Burning questions - Certainties and uncertainties concerning agrofuels

Draft discussion document

This draft paper is meant as input for a meeting between Dutch scientists and policymakers on February 18th,2010, titled "Brandende vragen. Zekerheden en onzekerheden in wetenschap en beleid omtrent biobrandstoffen". The meeting is organised by the agrofuels platform, within in the framework of the Development Policy Review Network (www.DPRN.nl).
We invite all participants to submit comments to the authors (k.kusters@uva.nl).
We intend to include a short report of the meeting as an annex to the final document. This will be shared with all participants before finalizing the document.

DPRN Agrofuels Platform

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DPRN

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This paper is part of the process entitled 'Social and ecological effects of biofuel policies', which is being carried out within the framework of the Development Policy Review Network (DPRN) and implemented by the Agrofuels Platform.

The Agrofuels Platform is a joint initiative of Both Ends, IUCN-NL / Natureandpoverty.net, AISSR (University of Amsterdam), Mekon Ecology, Alterra (Wageningen University), Law and Governance Group (Wageningen University), ETC International, Cordaid and Leiden University. For more information see http://www.agrofuelsplatform.nl

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Introduction

The last couple of years showed an increase in the production of biofuels from food crops such as sugar cane, corn, wheat, sugar beet and oil palm, largely driven by policies and subsidies to stimulate biofuel use. The European Union promotes biofuels as a measure to reduce CO_2 emissions and many countries promote biofuels to become less dependent on the import of (expensive) fossil fuels.[1] The environmental and social effects of increased production and use of biofuels are much debated. Proponents – who consider it the answer to both rising oil prices and the negative climatic consequences of fossil fuels – find themselves opposed to those who warn for the threats that biofuels pose to food security, biodiversity and poverty reduction.

Any discussion concerning biofuels is bound to be charged because it brings together a range of political and business interests in areas as diverse as energy security, the oil industry, agricultural policy, the food industry, poverty and development, climate change, biodiversity and the automobile industry. These discussions are only meaningful when they are based on unbiased information and a proper understanding of the actual effects of biofuel production.

There is an urgent need for more information regarding the effects of biofuel production on people and the environment. Scientists need time to research and analyse the actual effects. Policy makers and businesses, however, seem to be impatient and may (have to) take decisions on the basis of assumptions, but these assumptions, and their underlying values and motives, are not always properly communicated. A group of Dutch research institutions and NGOs created an 'agrofuels knowledge platform' aiming to contribute to an overview of the available scientific knowledge and the perspectives of various stakeholders. On Feb 18th, 2010, the platform organises a discussion between scientists and policymakers to discuss some certainties and uncertainties within the biofuels debate.

1.1. Purpose of the study

This document serves as input for a meeting on the 18th of February, 2010, between scientists and policy makers. The document has three main objectives. First we attempt to outline the positions of the various stakeholders, as to understand the motives for their decisions. Second, we present some of the available data related to the effects of biofuel production, derived mostly from academic publications. Third, we reflect on some of the most debated issues and the type of information that appears to be needed to improve decision making. On page 45, we suggest several issues for the discussion between scientists and policymakers during the meeting on February 18th, 2010.

A significant part of the information presented in this document comes from the Biofuels Info Service – an online information service managed by Natureandpoverty.net, coordinated by IUCN Netherlands Committee (http://np-net.pbworks.com). References to online sources, policy documents and newspaper articles are provided in the endnotes.

1.2. Some background information and definitions

Plants absorb solar energy through the process of photosynthesis and store it in the form of organic matter – 'biomass'. In order to do this, plants take up carbon from the surrounding atmosphere as well as water and nutrients from the soil. Biomass is thus a store of both energy and carbon. *Bioenergy* is the energy derived from biomass. Bioenergy can be produced directly through the combustion of biomass such as wood or straw. Biomass (e.g., from harvest residues or organic waste) can also be converted to gas to generate electricity and heat. Industrial processes enable liquid fuels for transport to be produced from biomass. These are called *biofuels.*

Biofuels are a renewable energy source. A growing tree takes up carbon, and burning the wood frees the same carbon in the atmosphere. This can be considered a closed natural cycle. Although crude oil also originates from organic matter, this was stored deep in the earth and taken out of the equation of the CO_2 balance in the atmosphere. Burning fossil fuels thus adds CO_2 to the atmosphere. Biofuels have been widely promoted for their 'carbon neutrality'. Substituting fossil fuels by biofuels could help to mitigate climate change, but this requires a favourable greenhouse gas (GHG) balance. The GHG balance refers to the net reduction in CO_2 emissions, i.e., the gross emission reduction minus emissions caused by biofuel production.[2] This means the full life cycle of the biofuel crop should be taken into account, including carbon storage in the soil, the use of fertilizers, and the chain from harvesting to consumption.

Biofuels can be subdivided in *bio-ethanol* and *biodiesel*. Biodiesel is a substitute for fossil diesel fuel and is primarily produced from oilseeds (rapeseed, soy, and palm oil). Bioethanol is an alcohol derived from sugar or starch crops (mainly sugar cane, corn and sugar beet) by fermentation and can be used in special engines or blended with petroleum fuel. Most of the world's biofuel is bioethanol, and 60% of the bioethanol comes from sugarcane.[3] Within the United States ethanol is mainly produced from corn. At the global level, the diesel/biodiesel market is smaller than the petrol/ethanol market. The main diesel market is the European Union. Biodiesel is particularly important in the German market, where it is derived from rapeseed (Peskett et al. 2007). Biodiesel production within Brazil is growing, of which 80% comes from soy.

A differentiation is needed between first, second and third generation biofuels. The definitions, however, vary. The distinction between first second and third generation biofuels is usually made based on three characteristics: the technology used, the use of edible or non-edible part of the feedstock and the CO_2 reduction potential. Here we follow the definitions published by IUCN NL (2008):

First generation biofuels are transport fuels produced through conventional technology from feedstock like wheat, corn, sugar, palm oil and sunflower oil, i.e., agricultural products which are also used as food and feed. Different crops are used in different countries (EU: rapeseed, wheat, sugar beet; US: corn, soybeans; Brazil: sugar cane; Southeast Asia: palm oil). Currently only first generation biofuels are commercially viable.

Second generation biofuels are produced through more advanced conversion technologies that allow the use of non-edible materials derived from plants (mostly lingo-cellulosic parts, like stalks and straw, but also woodchips). The CO_2 performance tends to be better than that of first generation biofuels because all source material is used and organic waste material can be used. A concern related to second generation biofuel is that, if all organic matter is removed from the land, soil fertility will decrease and the regulation of water and nutrient content may be affected. Technological breakthroughs and considerable investments in infrastructure are required to make second generation biofuel production commercially viable. The estimation is that the technology will be commercially available in about 10 years' time.

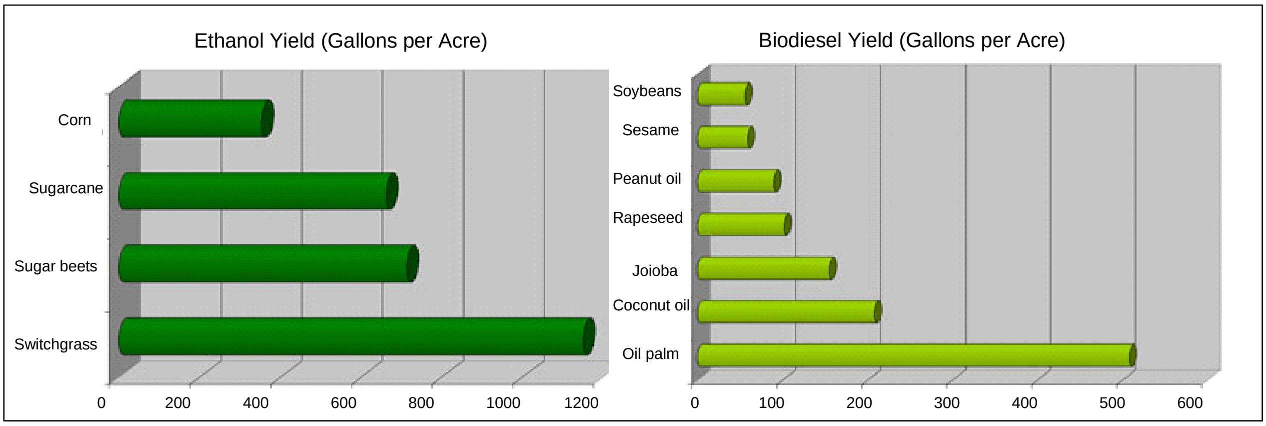
Third generation biofuel generally refers to the production of ethanol from plants that were modified for easier processing (e.g., poplar with lower lignin content), and the production of biodiesel from algae. These techniques are expected to have a better CO_2 performance than the use of first and second generation biofuels.[4]

The term *agrofuels* refers to biofuels for which agricultural lands have been used. We decided to focus our work on agrofuels, because at the moment virtually all commercially produced biofuels are produced from crops grown on agricultural lands. The term agrofuels includes so-called first-generation biofuels made from oil palm and sugarcane, but also second generation biofuels made from Jatropha, when grown on agricultural lands.

1.3. The main agrofuel crops currently produced

In theory all crops with an oil content or starch can be used for the production of first generation biofuels. However, a certain amount is needed to make the crop commercially attractive. Examples are oil palm, Jatropha, rapeseed for biodiesel and sugarcane, corn, cassava[5], and sweet sorghum[6] for ethanol. Currently, the most important crops used are those that were already substantially planted before the boom: oil palm, sugarcane, rapeseed, and corn. The popularity of various crops can be explained by their oil and sugar content which determine basic production yields per hectare (Figure 1).

Figure 1: Yield of various crops.



Source: http://www.landcoalition.org/cpl-blog/?p=779

Oil palm

Oil palm (*Elaeis guineensis*) plantations already cover over 13 million ha, primarily in Southeast Asia. Palm oil is used in the food and cosmetic industries, but the oil can also be used for biodiesel production. The demand for biodiesel adds to the already existing demand for palm oil. Malaysia and Indonesia are the world's largest producers of palm oil, but Malaysia's per hectare yields are about twice as high as Indonesia's, as production is more intensive, with better seed selection and a high use of fertilisers and pesticides. Further expansion of palm oil plantations is planned. Indonesia, for example, plans an additional 20 million hectares (Colchester et al. 2006). Oil palm production is already controversial. The establishment of palm oil plantations is associated with widespread land-conflicts between companies and state authorities on the one hand and local communities on the other hand. Moreover, palm oil plantations are often establishment at the expense of primary tropical forest, leading to biodiversity loss. If this is done with the purpose of producing biodiesel, the land conversion leads to emissions of the stored carbon (from the trees and the soil) and research shows that this leads to a negative GHG balance (i.e. negative for climate change). Clearing peat land for oil palm plantations (which is common in Indonesia) is particularly controversial from a climate perspective, as drained peat emits even larger amounts of carbon (see e.g., Ernsting, 2007; Danielsen et al., 2006; Roberts, 2007). Palm oil production is also growing in countries such as Colombia and Brazil and is planned in DR Congo.

Rapeseed / Canola

Oil from rapeseed (*Brassica napus*) – originally used for oils, soaps and plastics – has become the basis for biodiesel production in Europe. Although China is the largest producer of rapeseed, the European Union (especially Germany) is the largest producer of biodiesel from rapeseed oil, producing about 18 million tons per year. Europe's dominance is largely explained by the subsidies for rapeseed cultivation to meet the European CO_2 reduction targets. At the moment the production of biodiesel from rapeseed is more expensive than fossil-based diesel. The GHG balance is not very favourable as the production of rapeseed requires a lot of energy, for example through the use of fertilizers.[7]

Sugarcane
Production of bioethanol from sugarcane (*Saccharum* spp) is relatively cheap and today very energy-efficient (in terms of reduction of GHG emissions). Ethanol from sugarcane has been an important source of fuel in Brazil since the 1980s. Brazil has about 7 million ha of sugarcane, covering 2% of Brazil's arable land. With demand rising, this is expected to grow in the future.[8] The sugarcane crop and production technology has advanced over the years and, in addition the residue of the sugar cane, bagasse is used for energy generation in the ethanol factory. As a result, ethanol production from sugarcane on existing farm land has a positive GHG-balance. Within Brazil, the main concern is the expansion of sugar cane taking over land from soy and cattle producers that in turn move to the Amazon region. A recent study on sustainability of Brazilian bioethanol concluded that its production can be sustainable, but that there are many uncertainties for the future, related to these possible 'indirect effects' (Smeets et al., 2006). In other countries, such as Mozambique, sugar cane plantations are expected to expand rapidly in the near future, mostly on existing farm land.

