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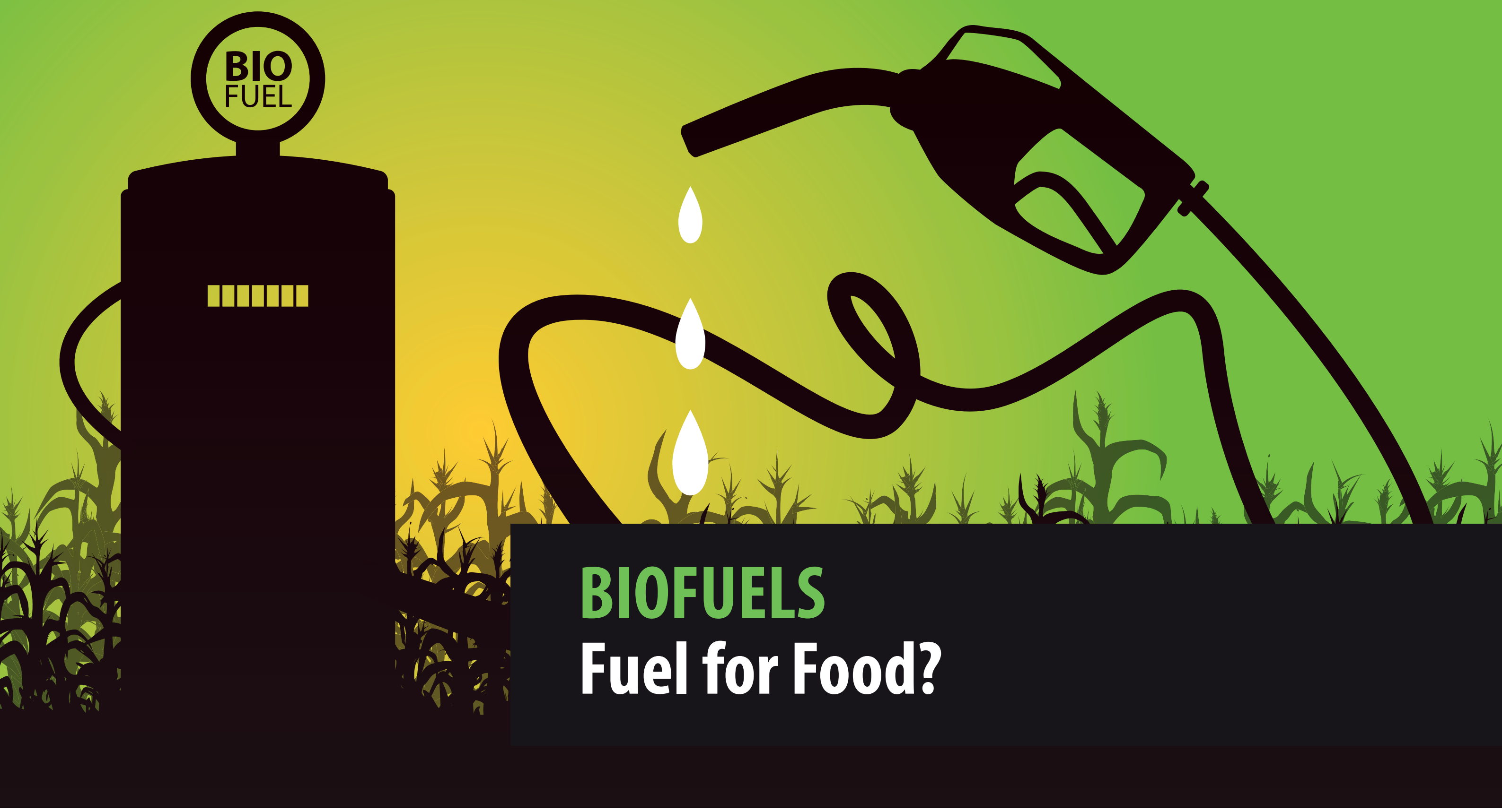


BIOFUELS
Fuel for Food?

