Trade Negotiations – is working within Brazil's Ministry of external relations, its claimed objective being "*To develop studies and an applied research aiming at supporting international trade negotiations and to* c*ontribute to a broader economic integration of Brazil in the global economy*".

Moreover the Cerrado is deforested twice quicker than the Amazon and "*The rhythm of Cerrado destruction for the last 40 years is not comparable to any other Brazilian biome. The area deforested in four decades equals 2.35 times the Goias territory* [800,000 km2]. *Every deforested hectare has generated 220 tonnes of carbon dióxide (CO2) in 20 years. Instead of retaining the main greenhouse gas, the Cerrado – or, better, its deforestation – has transformed itself in issuing source*"[112].

The advance cycle of agricultural frontier in the Amazon corresponds to the following dominos effect: not only the production of soybean and sugarcane has spread over the Amazon but its rise in the South, South-East and Centre-West has been accompanied by a transfer of bovine cattle to the Amazon. The investors begin to deforest by fire after having sold the most precious species and after making at times charcoal for export. They begin then an extensive ranching before growing crops, after few years, among which soybean or sugarcane. According to IBGE, the official Institute of Statistics, 70 to 80% of deforested

[108] Greenpeace Brasil, *O rastro da pecuaria na Amazonia*, 2008, http://www.greenpeace.org/brasil/amazonia/noticias/greenpeace-desvenda-o-uso-da-t
[109] Revista Brasiliera de bioenergia, Fevereiro 2009.
[110] Aurélie Billon, Emmanuelle Neyroumande, Cyrille Deshayes, *Vers plus d'indépendance en soja d'importation pour l'alimentation animale en Europe - cas de la France*, ENESAD et WWF-France, janvier 2009, http://www.wwf.fr/s-informer/dossiers/wwf-france-lutte-contre-la-deforestation-liee-aux-plantations-de-soja-!
[111] Peter Zuurbier and Jos van de Vooren, *Sugarcane ethanol Contributions to climate change mitigation and the environment*, Wageningen Academic publishers, 2008.
[112] http://www.linearclipping.com.br/funai/detalhe_noticia.asp?cd_sistema=45&codnot=411552

lands are converted into pastures, largely owing to very high rebates on loan interests to ranchers, and without specific environmental conditions up to end 2007.

70% of the 249 Mha of Brazil's used agricultural area in 2006, or 172 Mha, are pastures of which 62 Mha in the Amazon, this area having risen by 44% since 1985 whereas the cattle heads slaughtered has risen by 50% from 1998 to 2008, year in which they have represented 36% of national slaughters. For Paulo Barreto, researcher at the Imazon Institute, "*If 75% to 80% of Amazonia deforestation are due to the opening of pastures, this means that this process corresponds between 41% and 48% of Brazil's GHG emissions*". According to Carlos W. Porto-Gonçalves and Paulo Alentejano, "*The substitution of pasture to grow sugarcane transfers necessarily the cattle to the Centre-West region and the Amazon... On the 40% increase of the national bovine cattle from 1990 to 2006 (from about 147 M heads in 1990 to 206 M in 2006), 80.8% has occured in the Amazon which passed from 26 to 73 M of heads, **a** 181% increase*"[113]. And Greenpeace US estimates that, between 2007 and 2008, another 1.2 Mha have been destroyed[114].

A US Embassy's in Brasilia report of September 2008 confirms that "*The expansion of the sugarcane and ethanol industries and the increase in the price of land due to the competition for crop land derived from rising world food prices have contributed to the expansion of the cattle industry towards the Amazon and increased the debate about the environmental implications for the rain forest. Although reliable data is not available, it is estimated that there are currently between 70 and 75 million head of cattle in the so-called legal Amazon, which includes the rain forest and a major area of the Cerrados (savannah) of Brazil's center-west regions*"[115].