Corn
Corn (*Zea mays* L. ssp.) is used for the production of bioethanol. This is particularly common in the United States, where approximately 20% of the corn grown is used for the production of bioethanol. Producing bioethanol from corn is not very efficient. Even if all corn in the US was used for the production of ethanol, it would only cover 12 to 15 % of the transportation fuel needs in the US. With rising grain prices it is to be expected that corn-based ethanol will become uneconomic (Roberts, 2007). Ethanol production is also growing within the EU, especially in France and the United Kingdom (using corn and sugar beet).

Soy
Soy is mainly grown in the United States and Brazil. Soy meal is used as cattle fodder and a by-product in this process is soy oil, which can be used for biodiesel. Within Brazil the production capacity of biodiesel factories is rising fast. Today, 80% of all biodiesel produced stems from soy. As yet, biodiesel is not yet exported in large quantities as Brazil tries to keep up with domestic demand. The United States exports some biodiesel (supported by subsidies) to the European Union.

Box 1. Jatropha
Jatropha is another biodiesel crop, but is not yet produced in commercial quantities. In recent years, attention for Jatropha to produce biofuels soared. Jatropha (*Jatropha curcas*), also called physic nut, produces an oil that is used for candles, soap and biodiesel. It is a non-food, reasonably drought-resistant energycrop, which can grow on poor soils. The crop has clear fans and foes.[9] The proponents stress that the plant grows well on poor soils and can be used on marginal lands (and therefore does not compete with cropland), has a very high productivity, is easy to establish, and has a long live span (producing seeds for up to 50 years). For these reasons the plant has been embraced by industries, and large-scale plantations are being established all over the world, including Africa. Many are, however, still in a planning or pilot phase (covering only a couple of hundred or thousand hectares). In recent years several countries (India in particular) have been building plants for the production of biodiesel from Jatropha (Roberts, 2007). Moreover, several authors have argued that small-scale Jatropha cultivation provides interesting possibilities for small farmers (Hasan, 2007; Cotula et al., 2008), Foes, however, argue that the success of (both small-scale and large-scale) Jatropha cultivation has so far been limited, due to low profit margins, low yields and unrealistic expectations. Commercial viability has not been proven yet. Many pilots are established with government subsidies. They also warn that, even though Jatropha can indeed grow on poor soils, the plant will need sufficient water and nutrients in order to produce acceptable yields (Asselbergs et al., 2006). In the same line of reasoning, some point to the risk that commercial companies will look for good lands for large-scale Jatropha production, resulting in competition with food crop production and pushing aside small farmers (Seedling, 2007).

1.4. The expansion of agrofuel production

Although biofuels currently provide only 1.8 percent of transport fuels (UNEP 2009), global production and use of biofuels is increasing rapidly. World ethanol production for transport fuels tripled between 2000 and 2007 from 17 billion litres to more than 52 billion litres, while the production of biodiesel expanded 11 fold from less than a billion litres to 11 billion litres. Investment in biofuels production capacity exceeded US$4 billion worldwide in 2007. International trade has been relatively small (about three billion litres in 2006/07), but is expected to grow rapidly in countries like Brazil where in 2008 five billion litres were exported (UNEP, 2009).

Many countries, also the poorest ones, are in the stage of developing ambitious plans for agrofuel plantations, both for export and for domestic energy supply (BZOS, 2007). As a result, global production is expected to increase further, particularly in Brazil, the US, the EU, China, India and Malaysia. In Africa too, agrofuel business is taking off, because of the ‘availability’ of land, favourable climate, cheap labour, and supportive national governments eager to attract foreign investments.

Many southern countries see agrofuel production as a way to attract foreign investments, revive their agricultural sector, and reduce dependency on oil import.
In some cases, such as in Brazil, part of the expansion will feed into the local energy market. However, it is to be expected that the bulk of these projected production increases will be aimed at the export market, serving the energy needs of the United States of America and the states in the European Union. Thus, demand and policy changes in the OECD countries are key drivers for energycrop production. Indeed, the expansion of agrofuel production cannot be understood outside the context of government policies aimed at influencing the energy and agricultural markets through subsidies and tariffs.[10] The US government, for example, coupled subsidies for agrofuels to import tariffs, to make sure that subsidies will benefit domestic farmers.[11] Also, blending targets –targets for the percentage of biofuels to be mixed with fossil fuels in petrol and diesel – are important instruments to promote production of biofuels.

1.5. Summary of arguments pro and con

Pros of biofuel

- Agrofuels are an alternative for the insecure and exhaustible supply of fossil fuel.
- Agrofuel production can reduce the dependency of developing countries on expensive import of fossil fuels, and improve their trade balance.
- The feedstock used to make agrofuels is renewable - fresh supplies can be produced as needed - so in theory there is an unlimited and secure supply.
- Certain forms of agrofuels have a positive GHG balance as compared to fossil fuels; their use will thus have a positive effect on climate change.
- The production of agrofuels is not restricted to specific countries that can control supply and determine the price.
- The production of agrofuels holds economic opportunities for (investments in) the agricultural sector in developed and developing countries, generating employment and increase rural incomes.
- Agrofuels can be easily blended with fossil fuel to a certain percentage and used in existing car and lorry engines (in contrast to electricity or hydrogen for which other cars and engines are needed).
- Agrofuels offer opportunities for local energy provision which is badly needed as currently 1.6 billion people lack access to electricity and 2.4 billion people lack access to modern fuels for cooking and heating.

Cons of biofuels

- The GHG emission reduction potential of agrofuels strongly depends on whether of not natural land is converted (conversion of natural areas could even lead to a negative balance).
- Production of feedstock for agrofuel competes with (land for) food production, both direct and indirect.
- Production of agrofuel feedstock has an effect on food prices, with serious consequences for the poor.

- Production of agrofuel feedstock can lead to rising land prices and income inequality.
- Production of agrofuel feedstock poses a threat to biodiversity due to the economic incentives for clearing forests and using wetlands and peat lands for growing the required feedstock.
- Production of agrofuel feedstock and processing causes competition for scarce water resources.
- The threat that people will be displaced from their land for the construction of plantations or other large-scale agricultural schemes.

Dilemma
Scientific research shows that some biofuel crops may have a positive GHG balance. The balance, however, becomes negative when natural lands are converted. Proper land-use planning therefore becomes an important element in assuring (and assessing) the sustainability of biofuels. It should be noted that expansion of agricultural land will also occur due to a rising need for food by a growing world population. And crops such as soy and palm oil are planted because of this need. A producer will try to meet demand and is not concerned whether the produce is used for the food industry or as biofuel. A 'business-as-usual' expansion will not lead to meeting the objective of reducing GHG emissions and will not lead to a sustainable production (*vis-à-vis* criteria set on certain crops in international Round Tables).

2. Stakeholders' positions

2.1. European Union

The European Union communicates that climate change concerns are the main reason for promoting biofuels. Underlying is a need to diversify the EU energy strategy and becoming less dependent on the whims of oil and gas-producing countries in order to secure access to energy. In 2003 the 'Biofuels Directive' on the promotion of the use of biofuels and other renewable fuels for transport, set out indicative targets for Member States. In early 2006, the EU presented its 'Green paper – A European Strategy for Sustainable, Competitive and Secure Energy'.[12] In 2009 two relevant European Directives were published: the Renewable Energy Directive[13] (RED) and the Fuel Quality Directive (FQD).

Box 2. Position of the EU as expressed in the Renewable Energy Directive
"The control of European energy consumption and the increased use of energy from renewable sources, together with energy savings and increased energy efficiency, constitute important parts of the package of measures needed to *reduce greenhouse gas emissions* and comply with the Kyoto Protocol to the United Nations Framework Convention on Climate Change, and with further European and international greenhouse gas emission reduction commitments beyond 2012. It also has an important part to play in *promoting security of energy supply*, promoting technological development and innovation and providing opportunities for employment and regional development, especially in rural and isolated areas."

According to the RED, the overall target for renewable energy (which includes biomass, biogas, wind, solar, hydro and geothermal energy) across the EU is 20% in 2020. The RED gives binding targets for each member state. For the Netherlands this is 14%. Within this national target, each member state is obliged to accomplish 10% renewable energy within the transportation sector. As the 10% target for renewable energy in the transport sector is likely to be met primarily through the use of biofuels, we still tend to speak of a 10% "European blending target" (even though this is formally not correct). At the level of individual member states, obligatory blending targets may be in place (such as is the case in the Netherlands). As CO_2 emissions in the transport sector are still increasing, while most other sectors are effectively reducing emissions, the European Commission sees the use of biofuels as an effective way to reduce CO_2 emissions in the transport sector in the short term.

The RED sets binding sustainability criteria for biofuels in Article 17. The criteria are presented in Box 3 below. Market parties themselves will have to prove, through independent audits, that their biofuels meet the criteria. Only if the binding sustainability criteria are met, will the biofuel count towards the renewable energy target. In addition there will be a reporting obligation for Member States regarding the environmental and social effects of production. The guideline for the reporting obligation is currently being developed.

Box 3. Article 17 of the EU Renewable Energy Directive: Sustainability Criteria

1. The *greenhouse gas emission saving* from the use of biofuels and other bioliquids shall be 35%. With effect from 2017, the greenhouse gas emission saving from the use of biofuels and other bioliquids shall be 50%. After 2017 it shall be 60 % for biofuels and bioliquids produced in installations whose production has started from 2017 onwards.

2. Biofuels and other bioliquids shall not be made from raw material obtained from *land with high biodiversity value*, that is to say land that had one of the following statuses in or after January 2008, whether or not the land still has this status.

3. Biofuels and other bioliquids shall not be made from raw material obtained from *land with high carbon stock*, that is to say land that had one of the following statuses in January 2008 and no
longer has this status.

4. Biofuels and other bioliquids shall not be made from raw material obtained from *land that was peatland* in January 2008, unless it is proven that the cultivation and harvesting of this raw material does not involve drainage of previously undrained soil.

The Fuel Quality Directive sets standards for the quality of fuels. It states that the CO_2 emissions, measured over the life cycle of fuels, should be reduced with at least 6 percent in 2020. One of the ways to accomplish this is through using biofuels. Biofuels on their turn will have to comply with the sustainability criteria as outlined in RED.[14] The Fuel Quality Directive has been criticised by producing countries as it sets standards for the bio-ethanol and biodiesel that favours European producers.

2.2. The Dutch government

The Dutch government wants to make a transition to a more sustainable energy supply (de 'EnergieTransitie').[15] In September 2007, the work program '*Schoon en Zuinig. Nieuwe energie voor het klimaat'* was launched.[16] It spells out the ambitions of the current government to reduce emissions by focusing on efficient energy use, sustainable energy and the reduction of dependence on fossil fuels. In particular it wants to:

- Reduce emissions (of especially CO_2) in 2020 by 30% in comparison to 1990;[17]
- Raise energy efficiency by between 1% to 2% a year;
- Intensify the use of sustainable energy, from 2% to 20% of the total energy use by 2020.

In June 2008, the Ministers of Economic Affairs (EZ), Foreign Affairs (BuZa), and Housing, Spatial Planning and Environment (VROM) presented the '*Energierapport 2008'*, describing the government's long-term vision and ambitions, and the measures that will be taken up to 2011 to work towards a more sustainable energy supply.[18] The government will invest €7 billion and points at opportunities for the Netherlands and Dutch businesses. Energy from biomass is presented as one of a package of measures.[19]

In response to the heated debates on the use of biofuels, the Dutch 'Regieorgaan EnergieTransitie' published a document on the use of biomass for energy: '*Biomassa, hot issue. Slimme keuzes in moeilijke tijden*'.[20] It concluded that biomass is essential to achieve a sustainable energy supply. The advice: maintain ambitious goals, on the condition that the use of biomass takes place in a sustainable and intelligent way (p.7).

The Netherlands is one of the few European countries with legally defined blending targets for the transport sector already in place ('*Besluit biobrandstoffen voor het wegverkeer 2007*'). This policy sets the blending target for the Netherlands and offers room to implement sustainability criteria. So far, the Dutch government has not implemented any sustainability criteria, awaiting the criteria that are being developed by the EC. Due to unresolved uncertainties about sustainability and growing criticism of negative impacts of first generation biofuels, on 10 October 2008, the Council of Ministers agreed to bring down the biofuels targets for 2009 and 2010 from 5,75% to 4%.