Introduction

The term "biofuel" evokes the sense of something organic or environment friendly. A nearly super-hero role was expected of biofuels, with a vision of them saving us from an energy crisis, climate change, and alleviating poverty in the developing world. However, the results so far differ rather substantially from these expectations. In fact, it seems that not only will biofuels fail to provide a remedy to the global challenges, their overly supported production is well on its way to exacerbating the critical situation and contributing significantly to another global problem: the food crisis.

The aim of this paper is to introduce the topic of biofuels in a global context. Biofuel policies are so closely tied to many serious global issues that it is hard to ignore them. Glopolis offers a number of publications on hunger, the food crisis, and land grabbing; this publication seeks to elaborate on them by showing the role biofuels play in this rather unfortunate situation, as the link between hunger and biofuels is very strong. What biofuels are, the policies behind their production, and their impact on the poor will be looked at in greater detail in the following text.

What are biofuels?

Fuels produced from biological materials are called biofuel. Biofuels are used in transportation, for heating and to produce electrical energy. Biofuels are most relevant when talking about transportation, where it is expected to act as a partial substitute for fossil fuels, mainly oil. However, it is precisely this sector that is most problematic, as there are considerable concerns regarding the efficiency of biofuel production and its connection to a myriad of negative impacts it has worldwide.

There are two principle types of biofuel: biodiesel made from oilseed crops (palm, soy, sunflower, rapeseed, and jatropha) and ethanol produced from starches (maize and wheat) and sugars. What we can see here is that crops that are usually used for making food are very often used in manufacturing biofuel. The implications of this diversion will be given a closer look in the part of the paper devoted to the impacts of biofuel production.

Biofuels are further divided into three generations depending on how they are produced and what they are made from:

First generation: commercially available biofuel produced from food crops using conventional technology. Although it is not a food crop, jatropha is also included in this generation because it is produced using conventional technology and its cultivation competes with other food crops.

Second generation: produced using new technology, the large-scale commercial viability of this biofuel, still only in the demonstration phase, is not yet clear. Agricultural by-products such as wood waste and wheat stalks are used in production. The benefits of second generation biofuel are expected to be greater than those of the first generation.

Third generation: biofuels produced from algae using highly advanced technology. This biofuel is still in the research phase and commercial use is not expected in the near future.

Table 1: The main biofuel sources

1st generation		2nd generation	3rd generation
Biodiesel	**Bioethanol**		
Palm oil	Corn	Willows	Algae
Rape seed	Sugar cane	Poplars	
Sunflowers	Sugar beets	Grass	
Soy beans	Wheat	Agricultural waste products	
Jatropha		Forestry waste products	

Source: UNEP (2009)

About the crops

Sugar cane, sweet sorghum, maize and cassava are grown as food crops in Africa but are also considered as feedstock for ethanol production. Oil palm, soy, groundnuts and jatropha are being promoted for biodiesel.

Sugar Cane has been grown traditionally in parts of Africa as an export crop, with substantial industries in South Africa, Mozambique and Malawi. Originating in Asia, it grows well in tropical and sub tropical climates with considerable rainfall (60cm/year). It is grown in plantations and fields are burnt before harvesting, often by hand. Brazil is the world leader in terms of sugar cane cultivation and has also led the way in processing sugar cane for ethanol.

Sweet Sorghum is native to Africa, and is grown for food. The grain and the sugary syrup found its stems can be eaten. It likes dry warm conditions and can survive without irrigation. The high sugar content in the stems can be used for ethanol.

Maize is one of the most important staple food crops in Nigeria, and the crop covers some 60% of the country's agricultural land. It is traditionally grown alongside other crops in a mixed cropping system. The grain is used for food and animal fodder. Maize is used as a feedstock for ethanol in the US and Latin America and is being considered as a feedstock in parts of Nigeria.

Castor The castor oil plant is native to Eastern Africa and is found throughout tropical regions. It is widely grown in Ethiopia. The plants seeds, called beans, contain oil, protected by a toxic ricin coat. The oil is used medicinally around the world, but can also be refined to produce biodiesel.

Cassava is a starchy root crop that is eaten across Africa, Asia and Latin America, providing the staple diet for some 600 million people. It grows well even in poor soil, and its high starch content makes it a suitable feedstock for ethanol. Research is on-going into genetically modified forms of cassava and the Nigerian government and Shell are investing in research.