Professor Bruce Babcock, director of the Center for Agricultural and Rural Development at Iowa State University, has testified the 6 May 2009 in a hearing at the House of Representatives' Agriculture Committee on indirect land use and renewable biomass provisions of the renewable fuels standard (RFS)[116]. He disagrees with the California Air Resources Board (CARB) and EPA analyses that increased crop prices from biofuels expansion will increase deforestation in Brazil's Amazon and argues that, if "*There is evidence that cattle numbers and pasture have both increased in the Amazon region since 1996… preliminary data suggest that a fairly large proportion of the increase in cropland in the major crop-producing regions of Brazil was accommodated by increasing cattle stocking rates*". And he concludes: "*If Amazon forest is getting cut down to accommodate increased cattle numbers, and increased stocking rates accommodate increased cropland, then the primary impact in Brazil of increased crop prices will be intensification of cattle production: not loss of savanna and Amazon forest*". And, in an e-mails exchange with him, he adds: "*The reality in Brazil (according to the data that we have) is that increased demand for cropland is associated with a loss of pasture. But the number of cattle per ha of land in the regions where crops have expanded and pasture have contracted about accounts for all the loss of pasture in those states that expanded crops and lost pasture*". And he concludes: *"What will happen in the future if we continue to expand conversion of feed grains and oils into biofuels? That is the question that I think more care needs to be taken in answering*". In other words, for him the unquestionable rise in crops acreage in Brazil induced by the higher US (and hence international) price of corn is not linked to the – as much unquestionable – rise of pastures,

[113] http://alainet.org/active/29607&lang=es
[114] http://www.guardian.co.uk/environment/2009/may/31/cattle-trade-brazil-greenpeace-amazon-deforestation
[115] http://www.fas.usda.gov/scriptsw/attacherep/attache_lout.asp
[116] www.card.iastate.edu/presentations/babcock.landusechange.housesubcomm.final.5.092.pdf

hence of deforestation, in the Amazon because there has not been any displacement of pastures in the non Amazon regions but only an intensification of cattle production on lower pastures acreage.

Clearly there has been some intensification of cattle raising outside the Amazon and the Cerrado, but this has not prevented an extension of cattle and hence of deforestation as we have already seen, the more so as intensification of cattle raising has almost not started there.
In any case this intensification implies necessarily an increased consumption of concentrates (cereals and soy meals) requiring more land to feed the cattle and this land has eventually to be found on the frontier, in the Cerrado or the Amazon.

André Nassar, Director-general of Brazil ICONE research institute, stated in November 2008 that the expansion of sugarcane in the last years was not linked to crops and pasture expansion but he eventually admits: "*It is possible to assume that sugarcane expansion may cause indirect effect but it is not possible to measure it*"[117]. Nassar states that Brazil's cattle heads increase of 18.3 M from 2002 to 2006 has been accompanied by a drop of 5.4 Mha of pastures. However his graph shows also that cattle heads and pasture area have increased in the State of Para, in the heart of the Amazon, by 5.3 M heads and 2.5 Mha respectively. Above all Nassar's presentation at the EPA workshop of 10-11 June 2009 on lifecycle gas analysis shows that the stocking rate in North-Amazon has declined from 0.8 heads/ha in 2005 to 0.7 heads/ha in 2008 and it has even declined slightly in the South and the Center-West Cerrado from 2006 to 2008[118], contradicting the estimate that it will rise in 2007 made in a previous presentation[119]. And the last census on cattle in 2007 confirms an increase of 78% of bovine cattle in the legal Amazon from 1997 to 2007, particularly in the South of Para, North Mato Groso and Rondônia[120], of which 22% from 2002 to 2007. Clearly an increase in cattle heads with a decline in the stocking rate implies necessarily an increase, not a reduction, in the pasture area so that there is something wrong in these contradictory statements!

According to a report of 13 January 2009 by Paulo Barreto, Ritaumaria Pereira and Eugênio Arima of the Institute of man and the environment in the Amazon (IMAZON), "*The production semi-intensive and in feedlots has increased, but still remains tiny. The percentage of these types of ranching in total Brazilian cattle has risen from 1.5% in 1996 to 2.3% in 2005. Among the Amazon States, Mato Grosso and Tocantins present the largest cattle in these two types of intensification but have followed the same model as in the whole Brazil. The stabilization then the fall of feedlots and artificial insemination corroborate that… the most intensive production systems have been less profitable than the extensive ranching in the Amazon in 2007*"[121].

If intensive cattle production was theoretically the most profitable way to raise cattle up to 2005 – because, despite a decline of beef price, the decline in feed grains was even larger – this is no longer true as the price of grains has declined much less than the price of bovine meat since the ceiling in mid-2008: the world price of corn in May 2009 was 80% higher than

[117] www.braseuropa.be/Seminar%20EU%20Sustainability%20Requirements%20a%.
[118] http://client-ross.com/lifecycle-workshop/index.asp
[119] cgse.epfl.ch/webdav/site/cgse/shared/Biofuels/Regional%20Outreaches%20&%20Meetings/.../presentations%20day%201/Lima.pdf
[120] http://ibge.gov.br/home/estatistica/economia/ppm/2007/default.shtm
[121] http://www.amazonia.org.br/guia/detalhes.cfm?id=297322&tipo=6&cat_id=46&subcat_id=198

the annual price of 2005 whereas the world price of bovine meat (Argentina FOB) was only 50% higher in February 2009 than in 2005. And, as long as the mandate to produce more ethanol and biodiesel in the US and UE would not change, the high price of feed grains will not foster cattle intensification in Brazil.