Below we attempt to indicate the various positions of different government departments and some of their main considerations and interests related to bioenergy in general and agrofuels in particular. The information is based on interviews held with senior officials at the various departments. Though the interviewed officials got a chance to react on earlier versions of the texts, it should be noted that these are not official positions, nor does it intent to be a complete overview. Our mere aim is to provide a rough sketch of some of main arguments and dilemma's faced by the different departments.

2.2.1. Ministry of Housing, Spatial Planning and the Environment (VROM)

VROM has responsibility for implementing the EU's sustainability criteria
The Netherlands (together with Germany and the UK) has been pushing the sustainability agenda at the European level. The European Union has now defined sustainability criteria for biofuels and will establish a list of reporting obligations, through the Renewable Energy Directive. As Directives are addressed at member states, the member states will have to implement the criteria for reporting obligations themselves. Within the Netherlands, implementing sustainability issues for biofuels is in the hands of VROM.

The blending target has important positive effects
VROM strongly supports the blending target, and points out that the target, through its associated sustainability criteria, offers an important opportunity to enhance the sustainability of production. This is unique, as currently there are hardly any binding criteria for agricultural products. VROM expects that the sustainability criteria for biofuels have a positive effect on the wider agricultural sector, not least by triggering the discussion on the need to invest in sustainable agriculture. Also, VROM stresses that the blending obligation and the associated sustainability criteria apply to *all* European countries.

Biofuels are here to stay
Even though electric cars certainly have a future, heavy transportation (like trucks and planes), will continue to require liquid fuels. For this type of transportation, biofuels are the only alternative for fossil fuels. In other words, biofuels are here to stay, at least for a couple of more decades. The Netherlands and Europe will remain largely dependent on the import of biofuels, namely bioethanol from Brazil. An increasing amount of biodiesel will come from European countries, like the Ukraine, where biodiesel is produced from rapeseed. At the same time, VROM stresses the need to develop 2nd generation biofuels and alternative sources. Related to this, the Dutch government has already introduced an incentive for the production of 2nd generation biofuels with the 'Double Points Scheme for Advanced Biofuels'. This new scheme allows companies that sell biofuels made from lignocellulose, wastes and residues to earn double points when fulfilling their biofuel obligations. In other words, a company that meets its entire obligations for 2010 via these advanced biofuels, will only need to add 2% rather than 4% biofuel.[21]

Linking biofuels to rising food prices is misleading
Increased production of biofuels has been linked to rising food prices. According to the interviewed VROM officials, this is a largely artificial discussion, as it tends to overlook the changes in global food consumption and the associated growing production of feed for cattle.
In similar vain, they argue that it is misleading to discuss the negative effects of oil palm production for biofuels (2 to 3% currently), while neglecting the fact that a lot of oil palm ends up in non-food products, such as cosmetics.

WTO regulations are a hurdle to improve the sustainability of production
VROM stresses that the current sustainability criteria go a long way, especially in addressing the global environmental effects (climate change and biodiversity loss). At the same time it is acknowledged that local environmental effects and indirect land-use changes (ILUC) remain hard to monitor, not least because WTO regulations are a significant hurdle to develop strict criteria. In the absence of strict criteria, the Directive obliges biofuel producers to report on social and local environmental effects.

2.2.2. Ministry of foreign affairs – Netherlands Directorate-General of Development Cooperation (DGIS)

Implementing sustainability criteria on biofuels requires a legally binding international agreement
The European Commission faces a serious challenge in implementing the three sustainability criteria defined in the RED. The first, related to GHG emissions, should not be that hard to implement, as the reduction in GHG emissions is measurable. The second and the third criterion, however, are more difficult, due to the lack of legally binding international agreements. The second criterion, for example, implies that production of crops for biofuels should not go at the expense of 'high value biodiversity areas'. The problem is that there are no international legal agreements concerning 'high value biodiversity areas'. IUCN has a system to classify such areas, but this is not likely to be

accepted by producer countries, as it is a voluntary, one-sided classification by an NGO. Hence, ‘high value conservation areas’ will have to be defined in bilateral agreements. According to DGIS, the lack of legally binding international agreement is a very serious omission for international acceptable implementation.

Agrofuels should be part of converging production chains
People have always used biomass for food, fuel and fibre. In the modern economy feed-stock is also used in the energy sector and the bio-chemical industry. DGIS stresses that the production of biofuels for the transport sector cannot be approached in isolation from the other sectors. The demand for biofuels means that agriculture, energy and bio-chemical sectors are converging. The production and use of biomass, and its potential effects, should therefore be addressed as a whole, and from a global perspective. Treating the sectors separately leads to the awkward situation in which sustainability criteria only apply to palm oil used for biodiesel, but not when the same palm oil is used for cooking oil. According to DGIS, a discussion on biofuels should lead to a discussion of the sustainability of biomass production within the context of the wider ‘bio-based economy’. An important lesson that can be drawn from the debates surrounding biofuels is that there are currently not many instruments to stimulate sustainable agricultural production.

Biofuels are an opportunity for developing countries
Any economic development has effects – both positive and negative. For example, in recent discussions the argument was made that increasing food prices are bad for urban poor, while the positive effects of price rises for poor rural farmers were often conveniently neglected. An over-simplification either way does not help. According to DGIS, the precautionary principle should not mean that you stop all development efforts. DGIS stresses the need to look at the bigger picture – taking a macro-economic approach – and search for opportunities rather than for problems. Moreover, DGIS argues that we should look beyond the needs and opportunities of the Dutch farmers and the Dutch bio-chemical industry, as the bio-based economy does not start in the port of Rotterdam. According to DGIS, the production of agrofuels is primarily an economic opportunity for developing countries to decrease dependence on oil imports, to generate revenue from export, and to develop their agricultural sectors. For developing countries to capitalize on these opportunities, agricultural innovation is key. According to DGIS, the most important and promising innovations will be developed and implemented by knowledge institutions in developing countries and the support of innovation in the South should therefore become an important element in Dutch ODA.

Implementation in Europe needs more attention
Besides an importer from third countries, Europe is also a major producer of biomass and there is currently insufficient attention for the implications of the compulsory blending of biofuels for agriculture within Europe. From the perspective of DGIS, the Netherlands and Europe should start with practicing what they preach. The policies that Europe develops, including the sustainability criteria, also concern the farmers in Europe. What does it mean for EU Common Agricultural Policy? What are the GHG emissions from the land that were lying fallow and are now taken back into production? Is this expansion so different from what developing countries do? DGIS stresses that neither Europe nor

the Netherlands is in a position to tell other countries what to do or not. European countries and the Netherlands should thus start themselves with making changes, which requires more attention to coherent policies related to the climate, agriculture and nature.

2.2.3. Ministry of economic affairs (EZ) and the MoU with Brazil

EZ signed an MoU with Brazil, being the key provider of bioethanol

The EU-target for 2020 implies the use of 10 million tonnes of biofuels per year. For the Netherlands this amounts to 0.5 million tonnes. To meet these targets, the import of biofuels from the South will remain indispensable. In this light, Brazil, being the most important biofuel provider for the Netherlands, is a crucial player. Even though the Dutch Ministry of Economic Affairs (EZ) is not directly involved in policymaking that concerns the production of biofuels in the South, in April 2008 the ministry (in close collaboration with other ministries) signed the so-called '*MoU on bioenergy cooperation, including biofuels*' with Brazil. The MoU provides a framework for an open dialogue between the Netherlands and Brazil. It is broad in scope and concerns all biofuels in principle. In practice it has so far concentrated mostly on bioethanol, as this is the most important Brazilian biofuel for the Netherlands and Europe.

Sustainability is key element of the MoU with Brazil

In 2009, two meetings between Brazilian and Dutch delegations took place to discuss priorities. The last meeting focussed on sustainability issues related to the production of biofuels in Brazil. The focus on sustainability follows a motion of Van der Ham in April 2008, who demanded that work to be performed in the framework of the MoU with Brazil should be in line with the Cramer Criteria.[22] The MoU involves ten high priority areas for cooperation, and a substantial part of them can indeed be traced back to the Cramer Criteria. From the point of view of EZ, the MoU is relevant for Brazil, because more emphasis on sustainability increases their marketing possibilities in Europe.

The MoU with Brazil – by its nature – does not include any obligations. Other than the exchange of information, there are no targets or measurable criteria identified in the MoU with Brazil. Regarding the design of and compliance with sustainability criteria, EZ points to the European directive and stresses that, ultimately, the responsibility for meeting sustainability criteria lies with the producers themselves.

During the last meeting the possible negative effects of biofuel production on land-use on a macro-scale and indirect land-use changes (ILUC) were discussed. The main problem with such indirect land-use changes is that these types of effects are hard to operationalise, and even harder to measure.[23] Monitoring ILUC might therefore very well be the biggest challenge. The EC has included ILUC in her criteria, but the question remains how to implement it. This, EZ stresses, requires more scientific research.

For EZ the main interest is to make Rotterdam a biofuel hub

From the side of EZ, the main interest is in stimulating trade, and the development of opportunities for an important logistic function for the Dutch harbours and for the Dutch industry. The Netherlands wants to become (remain) the gateway for biofuels in Europe and Rotterdam has the ambition to become a biofuel hub for West-Europe. So far, that seems to be working out well. Import of bio-ethanol in Rotterdam was 1,2 million tonnes in 2007 and increasing every year. The Swiss company Biopetrol is building the largest-but-one biofuel plant in the world in Rotterdam.[24]

2.2.4. Ministry of agriculture, nature and fisheries (LNV) and the 'Biobased Economy' program

Efforts should be directed towards improving agricultural production systems
Although the production of biofuels from woody materials and algae through second and third generation technologies has great potential, LNV argues that the possibilities of first generation biofuels should not be dismissed, as first generation biofuels are crucial in the current phase of market development. The production of first generation biofuels can and should be improved significantly, for example by utilizing post-harvest losses, and by improving the productivity per hectare. Scientific efforts should therefore be directed to help people to intensify land-use systems. The Netherlands can play an important role, by helping producing countries to increase productivity through agricultural innovations.

The future is biobased
LNV expects that the near future will witness an explosion of new possibilities to use biomass, in various sectors of the economy. The so-called biobased economy has recently become an important topic of discussion at the highest management levels of many companies. The chemical industry is already investing in new and innovative technologies to use biomass for the production of plastics and other synthetic materials. This is, for a large part, an autonomous process within the chemical sector, triggered by new opportunities in combination with the expectation of higher oil prices in the future.

To stimulate a biobased economy, LNV initiated an interdepartmental program
LNV sees biomass as the key replacement of oil- and gas-based products and services, and promotes a transition from a fossil-based economy to a biobased economy. LNV therefore initiated an interdepartmental program on the 'Biobased Economy', including the other relevant ministries (VROM, EZ and DGIS). LNV established the program based on the explicit recognition that the biobased-economy should be addressed in an interdepartmental way, ensuring coherence between the ministries, as issues pertaining to the production and use of biomass are not confined to the agricultural sector, but also to the environment, energy, business and international cooperation sectors. The program aims for a dialogue with knowledge institutes, private sector and civil society within the Netherlands and wants to link up with the discussion at the European level. The program has created its own committee for research and tries to help the private sector in its endeavours to find biomass-related business opportunities. Currently the program is, for example, collaborating with the chemical industry, building a pilot bio-refining factory in Delft. According to the head of the program, the integrated interdepartmental approach towards the biobased economy is unique in Europe.

Energy from biomass is the last stage in a system of co-production
The program Biobased Economy envisions a 'system-innovation' with a key role for sustainably produced biomass. Even though biofuels receive a lot of attention (mostly as a result of the blending targets set by the EC), they are only a minor portion of the envisioned biobased economy. The program promotes co-production, which means that one unit of biomass is used for various end purposes, such as food, pharmaceutics, the chemical industry, construction and energy. According to the principle of co-production, smart use of biofuels will start with the highest value use (i.e., food), while the residues are used for lower value applications. Hence, the idea is to dissect different streams of biomass components for various end uses. This implies that the production of energy from biomass should be seen as the very last step in the biomass production chain – using waste streams for energy production. The concept of co-production implies that no one single sector should be considered in isolation, as that would produce sub-optimal solutions.

2.2.5. Committee for Biomass Sustainability Matters

In the Netherlands, the Committee for Biomass Sustainability Matters' (CDB: 'Commissie Duurzaamheidsvraagstukken Biomassa' in Dutch) was asked by VROM to advise the government on issues related to the use of biomass and sustainability. The CDB consisted of experts with various backgrounds from different stakeholder groups, and was chaired by Dorette Corbey. The committee recently published its first three advises.[25] The commission states that the large-scale use of biomass can contribute to reducing GHG emissions, poverty alleviation and sustainable development. However, without sustainability guaranties, stimulating the use of biomass is likely to be a step backwards rather than a step forwards.