Oil palm trees are native to West Africa, producing fruit and seeds which can be crushed to extract edible oil which is also suitable for biodiesel. Palm oil is the most widely used form of cooking oil worldwide and is found in a wide range of processed foods, as well as soap and animal feed.

Jatropha is seen as a particularly suitable crop for agrofuel production because unlike other feedstocks, it is not a food source. Promoters argue that it does not therefore compete with food or contribute to food shortages. It can also grow on marginal land in relatively dry areas, making it suitable for drought-prone regions. Studies have however found that jatropha plants do require water in the early stages and plants grown on more fertile land have higher yields.

Soy beans, sweet potatoes, peanuts, wheat, maize, sorghum and copra are also used as energy crops in African countries.

Source: FoE Europe

What are the main reasons for biofuel production?

Climate change

Biofuel GHG neutrality was at the top of the list of its benefits. GHG neutrality means that the crops intended for biofuel production act as a carbon sink, absorbing carbon from the atmosphere. When they are used as a fuel and burned, the carbon is released back into the atmosphere and subsequently absorbed again by the next biofuel crops. This repetitive process leads to no extra or no less carbon – hence, neutrality. However, this very simplified view of biofuel production does not take into consideration the significant amount of emissions created by changing land use (e.g. cutting down forests to grow crops), intensive industrial production where a high level of fertilizers and pesticides are used, and finally, fossil fuel is also used in machinery and for the transportation of the crops around the world.

What is carbon sequestration?
Carbon is found in all living organisms and is the major building block for life on Earth. Carbon exists in many forms, predominately as plant biomass, soil organic matter, and as the gas carbon dioxide (CO2) in the atmosphere and dissolved in seawater. Carbon sequestration is the longterm storage of carbon in oceans, soils, vegetation (especially forests), and geologic formations. Although oceans store most of the Earth's carbon, soils contain approximately 75% of the carbon pool on land — three times more than the amount stored in living plants and animals. Therefore, soils play a major role in maintaining a balanced global carbon cycle

Source: ESA (2000)

Direct land use change occurs when non-agricultural lands such as forests, peat lands and grasslands are converted into agricultural land, in this case "biofuel land". As biofuel production grows in scale, more and more land is converted for the purpose of growing crops to satisfy the demand for biofuels. Soil stores a vast amount of carbon, and direct land use change releases this carbon into the atmosphere, thus not exactly helping in the fight against climate change.

Indirect land use change occurs when agricultural land where food is grown is turned into a biofuel plantation, meaning that the food crop cultivation is displaced and moved to another area converted into agricultural land. Thus, biofuel production indirectly causes land change by displacing the original crops. We can find plants that were grown for food such as rapeseed oil being allocated to biofuel production, the consequence of which is that edible oil has to be imported – this more often than not would be from a developing country where land use change is the consequence.

However, there are more unfortunate consequences of biofuel production: the exhaustion and erosion of soil. It is not unusual for widespread deforestation to occur to ensure a sufficient area of fertile land for growing biofuel crops.[1] A few examples roughly illustrate how incredibly demanding biofuel production is on land: in order to cover global energy consumption for 2010 using various biofuels, we would need over 30% of the Earth's land for producing sugarcane-based ethanol, or over 50% of the Earth's land in the case of cellulose-based ethanol.[2] Growing jatropha over the entire surface of Africa for one year would produce less than one-third of the energy equivalent of oil production in a single day.[3] Another important factor casting considerable doubt on the sustainability of biofuel production is its high demand on water– its so-called "water footprint". Whereas 90-190 litres of water must be invested to produce 1 megawatt hour (MWh) of energy from petroleum extraction and approximately 7,600 litres of water for producing 1 MWh from enhanced oil recovery, 1 MWh from corn-based ethanol requires 2.3-8.7 million litres of water and soybean biodiesel an incredible 13.9-27.9 million litres![4]

Energy security

As fossil fuels are a non-renewable resource that is expected to be depleted one day, future energy security is a pressing issue. However, there are better alternatives for securing energy. Although directing biofuel usage towards heat and energy appears to be a more reasonable utilization of biofuels than for transportation purposes, similar problems could arise since extensive monoculture production of biofuel invariably creates the same environmental problems seen with large-scale production. The main issue here is sustainability: as long as production is sustainable, biofuels can be beneficial. However, this is seldom the case.