Brenda Brito and Paulo Barreto (IMAZON) have underscored the 23 March 2009 the reasons why extensive ranching and deforestation are going on and will continue to proceed: the official legalization of illegal occupations and their subsidization[122]: "*In the last decades more than 300,000 people have occupied the Amazon in an informal and illegal way… Only on federal lands 67 million hectares have been occupied, which equals to the territories of Germany and Italy. This unbridled occupation – where the occupants have exploited the wood and gained incomes from cattle without even paying any rent for land - has stimulated conflicts, deforestation and rendered difficult the sustainable use of natural resources of the region. The 10 February 2009, the government has published the Provisory Measure nº 458/2009 on the regularization of these areas. This Provisory Measure contains multiple provisions which give a premium to irregular occupants, as the donation of land up to 100 hectares and long delays to pay the other lands. To aggravate this situation, the reporter of the Measure, in charge of evaluating the 249 amendments proposed by Members of the national Congress, has produced a new proposed law which maintains and increase the incentives to a disorganized occupation of the region, beside the fact to consolidate an historical process of illegal grabbing of the Amazon lands*". Furthermore, "*That proposal maintains the perverse subsidies which may foster a new deforestation, as the offer of free lands renders more profitable to invade and deforest new areas rather than invest to raise the productivity of lands already deforested*"[123]. Besides, although the legislation on illegal occupations has resulted in the last years in many more fines, only 2 to 3 % of them have been paid eventually[124].

This is confirmed by an article in the newspaper "A Folha de Sao Paulo" of 6 June 2009: "*To clear the forest or original vegetation is less expensive than to recover the degraded lands. "The cost (to recover the degraded areas) is relatively low, between 1,500 and 3,000 reals[125] per hectare, but the value is not as low as clearing a virgin land and deforest more. This costs between 300 and 600 reals[126] per hectare", according to the Minister Roberto Mangabeira Unger (of Strategic Affairs), who has elected the issue as one of his priorities*"[127].

Happily and amazingly enough Brazil's 3 largest supermarkets chains – Pâo de Açucar, Carrefour and Wal Mart – have decided the 10 June 2009 to suspend their purchases of bovine meat sold by 11 slaughterhouses of the Amazon State of Para[128], following the recommendation made by the Federal Public Minister in Para, itself reacting to Greenpeace's Report "Slaughtering the Amazon"[129] of June 1, the non compliance with the "recommendation" being fined by 500 reals (around $250) per kg of meat sold[130]! If Brazilian

[122] http://news.mongabay.com/2008/0212-amazon.html
[123] http://www.imazon.org.br/novo2008/publicacoes_ler.php?idpub=3565
[124] http://www.pagina22.com.br/index.cfm?fuseaction=reportagem&id=170
[125] That is between $759 and $1,519 as of 8 June 2009.
[126] That is between $151.9 and $303.8 as of 8 June 2009.
[127] http://noticias.ambientebrasil.com.br/noticia/?id=46085
[128] http://www.agrosoft.org.br/agropag/210676.htm
[129] http://www.greenpeace.org/international/press/reports/slaughtering-the-amazon
[130] http://www.greenpeace.org/brasil/amazonia/noticias/ministerio-p-blico-federal-rec

public authorities are able to do this, Western importers should do the same[131] without fearing a Brazil's complaint at the WTO!

We should not underestimate the effects on biodiversity of deforestations linked to the higher prices of feedstocks to be processed in agrofuels. The Amazon is one of the richest tropical forests in biodiversity: 10% of land mammals, 15% of known plants, and five million of vegetal and animal species of which most are still unknown. On the other hand "*The expansion of soybean plantations in the Cerrado threatens a wooded savannah sheltering half of Brazilian bird species, up to 40% of mammals, reptils and fishes of the country and more than a thousand species of plants. Presently only 2% of the Cerrado area are protected*"[132]. The Pantanal, the largest tropical freshwater wetland ecosystem in the world, is also the habitat of a very rich biodiversity: "*More than 650 bird species, over 190 mammal species, 50 reptiles, 1,100 butterfly species and 270 fish species… Unfortunately, sugar cane and soybean production threatens this hotspot of biological biodiversity (Collins et al., 2005). There are specific concerns about water pollution from agrochemicals (particularly pesticides) used in sugar cane cultivation that can be washed into the Pantanal region from the sugar cane growing areas. In addition there are also concerns about organic residues (such as vinasse) from sugar production, which cause water pollution downstream of the plants in the Pantanal*" [133].