Their main recommendations are:
1) The European directives (the Renewable Energy Directive and the Fuel Quality Directive) identify sustainability criteria for the production of transport fuels and impose an obligation on Member States to report on this. The directives do, however, not guarantee that information concerning the nature and origin of transport biofuels is made public. The CDB therefore advises, in order to provide full transparency, that fuel providers are obliged to report on the nature and origin of biofuels, and disclose this information publically, as this allows consumers to choose for sustainable fuels.
2) Biorefining enables the production of various products from the same biomass, and as a result, the difference between liquid flows and solid flows is disappearing. Sustainability criteria should therefore not only be applied to biofuels, but also to biomass that is used for other purposes (e.g., electricity plants and bio-chemical industry).
3) Addressing indirect land use change (ILUC) is a huge challenge. To address ILUC the CDB advises a package of 3 coherent measures: 1) The introduction of an ILUC factor. The ILUC factor is initially set at 1 (i.e. 1 hectare of agricultural land for biofuel production equals 1 hectare of additional indirect land-use change). 2) The ILUC factor can be lowered to allow for biofuel derived from yield increase or

allocation of CO_2 emissions in co-products. Put simply, if a producer produces the same amount on half of the acreage, it has also halved the possible indirect land-use change effect. 3) Acknowledging the possible negative indirect effects of biofuel production on biodiversity that cannot be addressed adequately in an ILUC factor, the protection of biodiversity should be addressed directly. Therefore, the CDB proposes to introduce a small levy on fuels to generate money that is earmarked to biodiversity worldwide. Furthermore, the Commission recommends minimizing the effect of ILUC by prioritizing the use of waste and residues and degraded lands. In addition, investments in the efficiency of the agricultural sector are crucial to increase the yield per hectare.

2.3. Biofuel planning in low and middle income countries

The following information is not based upon interviews but has been derived from literature. It therefore does not reflect the opinion of a country mentioned.

In the case of many low and middle income countries – including Brazil, Colombia, Ethiopia, Indonesia, Liberia, Malaysia, and Tanzania – agrofuels have been seized upon as a new vehicle for the promotion of economic growth. After decades of declining prices for agricultural produce and gloomy perspectives with regard to the prospects for economic strategies based on the export of bulk agricultural produce, the sudden about-turn in market trends is leading governments to revisit their policies on agriculture. In the wake of the market upturn, international agribusiness, oil companies and finance institutions are demonstrating their preparedness to commit foreign direct investment in emerging markets for agrofuels. The enticing prospect of securing such investments for the development of agricultural production is leading to the development of agrofuel policies in an ever increasing number of countries. In some cases, such as Brazil and Indonesia, the countries concerned already produce a large proportion of the global market inputs for agrofuels. The Brazilian government, in particular, is an outspoken advocate of agrofuels, and claims that the production of agrofuel effects neither food production nor food prices. Instead, the Brazilian government sees agrofuel production as an “instrument to fight poverty” (FIAN, 2008).

In Africa, many governments look at the advantages of biofuel production for the economy. For example, both the Tanzanian and the Ethiopian government have declared that 20% of their country’s land may go towards biofuel production. Foreign companies have been invited to start plantations and production. Other countries, too, such as Mozambique and Liberia, have set ambitious national targets for energycrop expansion and have made significant progress in securing foreign investments. In Uganda, plans to cut down thousands of hectares of the country’s largest rainforest reserve for a sugar plantation for ethanol are currently suspended, following civil protest on the issue.[26]

The Chinese government aims to have 10% of all energy consumption from renewables by 1010 and 16% by 2020. This should partly come from biomass and the government therefore plans to ‘develop’ 13.3 million ha of forests for biodiesel production and power generation. 'Developing forest' could mean many things, ranging from the establishment of mixed tree plantations on agricultural lands to the conversion of high value natural forest to monocultural tree plantations . In addition to its domestic production ambitions, China is an important importer of palm oil for its biodiesel plants and the Chinese government encourages Chinese companies to invest in biofuel production overseas, particularly in Brazil, Malaysia and the Philippines (Roberts, 2007).

Table 1 below gives an indication of the plans to expand agrofuel production for a selection of southern countries. All countries presented in Table 1 are planning to at least triple their existing production of energycrops, and most are planning for a four to fivefold increase in production.

Table 1: Examples of planned agrofuel expansion

Country	Energycrop	Planned expansion
Brazil	Sugar Cane	From 6 million ha currently to 30 million ha
Brazil	Soy	From 20 million hectares to 80 million hectares
Colombia	Oil Palm	From 0,188 million hectares to 0,488 million hectares`
Ethiopia	Jatropha	New entrant to the sector with 1 million hectares to be planted, 17.2 million hectares identified as 'suitable'.
Indonesia	Oil Palm	From 6 million hectares to 20 million by 2020
Liberia	Oil Palm	New entrant with 0,7 million hectares planned
Malaysia	Oil Palm	From 6,4 million hectares in 2006 to 26 million hectares in 2025
Tanzania	Sugar Cane	New entrant with 0,4 million hectares to be planted
Tanzania	Oil Palm	New entrant to the sector with 0,1 million hectares to be planted

Compiled from: African Biodiversity Network (2007): Agrofuels in Africa – the impacts on land, food and forests. ABN: July 2007; Seedling. 2007. Special issue on biofuels, Barcelona: Seedling, July 2007.

2.4. Large-scale plantation holders and transnational companies

Gazetted targets for future biofuel consumption in many of the major energy consuming countries have encouraged large-scale investments from agribusiness, oil companies and finance companies. Investors have recently moved into the sector with an evident preparedness to commit large volumes of resources in emerging markets usually thought of as being risk laden.

Although most of the existing markets have an oligarchic character, being controlled by a handful of large companies, the scale of the market expansion appears to be creating many opportunities for new entrants, geared to the production of an increasingly wide range of different energycrops in an increasingly diverse range of production conditions. Without pretending to be comprehensive, table 2 below sets out a number of the significant commercial developments taking place.

Table 2: examples of investments in energycrops and downstream industries

Country	Energycrop	Examples of recent investments
Brazil	Sugar Cane /ethanol	U.S. $ 9 billion in 2006 into sugar production and alcohol refinery
Brazil	Whole agrofuel sector	U.S. $ 8.1 billion investment expected over 2007-201127
Indonesia	Palm Oil / bio diesel	U.S. $ 5.5 billion in palm oil in 2005 and $4 billion in 2007 in palm oil and refineries28
Ethiopia	Jatropha	U.S. $ 77 million for biodiesel production
Mozambique	Sugar Cane	U.S. $510 million for bioethanol by Central African Mining and Exploration Company

Compiled from: African Biodiversity Network. 2007. Agrofuels in Africa – the impacts on land, food and forests. ABN: July 2007; Seedling. 2007. Special issue on biofuels, Barcelona: Seedling, July 2007.

In various countries, especially in Africa, large investors have indicated there interest in large tracts of land and sometimes already obtained leases. Many investments, however, are still either in the planning phase or starting pilots. Much land speculation has taken place and due to the economic slowdown and more restrictive financing by commercial banks, many of these claims and pilots are not viable. A reality check is needed.

The automobile industry is investing in designing and producing flex-fuel cars – due to pressure from high fossil fuel prices and government regulations to reduce CO_2 emissions through alternative fuels. These special vehicles can run on conventional petrol, but also on blends with a higher percentage of ethanol (up to 85%). In Brazil there is ample experience with this type of cars and they are best-sellers. Flex-fuel cars are now developed and produced by various car manufacturers (e.g. Toyota, Volkswagen). In the US, executives from various automobile brands (GM, Ford, Chrysler) have been pressing their government to improve infrastructure and increase access to biofuel at gas stations to make their investments worthwhile. The number of fuel stations where biofuels can be taken in is on the increase (in the Netherlands at a much slower pace than for example in Germany). In the Benelux, Rotterdam was the very first: on 21 January 2006 Argos Oil opened the first biofuel station there.[29] On the other hand, Israel is going to invest heavily in hybrid cars (battery plus petrol) and an electricity grid for cars.

As companies have invested money in biofuel production, any publicity on negative side effects could potentially be harmful to their business. Abengoa Bioenergy, involved in the production of biofuels in the US, Europe and Brazil, for example, actively campaigns to dispute claims about the threats of biofuels for food security and the environment. It calls this 'manipulation'.[30] The private sector can also play a more constructive role in improving the sustainability of biofuel production.

Interestingly, the food and personal care industry is largely against the policies to promote the use of agrofuels because of the rise in the prices of prime commodities that its production causes. Unilever, for instance, is very critical about binding targets for mixing in biofuel and about government support for the development of bioenergy given to energy companies.

2.5. Dutch and international Non-Governmental Organisations

Development NGOs tend to be very critical of large-scale agrofuel production. They emphasize that growing agricultural feedstock for agrofuel competes with food production for human consumption. The price spike of prime commodities is considered to push millions of people worldwide into further poverty. Catchphrase: 'The fuel dollar of the rich competes with the food dollar of the poor.' Jean Ziegler, former UN Special Rapporteur on the Right to Food, called the European directive (10% biofuel in 2020) a 'crime against humanity'.[31] Development NGOs also point to the threats of displacement of pastoralists and farmers when agrofuels are produced on supposedly 'idle' or 'marginal' lands.

Oxfam International strongly opposes the support of agrofuels. They emphasize that agrofuels can neither replace global fossil fuels nor curb climate change. They also point to the food price effect, which they consider disastrous for the poor. Oxfam International calls for a freeze to biofuel mandates and measures to effectuate vehicle-efficiency. They call for Free Prior and Informed consent of communities where biofuel projects are planned. They stress that indirect effects cannot be contained by standards.[32]

Environmental NGOs, too, are generally critical of large-scale agrofuel production due to its threats to biodiversity[33] and the limited or even negative net effects on climate change. In this regard, Friends of the Earth, for example, is one of the more outspoken NGOs (see, e.g., Friends of the Earth, 2008)

WWF is one of the less critical environmental NGOs. Unlike Oxfam, WWF believes in the possibilities to contain the direct and indirect effects of agrofuels production by effective standard setting and policy design. According to WWF, agrofuel should be seen as only one element in a much wider and ambitious set of measures to curb climate change and secure energy supply. Promoting energy efficiency is most important. They point to stopping deforestation and carbon capture as crucial elements in any positive climate-energy scenario, and mention wind, hydro, solar and thermal energy as well as low-carbon natural gas as good options next to sustainably produced biofuels.

In its "Position on Biofuels in the EU" WWF writes:
"*WWF promotes fuel efficiency standards for all vehicles and the development of an alternative, more environmentally sustainable, transport strategy as priorities. Nonetheless, so long as fuel cells and sustainable hydrogen production remain in their infant stages, biofuels appear as the only fuel supply alternative for the transport sector. The EU aims for biofuels to represent 10 per cent of all road transport fuel consumption by 2020. If delivered in respect of the sustainability conditions outlined below, WWF supports the EU biofuels target. The development of biofuels should be part of a broader strategy dealing with transport and renewable energy*." (WWF, 2007:1)

Box 4. Opportunities for small-scale producers?

Cordaid (2009), in a policy paper titled ‘Energy from Agriculture: The opportunities and risks of biofuels for small producers and their communities’, distinguishes between three models of biofuel feedstock production:

(i) Small-scale agriculture for local energy production. At a small-scale, local farmers can produce their own energy, for example by recycling cooking fat to power a bio-diesel engine, and/or by growing an energycrop (preferably through intercropping) and sharing costs of processing with neighboring farms. Such a model would require investments to provide local producers and processors with training and technical assistance.

(ii) Small-scale agriculture producing for commercial – often regional – markets. Such a model requires a legal framework to allow contract farming from which producers can benefit. Small producers would need to be organised into larger collectives (to negotiate terms with powerful buyers). This model also requires access to capital by small producers, enabling them to make investments to keep up with demand for quality and quantity.

(iii) Large-scale export-oriented plantation agriculture. Currently this is the most common model. According to Cordaid, large investors generally benefit from this model, while small farmers are all too often marginalised.

Cordaid (2009) stresses that the opportunities for small-scale producers will come mostly from the second model, based on small farmers operating in commercial markets outside their immediate region.