Decreasing dependency on oil is a highly coveted aim of the EU and USA as it would reduce exposure to energy price volatility and possible supply disruptions. From a geopolitical perspective, oil is extracted in highly unstable regions and thus it might seem more "safe" for the EU and USA to satisfy their energy demand with domestic sources.

However, it is also important to look at the efficiency of biofuel production. One of the key parameters (criteria) in energy is energy return on investment (ERoI, or ERoEI – Energy Return on Energy Invested), sometimes also called net energy. To gain energy we must also invest a certain amount of energy, and it is precisely ERoI that expresses the ratio of energy input and output. Biofuel ERoI varies (0.8-10, within the EU it is 0.8-4)[5]; however, we can sum up that compared to other sources this is an extremely low value. According to relevant studies, in certain cases it is even possible to say that some biofuels cannot even be considered energy sources (see below). In other words, producing a more meaningful amount of biofuels is possible only thanks to subsidies that mainly the EU and USA provide to

1 FoE (2008):http://www.foeeurope.org/agrofuels/fuellingdestruction/FOEI_FuellingDestruction_mr_FINAL.pdf

2 Alternative Energy Sources and Land Use. Clinton J. Andrews, Lisa Dewey-Mattia, Judd M. Schechtman, and Mathias Mayr: http://news.cnet.com/8301-11128_3-20006361-54.html

3 David JC MacKay. Sustainable Energy without the hot Air: http://www.inference.phy.cam.ac.uk/withouthotair/cD/page_284.shtml

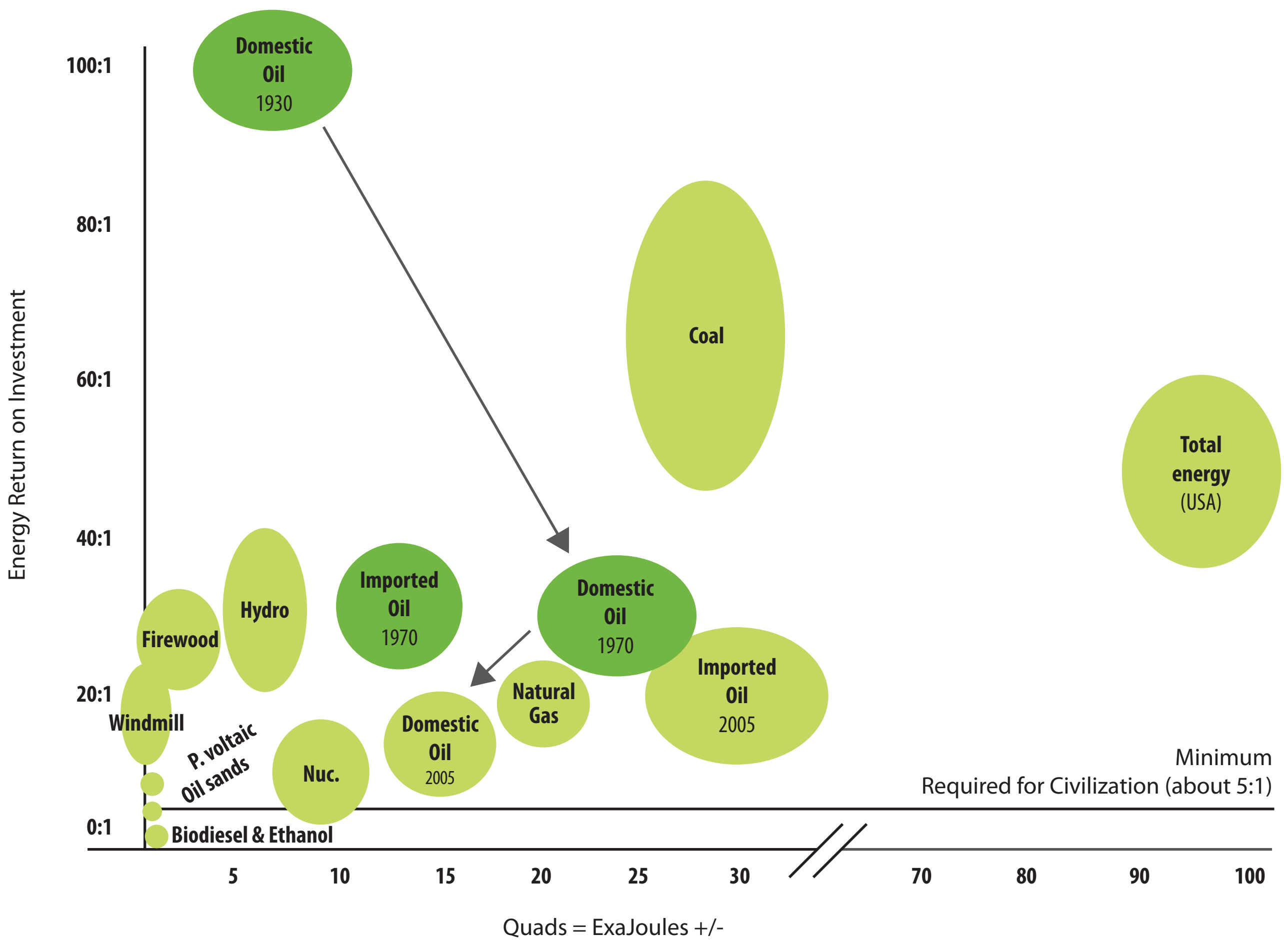
4 Nate Hagens, Kenneth Mulder. Energy and Water – the real blue – chips. http://fleeingvesuvius.org/2011/08/20/energy-and-water-the-real-blue-chips/