We should have devoted long developments to the disastrous impact of the disappearance of tropical forests and biodiversity of Indonesia and Malaysia[134] to make oil palm for export, and we have seen that the EU imports are rapidly increasing. Which does not show up in the feedstocks used in the EU to make biodiesel as oil palm has represented only 1% of the vegetable oils used in 2007, but rather to make up the food needs since its rape oil is largely affected to biodiesel. To cap it all the European Commission subsidizes cogeneration electric stations using renewable fuels, among which palm oil, particularly in Germany and Italy.

To conclude on this GHG emissions section, OECD has found that CO_2-equivalent GHG emission reduction per driven kilometer varies from about 30% for grain ethanol in the EU (wheat) and US (corn), to 40% for sugarbeet in the EU and 93% for sugar cane in Brazil. However, if most analyses of GHG emissions by agrofuels conclude to their positive impact, it is because they do not take into account the indirect land-use change in the rest of the world and because, according to the Nobel prize Paul Crutzen in 2007, they have underestimated by 3 to 5 fold the nitrous oxide (N_2O) emissions which are 296 times larger than those of CO_2. Indeed corn and rapeseed require large quantities of nitrogen fertilizers resulting in large N_2O emissions so that, if they are included in the analysis, corn ethanol and rapeseed biodiesel are worse for global warming than burning fossil fuels. These two points are well documented in the Proceedings of the Scientific Committee on Problems of the Environment (SCOPE), particularly in chapters 1 and 6[135].

The impact on water resources and their quality

The large rise in the US corn production, which has fostered its continuous cultivation instead of corn-soybean rotations, and the implied large consumption of fertilizers and pesticides whose losses, typically of 18 to 35 kg/ha, are swept along the Mississippi river, is one of the

[131] http://www.guardian.co.uk/business/feedarticle/8534553
[132] http://www.wwf.fr/s-informer/dossiers/wwf-france-lutte-contre-la-deforestation-liee-aux-plantations-de-soja-!
[133] randd.defra.gov.uk/Document.aspx?Document=GA01105_7190_ABS.pdf
[134] http://www.carbontradewatch.org/index.php?option=com_content&task=view&id=216&Itemid=256
[135] http://cip.cornell.edu/biofuels/

main reasons of the extension of the 'dead zone' totally deprived from oxygen in the Mexican Gulf, where many form of marine life can no longer survive. Donner and Kuchari suggest that if the US were to meet its ethanol production goals, nitrogen loading by the Mississippi River to the Gulf of Mexico would increase by 10-19 per cent[136].

According to researchers of Twente University in the Netherlands, one l of rape or soybean biodiesel requires 14,000 l of water whereas one l of ethanol requires 1,400 l of water when processed from sugar beet and 2,500 l when processed from sugarcane. But the most amazing finding is that, whereas jatropha is widely promoted as a crop adapted to arid conditions, 1 liter of jatropha biodiesel requires 20,000 liters of water, at least if one wants to harvest something tangible[137].

Another source of pollution from sugarcane ethanol is the release of vinasse but here the assessments differ according to sources. If, for DEFRA, it is "*a corrosive effluent with a very low pH and an extremely high mineral content. One litre of ethanol produces approximately 10 to 15 litres of vinasse. In the mountainous areas of northeastern Brazil, the costs of pumping and of land to store vinasse were prohibitive; it was therefore released into rivers, resulting in an enormous fish kill at every harvest. In limited areas, vinasse and wastewaters are recycled and used for ferti-irrigation*", for Weber A. N. do Amaral et al., "*The vinasse has a high organic matter and potassium content, and relatively poor nitrogen, calcium, phosphorus and magnesium contents (Ferreira and Monteiro 1987). Advantages of using vinasse include increased pH and cation exchange capacity, improved soil structure, increased water retention, and development of the soil's micro flora and micro fauna*"[138].

Besides, if "*The Amazon rainforest 'recycles' 50-80% of the rainfall on which it depends, through evapotranspiration, deforestation reduces the amount of evapo-transpiration and therefore has a strong drying effect*"[139]. We can acknowledge the same drying effects due to the massive deforestation occurring in Indonesia and Malaysia to grow palm trees for biodiesel and due to the cultivation of petlands which were powerful carbon sinks.