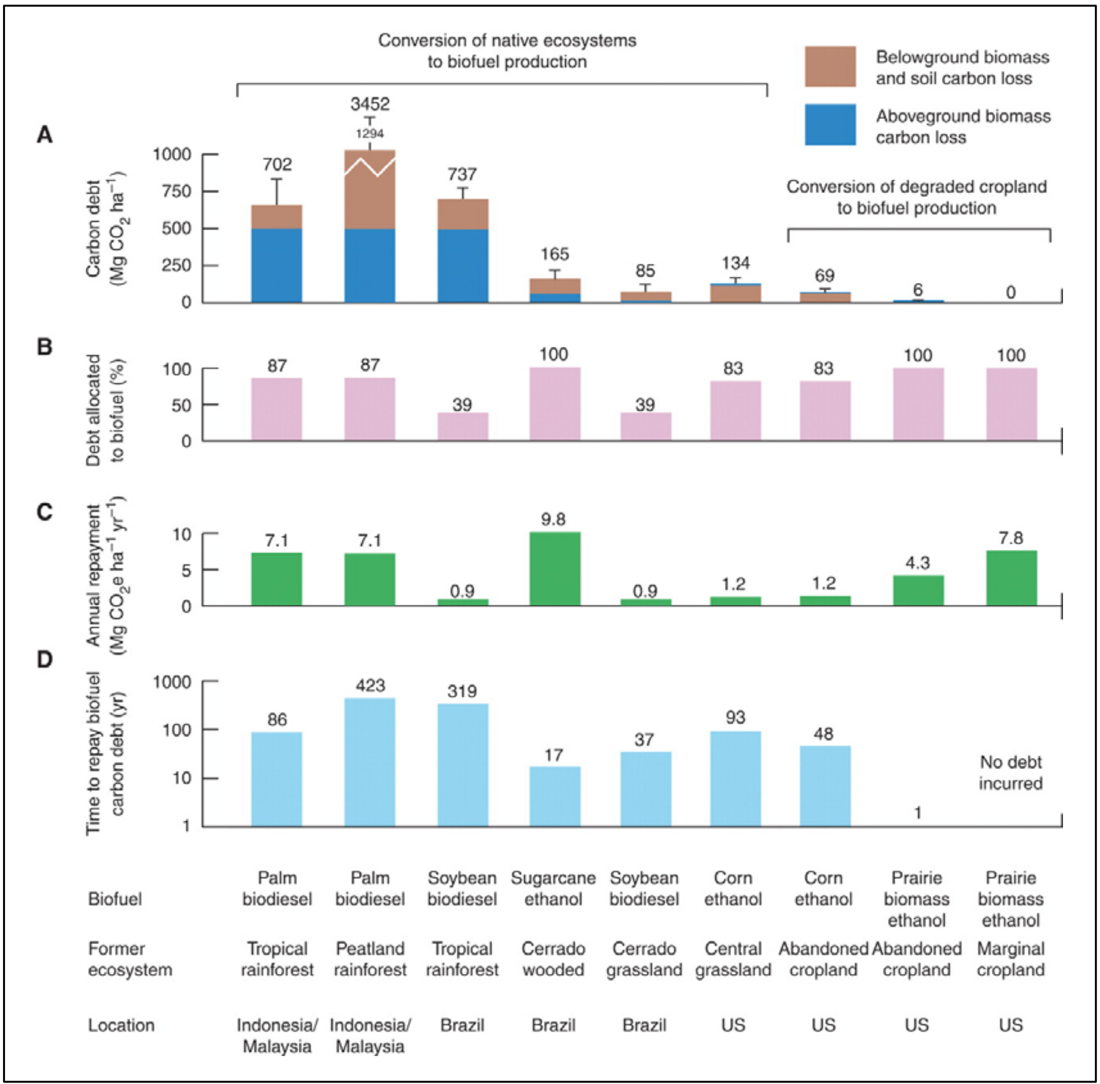
3. What is known about agrofuel production and its effects?

3.1. The role of agrofuels in mitigating climate change

Only a couple of years ago, agrofuels were widely promoted for their potential in combating climate change. The reasoning was that, theoretically, agrofuels are carbon neutral: when burnt, the carbon they release has been offset by the amount they absorbed while growing. The CO_2 that is removed from the atmosphere by growing feedstock is called the sequestration effect, or 'carbon uptake'. However, we now know that, when taking into account the full life cycle of biofuel production (i.e., land-use change, tilling, harvesting, refining, transport and consumption) only certain agrofuels prove to have a favourable GHG balance.

Life-cycle studies on the GHG balance usually show that ethanol from corn performs poorly when it comes to reducing GHG emissions, while production of ethanol from sugarcane is found to lead to a significant reduction of GHG emissions. However, such life-cycle studies often do not account for the direct and indirect CO_2 effects of land-use change, i.e., the effects of clearing forest or grassland that results from increasing production of energycrops, which releases much of the carbon that was stored in plants and soils. Searchinger et al. (2008) included the effects of land-use chance in their calculations and showed that the various production chains of biomass differ highly in terms of their GHG balance. The most salient example is the clearing of peatlands for palm oil production. Peat – which used to be mined in the Netherlands as a source of fuel – is decayed organic matter and forms layers in the soil. Riau province in Sumatra has one of the most significant peatland carbon stores in the world. The peat forests in Riau - covering 4 million hectares -account for just over a sixth of Indonesia's peatland area, but due to their great depth they hold more than 40% of the country's peatland carbon store (14.6Gt of carbon). If Riau's peatlands would be deforested and converted to palm oil, an equivalent of one year's global GHG emissions would be emitted (Greenpeace, 2007). Using peat lands in Indonesia and Malaysia for palm oil production thus leads to an enormous production of CO_2 that was stored in these soils before. It is estimated that it will take 600 years for the carbon emissions saved through use of biofuel to compensate for the carbon lost through peatland conversion (Danielsen et al., 2008)[34]

Figure 2: Carbon impact of biofuel

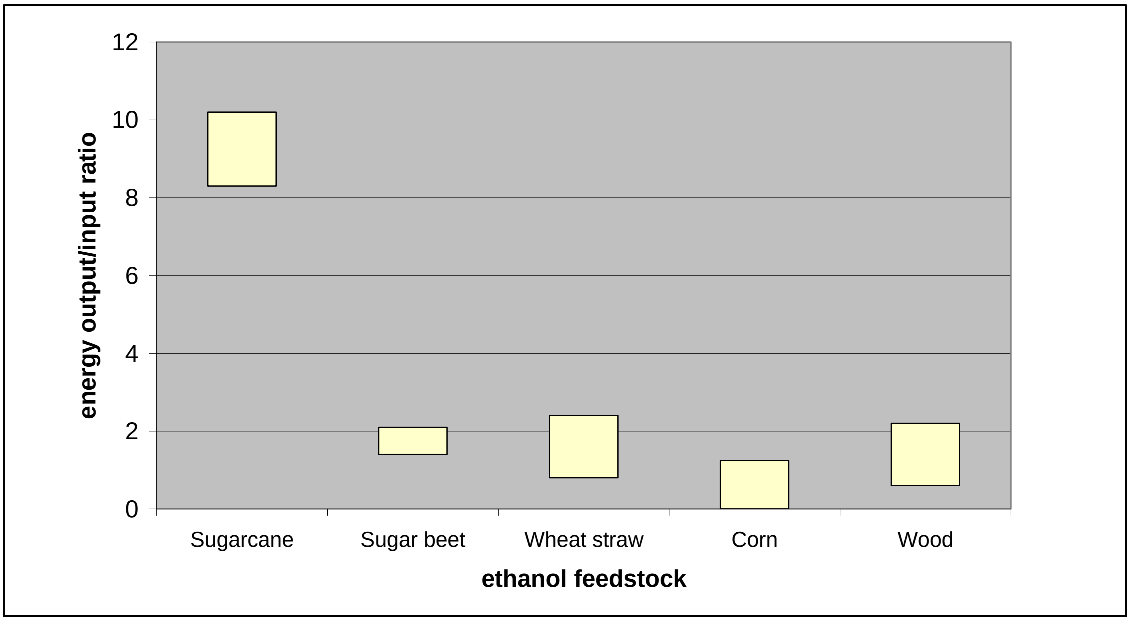


Source: Fargione et al. Science 319:1235–1237 (2008).

Converting rainforest, peatlands, savannas, or grasslands to produce energycrops is not a wise thing to do if you are aiming to reduce GHG emissions (see also UNEP, 2009). UNEP (2009) estimates that it would require between 118 and 508 million hectares of cropland, if first generation biofuels are used to meet 10 percent of the global transport fuel demand by 2030. These biofuels could thereby substitute 0.17 to 0.76 billion tonnes of fossil CO_2.. If however, biofuels would be produced on converted natural areas, the associated extra land-use change would lead to an additional 0.75 to 1.83 billion tonnes of CO_2. From the climate perspective, first generation biofuel production produced on natural lands does not make any sense (UNEP, 2009). **Converting natural lands - including forest, savannah, and peatland - for agrofuel production to mitigate climate change is contra-productive.**

Agrofuels can also be produced on existing agricultural land. When using existing agricultural land, the overall energy balance of various crops becomes crucial for GHG reductions. From an energy perspective, ethanol from sugar cane performs well (see figure 3). If ethanol from sugarcane was to replace 10% of the total gasoline consumption in the world – 34.75 million TJ in 2000, according to the IEA (2003) – carbon emissions would be reduced by 66 million tonnes (Ceq) per year. For that, another 30 million hectares of land are needed (Goldemberg (2006).

Figure 3. Energy balance of ethanol crops, with commercially available technologies.



Source: Goldemberg (2006)

The net energy balance of biodiesel is even more complex. Firstly, because the oil is mainly used by the food and pharmaceutical industry and this market is commercially more attractive than using the oil for producing biodiesel. Secondly, the crop with the highest oil production – oil palm – is mainly planted on deforested lands in Indonesia. In the near future production is expected to increase in South America (Colombia, Brazil, Peru). Regions such as Para in Brazil have partially degraded land (low productive cattle ranches) where production could take place. But whether this will occur in reality remains to be seen because investments are mainly driven by the costs of planting and the vicinity of infrastructure (factory, transport infrastructure).

Research shows that some crops can have a positive energy balance and can contribute to mitigating climate change. However, a 10% replacement of transport fuels with biofuels would already require substantial amounts of land. Biofuels can therefore only be a limited part of the solution.

If biofuels are produced on existing agricultural lands, but the previous users of that land turn to new lands, the net result is the same as when biofuel production takes place on natural lands. Hence, the worry about *indirect land-use changes*. Searchinger (2008), based on an analysis of ten major biofuel reports, reiterates that the GHG benefits of biofuel production depend largely on direct and indirect land-use changes. According to most reports reviewed, the overall GHG benefits of biofuel use are at best limited, and it is generally agreed that reductions in GHG emissions are more effectively achieved in other ways, for example by conserving energy (Searchinger 2008).

BeCitizen, a French consultancy bureau, analyzed five existing methods to calculate the impact of indirect land-use change on greenhouse gas emissions. The methods were all analysed according to the assessment criteria identified by the European Commission, which are: (i) the percentage of land displaced per hectare of biofuel planted; (ii) the type of land and the country where the substitution takes place, and; (iii) the GHG emissions linked to the indirect land-use change (ILUC). They found large differences when they applied the various methods to different biofuel production processes. They use these findings to conclude that the methods they analyzed are not robust and are therefore a poor fundament for policymaking. BeCitizen stresses that there is an urgent need to develop a more robust method to measure the GHG effects of indirect land-use change.[35] In addition, producing countries expressed their concern in a letter to the EC (15 December 2009) stating that the method for calculating ILUC is scientifically flawed.

Research shows that the threat of indirect land use changes of natural lands is real, and adds to an already increasing demand for agricultural products. The methods for calculating ILUC are, however, still controversial.

3.2. Social- economic effects

Investment in agricultural production is welcomed by many countries as a source of revenues for the state and to increase employment opportunities. Even before the growing demand for agrofuels, the massive expansion of production of sugarcane, soy, palm oil and cattle ranching led to high economic revenues for the producing countries and employment. Production expansion mainly takes place based upon converting natural lands and establishing large monoculture plantations.

There are some concerns related to this agricultural expansion. NGOs and researchers have been pointing to the (potential) negative effects of energycrop production on local people’s access to land and natural resources. A key issue in this regard is the degree to which the (local) state respects and upholds property rights. This in turn depends on the degree to which property rights are in fact known and documented: traditional claims to land may not be well documented, or the state may have little capacity to monitor and enforce legally held land rights.