5 David J. Murphy, Charles A. S. Hall. Year in review—EROI or energy return on (energy) invested. Annals of the New York Academy of Science. Ecological Economics Reviews. Volume 1185, Issue 1, pages 102–118, January 2010. Article first published online: 29 JAN 2010 http://onlinelibrary.wiley.com/doi/10.1111/j.1749-6632.2009.05282.x/full; Cílek, Václav; Kašík, Martin. Nejistý plamen. Prague: Dokořán, 2007. First edition.

biofuel producers. Sugarcane-based biofuel (essentially rum) produced in Brazil stands as an exception, as its ERoI ranges from 5-10.[6]

Energy Return on Investment of biofuels (Murphy, Hall, 2010)	
Ethanol (sugarcane)	*0.8 - 10*
Corn-based ethanol	*0.8 - 1.6*
Biodiesel	*1.3*

Figure 1: Balloon Graph – Energy Return on Investment



Graph description: The horizontal axis indicates the Energy Return on Investment (EROI) expressed as the ratio of energy output versus energy input for each energy source. The vertical axis shows the amount of energy expressed in quadrillion (10 to 15) BTU (British Thermal Units). The graph shows energy use in the USA. The same graph, with similar results, is possible to prepare for energy sources and energy consumption in the world.[7]

Source: Cobb (2008)

Poverty alleviation

Biofuel production has also been perceived as a solution to poverty in rural areas. One of the main benefits for the local people was new job opportunities, offering them a better livelihood. A study from South Africa[8] shows that the effect of growing biofuel crops on poverty (in this case on income poverty) is highly dependent on the type of crop. Sugarcane and groundnuts are considered better options for increasing the incomes of farmers. On the other hand, with maize and sunflower crops it would be necessary to provide greater support to small-scale farmers for the effect to be positive. Especially in the case of maize, considerable problems with the food security of the poorest members of the population can arise due to maize being a staple crop. Improved infrastructure due to investments by biofuel companies in the area is also cited as an added benefit. Reality, however, shows biofuels in a different light, as their effects on developing countries are by and large discouraging. We look at the impacts on developing countries below.

6 Murphy, Hall 2010.

7 Kurt Cobb – Balloon Graph by Charlie Hall: http://energybulletin.cz/?q=clanek/bublinovy-graf-charlieho-halla

8 Ngepah, N. N., (2011): http://www.academicjournals.org/jdae/PDF/Pdf2011/Feb/Ngepah.pdf

EU 2020 biofuel target

The Renewable Energy Directive (RED) and the Fuel Quality Directive (FQD) were adopted with the aim of limiting greenhouse gas (GHG) emissions and promoting cleaner transportation[9]. This legislation stipulates that 20 percent of all energy in the EU must come from renewable sources by the year 2020. Although this is generally considered a good development, there is a further requirement that a minimum of 10 percent of transportation fuels must also come from renewable sources. This target will be fulfilled almost entirely by biofuels. However, Europe does not have enough land to accommodate the huge amount of biofuels needed to attain the required 10 percent. An easy solution seemed to be to move production to other countries, where there is enough land to do so, namely to developing countries. The impacts of this are looked at below.