We should mention finally the pollution of waters and depletion of soil fertility and biodiversity due to the monoculture of feedstocks, an excessive use of fertilizers and pesticides, and more and more of GMOs, and, for the sugarcane, the burning of canes before cutting and the non restitution of bagasse to the soil.

Conclusion

This overview of present and above all future impacts of agrofuels on food security shows the absurdity of their promotion on all grounds: they can only continue to aggravate food insecurity in the long run – increase in the number of chronically undernourished people –, violation of human rights, exclusion of small farmers and extension of unemployment, GHG, pollution of waters and soils and loss of biodiversity. They are benefitting only national and international agrobusiness, which includes also the large farms taking advantage of high agricultural prices to marginalize the smallest ones. In a word agrofuels are drawing us on a

[136] http://www.pnas.org/content/105/11/4513.full
[137] http://www.alphagalileo.org/ViewItem.aspx?ItemId=58317&CultureCode=en
[138] Weber Antônio Neves do Amaral et al., Environmental sustainability of sugarcane ethanol in Brazil, in Peter Zuurbier and Jos van de Vooren, *Sugarcane ethanol Contributions to climate change mitigation and the environment*, Wageningen Academic publishers, 2008.
[139] randd.defra.gov.uk/Document.aspx?Document=GA01105_7190_ABS.pdf

path opposite to sustainable development at the energy, economic, social and ecological levels. Moreover, and this is noteworthy, all the international institutions have condemned them.

Why then the EU and US are they persisting to promote them whilst they must subsidize them heavily and maintain a high import protection on ethanol? And why most DCs are they following suit? For these ones the answer is obvious: as they are aware that the EU and US will be obliged to import a large and growing share of the huge volumes of agrofuels they have mandated, they promote private projects for export, an appreciable source of hard currencies. All the more that they reckon that the EU and US will be less and less competitive after the conclusion of the Doha Round and bilateral free trade agreements they are negotiating with them, which will reduce the EU and US subsidies and their import protection. But this is a highly dangerous bet for the less DCs such as of Sub-Saharan Africa which are already facing fast increasing food deficits which will widen even more because they will never be competitive with South-East Asia for biodiesel and Brazil for ethanol.

As to the EU and US governments, they justify agrofuels after all by the necessity to continue supporting them as a temporary step to the profitability of second generation biofuels, which will benefit from the infrastructures and markets created for and by the first generation. The second generation biofuels are viewed as avoiding all the negative effects of agrofuels: they will not compete with food products and the land to grow them, they will not need chemical fertilizers and pesticides and will have a positive GHG balance. This view is highly questionable as the second generation based on vegetal biomass (agricultural and wood wastes, highly cellulosic dedicated crops and plantations) will compete not only with the agricultural lands available for food and non food crops but also for the other uses of wood, including for direct energy, considerably more efficient than biofuels. On the other hand the soils fertility will fall if we cease to restitute harvests residues[140].

The more so as their profitability will remain problematic for a long time, despite many on-going researchs and pilot plants. Although most experts and political authorities bank on their profitability between 2015 and 2020, the International Energy Agency (IEA) does not see it before 2030[141]. Independently of perfecting more efficient industrial processes, the cost of growing, collecting and transporting such heavy matter to large-scale plants will remain high. For the IEA the second generation ethanol would be profitable only for a production cost at the plant gate of $0.80 to $1 per litre of petroleum equivalent and the second generation biodiesel for at least $1/l of diesel equivalent diesel, but the costs would not drop at $0.70 per l of ethanol and $0.80 per l of biodiesel before 2030. Which corresponds to an oil barrel (159 l) price of at least 111-127 $.

Meanwhile the EU strives to marginalize the criticisms to the social and environmental impacts of agrofuels by trying to condition its imports through their certification in the exporting countries. However the experience of certification of tropical wood imports did not work[142]. All the more there is no credibility whatsoever that it could work for ethanol imports from Brazil, or for oil palm and biodiesel from Indonesia, Malaysia or Colombia, given the massive violation of human rights and their negative impact on the environment.

[140] World Rainforest Movement, *Ethanol from cellulose: A technology that could spell disaster*, December 2008, http://www.wrm.org.uy/

[141] www.iea.org/textbase/papers/2008/2nd_Biofuel_Gen.pdf

[142] Chris Lang, *Why certification of agrofuels don't work*, Bulletin rain Forest Movement, October 2008, http://www.wrm.org.uy/