For Indonesia, the effects of large-scale commercial production of oil palm on people’s access to land and resources are relatively well documented (e.g., Colchester et al., 2006;

Zakaria et al., 2007). Studies reveal numerous conflicts between companies and local communities regarding access to land. Such conflicts tend to be the result of weak (implementation of) laws regulating land acquisition. The Indonesian government regards approximately 75% of the country's land surface as 'state land'. This means the government can hand out industrial concessions to companies on these lands, even though major parts of this area are actually used by local people (Colchester et al., 2006; FOE/LM/SW, 2008; FPP/SW, 2007).

Box 5. Direct and indirect employment

Large-scale biofuel production can have various effects for local livelihoods – both positive and negative. On the positive side, agrofuel production may provide significant employment opportunities in rural areas, both in the production and processing sectors, potentially driving up rural incomes and improving access to health and education. There has been some research on the employment effects of ethanol production from sugarcane in Brazil. BZOS (2007) found that the sector generates a large number of jobs, and has many indirect employment effects.[36] The Brazilian sugarcane sector provided 700,000 direct and 3.5 million indirect jobs in 2004. However, the number of jobs generated per ha of land may be low when compared to small-scale farming. Smeets et al (2006) found that wages in sugarcane and ethanol production in Brazil are generally well above the minimum wage. But the sector is characterized by bad working conditions, especially related to the burning of sugarcane and cutting through manual labour. FIAN (2008) reports not only on poor working conditions on Brazilian plantations (e.g., exposure to pesticides and excess heat and sun) but also cases of slavery and child labour.[37] The current trend towards mechanical harvesting of sugarcane will solve the bad working conditions but will also result in a net loss of jobs.

Box 6. Will biofuel production be beneficial for Africa?

For OECD countries, the production of biofuels is clearly generating benefits. It helps them to meet the CO_2 reduction targets, it decreases their dependency on oil producing countries, and it is good for their agricultural sectors. However, the extent to which biofuel production provides opportunities for poor countries in Africa is an issue of debate. Surely, in a globalised world, biofuels are most competitively produced there were large-scale plantations can be established, and where land and labour are cheap. Africa, in this light, is an attractive continent to invest in. But, predictions on the net effects for Africa differ, because they use different assumptions. The International Food Policy Research Institute (IFPRI), for example, predicts important benefits for Africa, assuming that infrastructure in Africa will improve rapidly, enabling Africa to benefit from rising prices for agricultural commodities. The Food and Agricultural Policy Research Institute (FAPRI), on the other hand, applies models with a much slower development of infrastructure, leading to the prediction that the increasing food prices will have overall negative effects for Africa, being a net importer of food (based on interview with Dr. Ir. Prem Bindraban).

In Africa, there are several examples of international companies investing in energycrop plantations (mostly Jatropha, but also other crops like sugarcane).[38] Reportedly, this is leading to the displacement of smallholders (Seedling, 2007). In Ethiopia, the government embarked on an ambitious plan to stimulate energycrop production – the Ethiopian Biofuels Development and Utilization Strategy. However, there is no land inventory on the basis of which development of plantations can be properly planned. This is expected to lead to both biodiversity loss and local people losing access to land (Seedling, 2007). Lakew and Shiferaw (2008) did a study on energycrop production in Ethiopia and found the requirements for investors in large-scale energycrop production are minimal. At the time of the study, the authors estimated that about 1.65 million hectares were assigned to investors, much of which was also in use by local people. Similar experiences have been recorded in Tanzania (ABN, 2007) and Ghana (Nyari, 2008).[39]

The government of Mozambique allocated a large tract of land in Massingir (Gaza province in the Southwest of the country) to the company Procana for the production of ethanol from sugarcane. An investment of US$510 million was promised. This investment was controversial for various reasons, including a lack of company transparency[40] and the location of plantation. According to Procana, the land allocation process was correct and land rights had been respected (based upon the DuAT regulation: Community Consultation for the Granting of Rights for the use and Exploitation of land). In this case, however, ProCana took possession of half the land intended for the resettlement of communities displaced by Limpopo National Park. Local communities also claimed that that Procana did not respect the land boundaries ceded to them[41] and were worried that the sugarcane plantation would draw too much water from the watershed. At the end of December 2009, the government of Mozambique cancelled the contract with Procana, as Procana did not live up to its investment promises.

Box 7. Access to water

The effect of energycrop production on access to (clean) water is an important aspect that needs special attention. Energycrops such as sugarcane consume enormous amounts of water, both as a crop and during the processing into ethanol. This can have large effects on local water availability. Effects of chemicals on water quality also need to be taken into account. AidEnvironment did a study for Wetlands International on the potential environmental impacts of energycrop production on Wetlands in Africa (Sielhorst et al., 2008). They compared sugarcane, oil palm, Jatropha, cassava and sweet sorghum concerning their requirements, and their potential impact on wetland conversion, water availability and water quality. The study reveals that special attention should be paid to the water needs of biofuel production, especially in drought-prone areas and stresses the need for careful land-use planning.[42]

In Brazil, commercial and large-scale sugarcane and soy production resulted in significant land concentration and high economic revenues for the state and the companies. Currently, of all lands planted with sugarcane, 70% belongs to only 340 industrial mills, with an average holding size of 30,000 ha. Historically, the process of land concentration is associated with expulsion of small farmers and up till today this leads to land-related conflicts. Soybean production (which has grown enormously since the 1970s for its use as feed) has lead to massive displacement of small farmers who did not have official prove of land tenure. Employment on soybean plantations is low, thus forcing displaced farmers to either move to urban slums or to move on and deforest land for agriculture (e.g.,Van Gelder and Dros, 2006). Considering that soy has become the most important crop for the production of bio-diesel in Brazil, increased demand for soy (following government legislation on mandatory biofuel blending requirements for diesel starting at 2% in 2008 and rising to 5% in 2013), is likely to increase such processes of land concentration and displacement of local farmers (Cotula et al., 2008).

Based on a review study on the impact of agrofuel expansion on poor people's access to land in producer countries, Cotula et al (2008) conclude: "*While biofuels may give some small-scale land users opportunities to strengthen access to land, in general we might expect rising land values to provide grounds for increased land access to more powerful interests at the expense of poorer rural people. Major concerns associated with such changes include increasing land concentration, lack of respect for existing land tenure, especially where it is sanctioned through traditional rather than legal authority, lack of prior informed consent in land acquisition, and in some cases aggressive land seizure*."

Many countries lack a proper regulatory framework to ensure that the development of the agrofuel sector does not compromise people's right to land and natural resources. There where land tenure is unclear and legal frameworks are disputed, industries looking for land to cultivate energycrops may choose to use aggressive land seizures. In the 1990s such cases have been reported with oil palm companies in Indonesia. More recently, worrisome stories come from Colombia, where expansion of oil palm plantations on the Caribbean coast is reportedly accompanied by armed groups, driving local communities off their lands (Balch and Carroll, 2007 cited in Cotula et al., 2008).

Land inventories and secure property rights are key to ensure that large-scale commercial interests do not negatively affect people's access to land. Hivos/SEI (2008) conclude on the basis of a knowledge survey among experts that tenure regulations are generally regarded as a key condition to prevent that industrial interests push smallholders from their lands. Likewise, a study by IIED and FAO[43] found that the potential of bioenergy production to contribute to an 'agricultural renaissance' depends largely on the security of land tenure.

In conclusion, one could say that investment in agrofuels could lead to the same conflicts as conventional agricultural expansion. In order for agrofuels to become environmentally sustainable and socially acceptable, existing practices have to change. Whether this is likely and feasible is up for discussion.

Agrofuel production on marginal lands?
Referring to the negative impacts of first generation biofuel production, some argue that biofuels (1st and 2nd generation) could also be grown on or harvested from 'degraded' and 'abandoned' agricultural lands. Others, however, stress that areas that are identified as 'marginal', 'unused', 'idle' or 'waste' lands are often used by local people for other purposes like livestock farming. Environmental and development organizations therefore warn that using degraded or idle lands is too easily proposed as *the* solution for sustainable bioenergy production. Even in the case of second generation biofuel, the competition for land and water is likely to remain. Cotula et al. (2008:3) write: "*Clearer definitions of concepts of idle, under-utilised, barren, unproductive, degraded, abandoned and marginal lands (depending on the country context) are required to avoid allocation of lands on which local user groups depend for livelihoods."*

Negusu Aklilu, director of Forum for the Environment in Ethiopia, points out that in Ethiopia concessions for plantations are given out without prior assessments, let alone consultation. What looks like 'idle land' to the external eye is likely to turn out to be grazing land or have important ecological functions. Further, he argued: "*The argument that agrofuel crops such as Jatropha can be grown on degraded land does not account for the fact that, even though this is technically possible, better quality land requires less irrigation. The yields are correlated to water availability, so in practice, agrofuel producers rather lobby or bribe governments for better tracts of land, thereby reducing their irrigation costs. In Ethiopia, no company has applied for or taken degraded land areas for agrofuel production so far*." [44]

The UNEP (2009) calls for comprehensive assessments of the amount of degraded land that could be used for the production of agrofuels, set against the other potential uses (e.g., food production, forestry, natural regeneration).

A commercial investor is not likely to use marginal or degraded lands, as this would require high investments and less productivity. In order for this to occur, governments would have to subsidize such investments. Whether this is a wise investment of public money is up for discussion.

3.3. Biodiversity

"*…as long as environmental values are not adequately priced in the market there will be powerful incentives to replace natural ecosystems such as forests, wetlands and pasture land with dedicated energycrops, thus harming the environmental credentials of biofuels*." (Doornbosch and Steenblik, 2007: 4)

Environmental impacts should be measured along the chain (from production to consumption), taking into account the effects on climate change, soil depletion and erosion, siltation of rivers, pollution (from chemicals and waste), water quality and quantity, and biodiversity. Obviously, environmental effects will differ greatly, depending on which raw materials, which technologies and (most importantly) which lands are used. The effects on biodiversity are receiving most attention by environmental NGOs. The main worry is that expansion of energycrops takes place at the expense of previously uncultivated areas (forest, savannah, grassland) and as such leads to habitat destruction and biodiversity loss (e.g., Zah et al., 2007; Sielhorst et al., 2008).[45] In addition, ill-planned conversion can lead loss of ecosystem functions. The Millennium Ecosystem Assessment produced a convincing argument to avoid further loss of ecosystem functions as this is detrimental to our economic system and well-being.

There is some debate on the extent to which, at a global scale, the demand for biofuels is causing biodiversity loss. Some argue that the effect of biofuel production on biodiversity is relatively limited; claiming that agricultural expansion for crops that have *no* energy end-use is the main driving force behind the loss of biodiversity. Indeed, energycrops make up only a small percentage of the total global agricultural area. The UNEP (2009) estimates that global land use for biofuel crops was about two percent of global cropland in 2008, or about 36 million hectares. It seems therefore safe to say that biodiversity loss is not caused by energycrop production in particular, but rather by agricultural expansion in general. At the same time, the UNEP (2009) warns that the effect of increased demand for biofuels on agricultural expansion in the world will be significant, estimating that about 118 to 508 million hectares of cropland will be needed to meet 10 percent of global transport fuel demand by 2030. The Gallagher Review (RFA, 2008) concludes that the targets defined in the European Renewable Energy Directive (RED) is likely to lead to agricultural production expansion into sensitive lands such as forest and peat land areas.

Louise Fresco (2006) emphasizes that, to avoid biodiversity loss, there is a need to invest in general agricultural management and to avoid the production of low yielding annual crops. She argues that biofuels as such are not a problem, but that the problem should be sought in low agricultural productivity and efficiency. In this regard, the crop choice is crucial, as it largely determines the need for agricultural lands. Biodiesel from soybean production, for example, needs a lot of land, while bio-ethanol production from sugarcane needs much less land. If cellulosic feedstock are also used (e.g. switch grass, and fast growing trees) for the production of biofuels, even less land is needed. Fresco (2006) proposes to use the savings from avoided oil import and income from energy production for investments to increase agricultural productivity.

Considering the biodiversity impact of agrofuel production, there is a distinction between direct and indirect effects, and between local, and regional/global effects. When establishing oil palm at the expense of forest, this has a direct negative effect on local biodiversity. Indirect local effects on biodiversity occur when oil palm is established on existing agricultural lands, but displaces farmers, who are subsequently forced to move on and open up new lands for food production at the expense of forest. At regional and global levels, too, such ‘leakage’ effects take place, i.e., when bio-crop production replaces food production this is likely to lead to increased food production in other areas, possibly at the expense of previously uncultivated areas. A national-level leakage effect has been observed in Brazil, where sugarcane production for ethanol pushed soy production and cattle ranching to other areas such as the Amazon and the Cerrado (see, e.g., Birur et al., 2007). At the global level, similar replacement effects can take place.