The European Union's targets for renewable resources for the year 2020 have prompted biofuel support at several levels:

- Budgetary support (domestic subsidies and tax exemptions)
- Mandates (targets imposing a minimum percentage of biofuel-use)
- Trade measures (import tariffs)
- Promoting research and development

To reach the EU targets, considerable tax exemptions and reductions have been provided as a way of supporting biofuel production. Mandatory blending targets, on the other hand, impose a minimum percentage of biofuels that has to be blended with fossil fuel (10% by 2020). "A major difference between tax exemptions and mandatory substitution policies is that the cost of the former is met from public funds whereas the higher fuel cost due to compulsory blending falls on the fuel supplier and hence, most probably, on the fuel user."[10] Moreover, these mandates put pressure on food prices.[11] Biofuel crops that are grown in the EU receive subsidies as a type of support, too. What this in fact means is that biofuel production is made a lot more economical than it actually is – without these subsidies biofuels are uncompetitive and make little economic sense.

In Table 2 we can see the amount of tax exemptions and agricultural subsidies in the EU for 2006 and the expected amounts in 2020 (assuming the levels stay the same as in 2006).

9 Client Earth (2011): http://www.clientearth.org/reports/clientearth-briefing-reporting-obligations-renewable-energy-fuel-quality-directives-social-sustainability-requirements.pdf

10 JRC (2010): http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/15287/1/jrc58484.pdf

11 IMF (2011): http://www.imf.org/external/np/exr/faq/ffpfaqs.htm

Table 2: The main EU industrial biofuel subsidies in 2006 and 2020

€ millions	2006 costs to the EU taxpayer	2020 projected costs to the EU taxpayer
Tax exemptions for producers	2 960	9 506
Agricultural support	1 448	4 216
Total subsidy	4 408	13 722

This assumes that payments and exemptions continue at the same level from 2006 to 2020. While the rate of tax exemptions is already falling in some countries, this is countered in part by increased volumes.

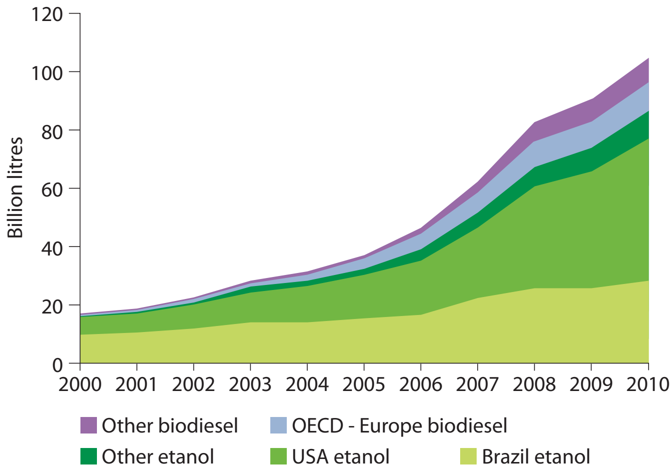
Source: Action Aid (2010)

Generally, domestic production of biofuels is favoured over imports, and for many exporting countries there are tariffs which in the end make biofuels even more expensive for consumers in the EU. There are many countries – African, Caribbean and Pacific (ACP) countries under Economic Partnership Agreements (EPAs), and a number of developing countries like Guatemala, Sri Lanka, or Colombia, however, that are exempt from tariffs and it is these countries that are the frequent targets of biofuel companies. "Whether the 2020 mandatory targets are met largely by imported biofuels rather than domestic production will be a key determinant of the extent of land use changes and other knock-on impacts of these targets within the EU."[12]

What these targets mean for developing countries

The EU target of increasing the use of renewable energy for transportation will lead to a greater demand for biofuels. This in turn will push up the prices of crops used for biofuels, thus encouraging production of those crops in a greater scale and in more developing countries, further displacing food crops.