For example, the diversion of European rapeseed oil from food to fuel purposes has increased the demand for Indonesian oil palm for the European food industry (Thoenes, 2006) and may thus cause agricultural expansion in Indonesia at the expense of natural forest.[46]

Box 8. Physiological limitations
In relation to the increasing demand for agricultural products, some scientists point to the limited availability of water and nutrients, which form the 'basic physical and physiological limitations' of the natural environment. The crop physiologist Thomas R. Sinclair, for example, warns that, no matter what technology is being used, the close relationship between the available amounts of water and nitrogen and the amount of plant mass they can produce—not human demand—will determine how much biofuel the world can produce (Sinclair, 2009).
The Netherlands-based Nutrient Flow Task Group (NFTG) is trying to raise attention to the scarcity of phosphor – or 'the next inconvenient truth' as the Broker (issue 15, august 2009) called it. Phosphor is an essential nutrient for plants and animals. Increased agricultural production leads to a rising demand for phosphor, while de global phosphor supplies are estimated to be exhausted within 100 years.[47]
Bindraban et al. (2009) note that most studies on the potential global biomass production do not take into account the ecological limitations.

Box 9. Invasive Species
Invasive species form another direct threat to biodiversity. IUCN's Global Invasive Species Programme (GISP) has identified all the crops currently being used or considered for biofuel production and ranked them according to the risk they pose of becoming invasive species. The report (titled 'Biofuel Crops and Non Native Species: Mitigating the risks of Invasion') calls on countries to carry out risk assessments before they plant biofuel crops. It urges governments to use low-risk species of crops for biofuels and introduce new controls to manage invasive species.
The giant reed (*Arundo donax*), for example, is a proposed biofuel crop from West Asia which is already invasive in parts of North and Central America. Naturally flammable, it increases the likelihood of wildfires – a threat to both humans and native species in places such as California. In South Africa, the giant reed is considered a national problem as it drinks 2,000 liters of water per standing meter of growth, threatening water security for the nation's growing human population.
Many of the plant species being considered for biofuels have the potential to become invasive if introduced to new areas, the report warns. Few governments have adequate systems in place to assess risks of invasion or contain them once they occur, and developing countries are the most vulnerable.[48]

3.4. Food security

One of the main concerns is related to food security – both for the growing world population as well as within countries. The recent price spikes of food threaten the livelihoods of millions of people in developing countries in Africa and Asia.[49] In 2007, food riots took place in places as diverse as Mexico, Bangladesh, Haiti, Egypt and Senegal.[50] The increasing production of biofuels has been blamed as one of the causes for the rising food prices. The argument is that the production of energycrops on the same agricultural fields as food or feed has lead to competition for land and rising prices for agricultural commodities.[51]

But, are rising prices are a good or a bad thing? Some stress that the current rise in prices holds opportunities.[52] In the first place, rising prices of agricultural commodities will have positive income effects for farmers who are net producers of agricultural commodities. Furthermore, for the first time in years, strong calls are made for renewed attention to the long-neglected agricultural sector in developing countries (see, e.g., The World Development Report, WDR, 2008). [53] Notwithstanding these potential positive effects, rising food prices are harming the landless and urban poor (Hivos/SEI, 2008). Clancy (2008) stresses that most people purchase most of their food, and are thus vulnerable to food price rises, while a much smaller number of households, those who are net producers of food, may benefit from increased crop prices.

The estimates for the impact of biofuel production on food prices vary widely. This is little surprising because it is such a politically sensitive issue and because it is highly complex to calculate. Clearly, it would be too simple to attribute food price rises solely to energycrop production. Other causes for the recent spike in food prices are: crop failure and bad harvests due to climate change (erratic rainfall and desertification), long-term low investments in agriculture, speculation with prime agricultural products such as wheat and grain, low grain stocks , high fertilizer and diesel prices for farmers (due to high oil prices); and, last but not least the growing world population with changing consumptions patterns, especially increased meat and milk consumption in China and India.

Without discarding the importance of other factors, there is widespread consensus that the growth of agrofuel production implies a real threat for food security, particularly in developing countries (e.g., Hunt, 2008, FAO, 2008, World Bank, 2008, Searchinger, 2008). The FAO (2008) states that biofuels have been, and will be, a significant factor in explaining rising food prices, and the World Bank (2008) concludes that the large increase in biofuel production from grains and oilseeds in the US and EU were the primary cause of the rising food prices between 2005 and 2008. Bindraban et al. (2009) found that estimations of the effect of biofuel production on recent rising food prices vary between 30 and 80%. The most-cited estimate may be that of the International Food Policy Research Institute (IFPRI), which holds biofuels responsible for 30% of price increases.[54] It should be noted that such statistics generally reflect only global market prices; local fluctuations and price shocks can show considerably different patterns.

The Gallagher Review states: "… *increasing demand for biofuels contributes to rising prices for some commodities, notably for oil seeds, but the scale of their effects is complex and uncertain to model. In the longer term, higher prices will have a net small but detrimental effect on the poor that may be significant in specific locations. Shorter-term effects on the poor are likely to be significantly greater and require interventions by governments to alleviate effects upon the most vulnerable.*" (RFA 2008: 9)

Box 10. US ethanol production and World food prices
The use of corn for biofuels seems to have been one of the drivers of food prices increases, such as the increasing price of maize which caused the *Mexican "tortilla crisis*" (Spieldoch, 2007). The corn acreage in the US increased at the cost of other crops, especially soy and wheat, which has influenced the prices of both. This, plus the fact that corn production was subsidized by US government, has led Mexican farmers to switch to other crops, and Mexico became dependent on imported corn. When the US government started to promote the use of corn for ethanol, the supply of US corn dropped, leading to shortages in Mexico and hence high corn prices (Tortilla crisis). Elobeid and Hart (2007) used agricultural models to estimate the effect of different scenarios of future US bio-ethanol production expansion on commodity prices and food costs in the world. They found that the areas were corn is a dominant grain for food consumption (including Sub-Saharan Africa an Latin America) will experience the largest increase of food prices ('at least 10%'), while regions where rice is the main food grain show modest food price increases ('less than 2.5%').

3.5. Recent scenarios on the potential and effects of agrofuels

Netherlands Environmental Assessment Agency (2008)
A recent study by the Netherlands Environmental Assessment Agency (MNP), within the framework of the Netherlands Research Programme on Scientific Assessment and Policy Analysis for Climate Change (WAB), analyzed eight studies that estimated the global potential of biomass for energy purposes (Lysen and Van Egmond, 2008). The study found huge variations in estimations, varying between zero in the pessimistic scenario of Wolf et al (2003), up to 1500 EJ in an optimistic scenario of Smeets et al (2007). The study specifically addressed factors that effect the potential, such as food production, water use, biodiversity, energy demand and agricultural economic. None of the studies, however, provided a complete analysis of all relevant parameters. Unresolved issues that require more research are, for example, competition for water, future diets, and the effects on demand for agricultural lands and food prices. The report also notes that most potential studies do not – or to a very limited extent – address the effects of biomass on biodiversity.

Taking into account water availability, soil quality and protected areas, the authors expect that biomass can provide between 200-500 EJ/year. The three main sources would be i) waste streams (residues from forestry and agriculture, and other organic waste); ii) additional forestry; and iii) energycrops. One of the main conclusions of the report is that the estimations of the demand for energy tend to be lower than most estimations regarding the potential of biomass for energy purposes. In other words, according to the authors, biomass can play a significant role in meeting the energy demand. In this, they see a limited role for (sustainably produced) agrofuels and an important role for wastes and residues. The study emphasizes that annual crops are not suited as important source for energy, as their potential is relatively small, while there effects are potentially large (Lysen and Van Egmond (2008).

Another study of the Dutch Netherlands Environmental Assessment Agency (Eickhout et al, 2008) found that meeting the biofuel targets that are set in the EU and the US would require 60 million hectares by 2020, which means that crops for biofuels will consume 70% of the total agricultural expansion for wheat, maize, oilseeds, palm oil and sugarcane, much of which will take place outside Europe and US. The agency predicts negative effects on biodiversity and advises to reconsider the 10 percent biofuels target of the RED, because the GHG benefits are low, and the risks for biodiversity and food security are severe (Eickhout et al, 2008).

United Nations Environmental Program (2009)
The UNEP, focusing on crop-based fuels, presents a pessimistic view. In 2009, its International Panel for Sustainable Resource Management launched a new report with a broad assessment of the Pros and Cons, based on a review of published research up to mid-2009 and the input of independent experts world-wide. The report concludes that, if current mandates[55] for biofuel production are not reconsidered, expansion of agriculture for the production of agrofuels is likely to result in the widespread loss of biodiversity. Reconsideration of current biofuel mandates, targets and quota should limit the demand to levels which can sustainably be supplied. According to the report it is more sensible, from a climate point of view, to use lands for reforestation or solar power than planting energycrops. The report states that the use of waste and residues (such as biomethane from manure and second generation ethanol produced from agricultural and forestry wastes) provides a much safer and more sustainable option for bio-energy than the use of agrofuels (UNEP, 2009).

Searchinger (2008)
Searchinger (2008) analyzed ten major reviews of biofuels policies, and draws the following conclusions:

- liquid biofuels will make only a limited contribution to world energy supplies and greenhouse gas reduction;
- direct and indirect land-use effects are likely to greatly reduce the GHG benefits;
- biofuel production has been a major cause of rising food prices;
- expansion of energycrop production will primarily take place outside Europe, with potential to contribute to economic development. Energy production from agricultural residues is likely to become more important within Europe;
- biomass is much more efficiently used in electricity production compared to biofuels, both in terms of GHG emissions and costs;

- for sustainable and effective use of biomass for energy production, heat and power generation[56] from organic (agricultural, forestry and urban) waste is more promising than the production of biofuels from energycrops.

Searchinger (2008), just like the UNEP (2009), recommends reconsidering biofuel mandates that are currently in place, including the 10 percent mandate of the EC. In stead, money should be spend on research and development

Bindraban et al (2009)

Bindraban et al (2009) assess the potential effects of the obligatory blending target of 10% in 2020 for the Netherlands, using the Cramer Criteria as reference. The study is based on a broad review of literature and consultation with experts. The authors emphasize that the growth of agricultural productivity in the coming decennia is constrained by the lack of investments in agriculture during the last decennia, as most investments in agricultural development will take at least 10 years before they generate effect. Moreover, they stress that possibilities for productivity increase are bounded by the natural limitations, such as land, water and nutrient availability.

According to Bindraban et al (2009) more agricultural lands are needed in the future for the production of food, as productivity increase will not match the increasing demand for food. Agrofuel production will further increase the demand for extra agricultural lands. They do not foresee a large potential of increasing production on 'marginal' areas, as these require huge external inputs (water and nutrients) and lack the necessary infrastructure. Hence, agricultural production on marginal areas would require huge investments, while yields will be limited. Agricultural production (for both food and fuel) will thus concentrate on fertile areas, with sufficient water available. This means that agrofuel production will compete for natural resources with the production of food. Expansion of agricultural lands for the production of biofuels will result in extra GHG emissions, and the loss of biodiversity.

The authors calculate that the 10% target for biofuels in the Netherlands would require between 612,000 and 810,000 ha of agricultural lands – the amount of land that could feed 2.7 to 3.6 million people with a European diet. They conclude that with a 10% target in 2020, it will be impossible to meet all the Cramer criteria. Further they argue that it is unlikely that biofuels will contribute to the objectives of the Convention on Biological Diversity, the UN Framework Convention on Climate Change and the MDGs.

Box 11. The Dutch academic debate

Among researchers internationally there is no consensus on the merits and drawbacks of the use of biofuels. In the Netherlands, 'proponents' of agrofuels can be found at the Copernicus Institute, Utrecht University, led by Prof. Dr. André Faaij. At Wageningen University, scholars like Prof. Dr. Ir. Rudy Rabbinge[57], Dr. Ir. Martha Bakker and Dr. Ir. Prem Bindraban, are more critical on biofuel policies (see the interview with Martha Bakker Bindraban in the annexes). There are also academics who argue that problems related to biodiversity loss and food security should be seen in a much wider context. Prof. Dr. Ir. Jan Douwe van der Ploeg, also at Wageningen University, points the finger at neoliberal trade policies, food imperia, and the marginalisation of small-scale agriculture.[58] Likewise, Prof. Dr. Ir. Louise Fresco of the University of Amsterdam expressed scepticism about how the impact of agrofuel production on food prices is publicised in the media and instead points at the neglect of the agricultural sector as a whole[59].