Figure 2: Global biofuel production 2000-2010



Source: IEA (2010)

12 JRC (2010): http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/15287/1/jrc58484.pdf

Increased biofuel production has lead to a number of unfavourable impacts, mainly on developing countries:

- Food price hikes
- Land grabbing
- Displacement of local people
- Loss of biodiversity

One of the most significant contributors to the worsening hunger crisis[13] is biofuel. It is estimated that they are responsible for 30%-75% of the rise in food prices in 2008. Even with the lower estimate of 30%, this still means that there are 30 million more hungry people in the world and a further 260 million are at risk of hunger.[14] "Food prices are literally a matter of life and death, especially for the poorest of the poor, who already spend anywhere from 80% to 90% of their income on food. For them, a small increase in the price of bread or rice means the family goes hungry. Global food prices rose sharply in 2007-2008 and have remained high since. While prices are expected to ease somewhat, they will still average 20-30% higher in the next decade than over the past 10 years."[15]

Biofuels must be grown somewhere and, given the huge rise in their production, a lot of land is needed to satisfy the demand. A frequent term in this debate is "land grabbing" or in other words, investment in land.[16] Land originally used for food production is replaced by biofuels; the local farmers are often displaced or are taken on as workers on the new biofuel plantations. Although this might be considered a good opportunity for gaining better income and improving infrastructure in the area, a great deal of evidence shows that working conditions for the local people are poor, their remuneration lower than agreed upon, and many guarantees of building infrastructure and schools not realised. Those that are displaced often have no choice but to move to marginal land, where the soil is of low quality, or to clear forest areas to grow food (causing the indirect land use change described above).

"Companies are now focused on persuading local farmers to grow biofuels on their own land, displacing food crops where there is water and soil fertility, and shifting the burden for crop failure onto the farmers. But compared to growing food crops, the farmers complain of suffering financial losses, earning just $60 per hectare instead of the promised $400 per hectare."[17]

Guatemala case study

Guatemala has been discovered internationally as a suitable area for biofuels production, both for ethanol (sugar cane) and biodiesel (oil palm). This has given rise to a new wave of land dispossession, targeting the few remaining indigenous and peasant lands. The area planted with sugar cane in Guatemala increased from 3.4 percent of the total agricultural area in 1980 to 14 percent in 2008. Similarly, the area dedicated to palm oil increased from 35,000 to an expected 100,000 hectares in 2010. The areas deemed suitable for conversion to sugar cane and oil palm are also those where the Secretariat of Agrarian Affairs has registered the highest levels of land conflict.

The Polochic Valley region in the north west of the country is one of the areas targeted for increased sugar cane cultivation. In 2005, the Widmann family moved their sugar cane refinery from the south coast to the Polochic Valley, renaming it Chawil Utz'aj ('Good Cane' in the local Q'eqchi language), using a loan of $26m from the Central American Bank for Economic Integration (CABEI). By 2008, Chawil Utz'aj had planted 5,000 hectares of sugar cane. The farmers saw themselves with no option but to seek refuge in the steep and infertile lands of the Sierra de las Minas.

According to media articles, by 2010 Chawil Utz'aj was struggling to repay the loan. The mill's land was put up for public auction. Farming families who had to leave the valley a few years earlier decided to return in late 2010 to occupy the land for food production. However, as has been recorded by a human rights mission from the UNESCO program on sustainability of the University of Cataluña, in March 2011, private security units forcibly evicted more than 800 families in 14 communities in the Polochic Valley.

Source: Oxfam (2011)

It is generally known that large-scale intensive monoculture (single crop) farming has very bad effects on biodiversity. Thus, the scale of production, type of crop, and previous land use all determine the impact biofuels will have on the diversity of the surrounding nature. The evidence available so far shows negative consequences for the environment, especially when looking at direct and indirect land use change. Furthermore, biodiversity can even be adversely affected by post-conversion management through pollution created by fertilizers and pesticides, for example.

"The expansion of biofuel production in the tropics has resulted in the loss of tropical forest and wetlands, and in temperate regions biofuel production has encroached into set-aside lands. Biofuel feedstock plantations (particularly oil palm and maize plantations), have been shown to support far lower levels of biodiversity than natural ecosystems, and can cause soil erosion and the pollution of watercourses."[18]

13 You can find an introduction on hunger and the food price hike of the 2008 economic and food crisis in Glopolis' publication "Hunger: The Nightmare of Millions" (2011): http://www.glopolis.org/en/articles/hunger-nightmare-millions/

14 Action Aid. Meals per Gallon (2010): http://www.actionaid.org.uk/doc_lib/meals_per_gallon_final.pdf

15 OECD (2011): http://www.oecd.org/document/25/0,3746,en_2649_37401_48208217_1_1_1_37401,00.html

16 A good introduction on this can be found in Glopolis' publication "Land Grabbing: A Threat to Food Security" (2011): http://glopolis.org/en/articles/land-grabs-in-africa/

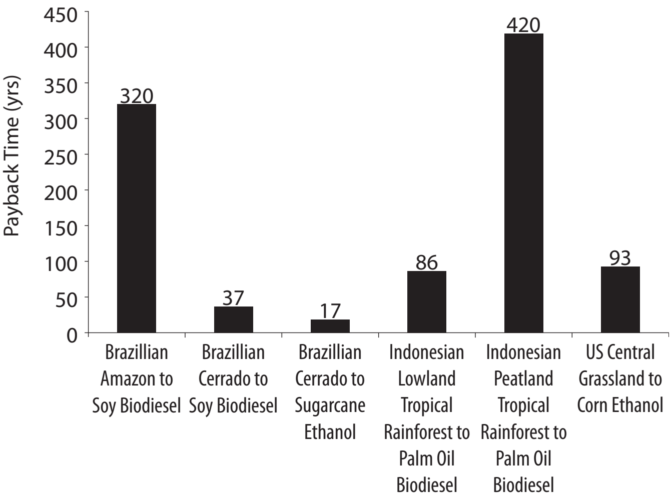
17 Gaia Foundation (2010): http://www.gaiafoundation.org/content/biofuels-failing-africa-report-ethiopia

18 UNEP (2009): http://www.unep-wcmc.org/medialibrary/2011/03/11/628e876f/The%20impacts%20of%20biofuel%20production%20on%20biodiversity_final_for%20release.pdf

It is mainly due to land conversion that the expected GHG emission benefits of biofuels are not materialising. For example, while there can be large GHG emission savings by using palm oil, changing the land use of rainforest and peat lands can in fact result in an 800-2,000% increase in emissions than equivalent fossil fuels.[19]

By comparing the increase in emissions due to this type of land conversion to the potential emissions savings of using biofuels, we can calculate our "carbon debt," or the number of years we will have to wait for biofuel production to pay back. In carbon rich areas such as rainforests and peat land, the number of years is as high as 420.[20] This number is very real for Indonesia and Malaysia, where land conversion is occurring for palm oil biodiesel production. The payback time for soy biodiesel production in Brazil is expected to amount to 320 years.

Figure 3: Payback time for different biofuels and land use change



Source: Oxfam (2008)

Conclusion

Biofuels are here to stay, so the question is more about how to produce them so that we keep the negative effects to a minimum. First of all, biofuel must be produced sustainably. They should not compete with food crops and should not induce such high levels of direct and indirect land use change, which lead to a loss of biodiversity and increased GHG emissions in our atmosphere. It is necessary to ensure that the biofuels produced offer real GHG savings. If biofuel production is to help in the fight against poverty, local people must be offered decent working conditions, smallholder organisations should be promoted and indigenous communities must not be displaced.

One of the easiest ways to counter climate change, the energy crisis and the food crisis is to reduce our energy consumption. This can be done through investment in alternative and more sustainable forms of transportation (bicycles and electric cars), improved vehicle efficiency standards and clean energy.[21] Moreover, there should be investment in the research and development of further possible utilization of biofuel by-products, for example for the production of alternative fuels (biogas, butanol), animal feed and compost.

More concrete recommendations regarding the EU's stimulation of biofuel production:

- Cease the implementation of new biofuel mandates
- End subsidies and tax exemptions for biofuels
- Reduce tariffs on biofuels

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