4. Discussion

Most scholars and practitioners agree that the potential of current technologies to provide a significant share of the current energy demand without compromising the environment and food security is limited (e.g., Doornbosch and Steenblik, 2007). However, there is huge disagreement on the implications of these limitations.[60] On the one hand there are those who argue against further investment because of the potential negative effects for the poor and the environment (e.g., Pimentel et al., 2009). On the other hand there are those who argue that more investments are urgently needed, pointing to the potential positive effects for the poor and the environment (e.g., Fresco, 2006). The lack of nuance in claims made by NGOs, businesses and governments, make discussions even more complex. The proponents present a rosy picture where energycrop production rehabilitates degraded lands that were previously unused, provides watershed protection, decreases dependence on imported fossil fuels, provides local access to energy, and provides employment with decent wages to people that would otherwise be unemployed. According to President Lula of Brazil, for example, bioenergy production is key to fight poverty. The opponents present a gloomy picture in which forests are destroyed to make place for plantations, scarce water resources are depleted, production processes are inefficient and do not lead to net reductions of GHG emissions, working conditions on plantations are dehumanizing, and small-scale farmers are displaced on massive scales.[61]

The level of disagreement found – both among academic as well as among activists and practitioners – is daunting. As Knauf et al. (2008) state: the current debate is dominated by extreme viewpoints. How to make informed policy choices when the effects of bio-energy production are still so unclear? The Gallagher Review chooses the middle-ground. It argues to increase investments in research and policy structures in the bioenergy sector, as this is needed for the development of technologies, to transform the supply chains, and to develop and implement adequate control systems to address displacement and food price effects. At the same time the Gallagher Review – from a precautionary principle point of view – calls to slow down the rate of introduction of biofuels, for example by lowering the targets, until proper systems and technologies are in place (RFA, 2008). Strikingly, this recommendation is found in all of the most recent overview studies that were assessed for this report (e.g., Eickhout et al, 2008; UNEP, 2009; Searchinger, 2008). A similar point is made by Peters and Thielmann (2008), who argue that more research on current impacts and new technologies should precede large scale stimulation of bioenergy production through tax measures and blending targets.

4.1. Second generation biofuels?

Second generation plants that are currently being developed are either ethanol plants using lignocellulosic feedstock or FischerTropsch-diesel plants. The advantage of production of biofuels from lignocellulosic materials is that it can be integrated in first generation biofuel plants. FischerTropsch-diesel plants require particularly high investments, without guarantees in terms of economic competitiveness. Bindraban et al

(2009) estimate that the contribution of second generation biofuels in the total biofuel mix will be between 0 and 40 percent in 2020.

Development of second generation bioenergy (i.e., energy from tree crops and waste streams) is generally seen as a way to take advantage of the opportunities, while minimizing the negative effects. With second generation technologies biomass is converted more efficiently into biofuel, which causes the use of land to diminish (requiring a smaller arable land area) and improves the GHG balance. Furthermore, production of second generation biofuels is less likely to result in direct competition with food. But there may be indirect competition. When crops are cultivated for the production of second generation biofuels, they will compete with food crops for land and water. Also, when the residues of foodcrops are used for the production of biofuels, this implies these residues can no longer be used as organic fertilizer, and this may thus effect food production indirectly.

At the moment the use of second generation biofuel is not yet commercially viable. Optimists estimate that they will increasingly be used between 2010 and 2015. This will depend on technology breakthroughs and investments in infrastructure. Biorefining ('bioraffinage') matches well with second generation biofuel production. Biorefining is a way of splitting up plant/organic material into a number of components, thereby increasing the economic value and often improving the GHG as well. Grass, for example, provides fibres (for combustion, the building industry, or second generation biofuels), proteins (for fodder) and polysaccharides (to produce chemicals). Producing chemicals from green organic materials has a strong indirect positive effect on the greenhouse gas balance, because usually chemicals are synthesized witch uses a lot of (fossil) energy.[62]

A possible barrier to the development and implementation of second generation technologies is formed by the current high demand for first generation biomass. Most investments are currently done in first generation biofuels. This is the so called 'lock-in effect'. A company like Shell has major infrastructure available for the production and distribution of fossil fuels. The blending of biofuels is relatively easy for them. After years of commitment to 2nd generation biofuels, Shell announced on 2 February 2010 a US$12 billion investment in 1st generation sugarcane ethanol in Brazil.[63] Also, while the development of second generation biofuel has many advantages, the opportunities for small businesses in developing countries may be limited, as the use of advanced technologies favours large-scale businesses (UN-Energy,2007).

Further, Eickhout et al. (2008) stress that, when land-use changes are taken into account, second generation biofuel production can also cause increases in GHG emission. Producing biofuels from waste materials is seen as one of the best options, but this too requires advanced technologies and could trigger unwanted effects. Sustainability criteria should therefore also apply to these production chains.

4.2. Large-scale versus small-scale production

"*Large-scale privately owned plantations are not the only economically viable model for biofuels feedstock production. Producers' associations, governments and investors may want to explore alternative business models such as joint equity in production and processing. Policy instruments based on financial incentives can help provide for inclusion of small-scale producers in the biofuels industry.*" (Cotula et al 2008:3)

Agrofuel production is attracting investors, and is likely to bring economic opportunities. The question is, to whom? In some cases there will be opportunities for small farmers and small and medium-sized enterprises to benefit, in other cases large industrial companies will benefit. In the latter cases, activities may either lead to increased employment opportunities, but it could also lead to displacement of small farmers and poor labour conditions for plantation workers (UN-energy, 2007). In inter-cropping and agro-forestry systems a high-productive cash crop can be very attractive for a farmer (for example some palm oil trees). But such systems cannot meet overall demand.

Experience with oil palm producers in Southeast Asia suggest that it is not self-evident that small farmers will benefit from increased demand of agricultural crops. In Indonesia smallholders tend to be tied, often by debt and by technical constraints, to large palm oil concerns, limiting their ability to negotiate fair prices or manage their lands according to their own inclinations. Proof exists that small-holders did not profit from the high rise in the price of palm oil on the world market. In stead, the companies – including transnational companies – increased their profit margins. This is mainly due to the current business model of the larger companies (processing in the cheapest place and enhancing profit margins to increase shareholder value). Smallholders also lack the time, skills and resources to develop and document the management plans required by independent assessors as evidence that they are looking after their crops and lands in conformity with standards. Smallholders can rarely afford the costs of independent certification itself, while economies of scale make this investment proportionately much less daunting for large estates (Vermeulen, and Goad, 2006; Anderson, 2006).

The possibilities for small-scale production depend to a large extent on the crop, the technology and the market. For example, ethanol production requires large economies of scale because the production process in the distilleries is rather complex. Biodiesel, on the other hand, offers better opportunities for small-scale production. For export purposes, large-scale production has an advantage, because it is easier to achieve consistent quality standards, while small-scale production could very well provide the resources for decentralized energy systems, for instance for use in electricity generators (World Bank, 2008). UN-Energy (2007) predicts that the future will see a mix of scales, i.e., large-scale capital-intensive industrial production, but also farmer cooperations that compete with these businesses (possibly protected by policies and supported by agricultural extension services) and small and medium scale production for local energy production. For large, medium and small-scale energycrop production to co-exist, secure land rights for small landholders is an important condition (Cotula et al., 2008).

The Brazilian Biodiesel Program is a good example of an attempt to include family farmers in biofuel production. Although farmers that participate in the scheme did see a rise of income, 80% of the current biodiesel production comes from soy oil from large plantations. This shows how difficult it is to include family farms in a commodity market, and how difficult it will be to reach an economy of scale with family farms. It might well be that for family farms (which need a diverse system to cope with external shocks) it is more profitable to produce (perishable) food for a growing urban market.[64]

4.3. Local energy self-sufficiency and the export market

Energy security is an important issue for many developing countries. Most of the developing countries are net importers of oil and this dependence is a huge weight on their foreign currency reserves. This situation is aggravated if countries subsidize petrol at the pump. Furthermore, future access to affordable oil is uncertain, because oil demand is going to rise further in the future (particularly in China and India), while oil production is in the hands of a limited number of countries.[65] In theory, domestic bioenergy production offers opportunities to become less dependent on oil imports, improving the trade balance (Dufey, 2006).

But, will domestic energycrop production also lead to local access to energy? Some are sceptical and point out that energycrop production is not likely to improve local access to energy, as its production tends to be dominated by industrial elites interested in export. An example used to back up this argument is Nigeria, which is a major oil exporter, while a large majority of the population lacks access to energy from fossil fuels (Seedling, 2007). Others stress the opportunities for local decentralized biofuel systems, especially in remote, off-grid rural areas. Biomass that can be converted to energy with simple technologies has potential for decentralized production of biofuel. Some communities in Mali, for example, use Jatropha to power generators that provide electricity to households (Hasan, 2007).[66] Also, lessons can be drawn from the Brazilian experience with its special program for small farm biodiesel production (Knauf et al., 2007). Actual experiences, however, are scarce, as many initiatives are in a pilot-phase. Ethanol production is not feasible at the community-level, and biodiesel production still requires large tracts of land to meet the demand of a village. So far, locally produced biomass does not replace the need for fossil fuels nor meet electricity needs. More sophisticated biomass systems could replace the burning of fuel wood. But why would a household buy technology when fuelwood is free? Biogas installations have proven to be competitive with biomass use for cooking (poor urban households generally buy charcoal, which is relatively expensive), but in urban areas LPG-tanks would probably be cheaper and have less in-house gas emissions. Only if gas has to be imported, locally produced fuel can be competitive if there is enough production and sufficient domestic demand. Brazil has gained experience with the introduction of ethanol gel (ethanol itself is too combustible and led to many accidents).

There is a potential conflict between the use of biomass for local energy production and other uses of biomass, such as the use of agricultural residues for animal feed, fertilizer and construction materials. Also, the costs of (simple) biofuel technologies are likely to be a huge barrier, as current energy in the form of fuel wood generally has no financial costs. Therefore, credit schemes will play a key role in getting such decentralized systems operating in the field (UN-Energy, 2007). According to UN-Energy (2007) the most promising bioenergy technologies for local systems are bio-gas through biofermentation systems, small-scale biomass gasification and power production from liquid biofuels such as vegetable oils and biodiesel (existing diesel engines can be adapted to use biofuels).

4.4. Towards sustainability through standard setting and certification?

Most stakeholders agree that, for biofuels to be sustainably produced and used throughout its entire value chain, a comprehensive and mandatory certification scheme is a *sine qua non*. Fresco (2006) argues that sustainability criteria can be applied even more structurally and points to the possibilities within the WTO regulations for countries to refuse market access for bioenergy on the basis of environmental criteria.

Certification clearly has limitations. First, there is a risk that, due to complex procedures and high costs of certification, small producers are put at a comparative disadvantage. Second, and related to the previous point, sustainability criteria lead to higher production costs and the certification process costs money. In order to remain competitive with alternatives this would require external financial support (Smeets et al., 2006). If the same sustainability criteria would be applied to fossil fuels and the negative effects on the environment would be included in the price of fossil fuel, the balance would shift to certified biofuel without the need for subsidy.

Third, certification can be – and is – used as an 'import barrier in disguise'. Fourth, there are large markets that may be less interested in certified products (e.g., China and India). And, fifth, while the aim should be to come to one comprehensive global certifying scheme, it is hugely complex to develop internationally agreed criteria and monitoring systems for certification schemes. Finally, yet importantly, one of the main criticisms on certification schemes is that they cannot properly address the macro impacts and indirect effects of large scale production. It is difficult to apply a set of criteria related to macro impacts (e.g., the cumulated effect of agricultural lands on ecosystem functions and increasing food prices) to individual companies.

The Roundtable on Sustainable Biofuels (RSB), initiated in 2007, has developed a set of draft Principles and Criteria for sustainable biofuel production, which can be downloaded (as a PDF file) at http://bit.ly/RSBNewVersion. RSB is planning to establish a certification system based on these Principles and Criteria in 2010. Also, BIOPEC – a Dutch public-private partnership – is setting up a certification scheme for biomass streams. Certification includes both the establishment of a body responsible for the development of a coherent, specific, measurable and attainable certification system, as well as the establishment of an audit system (inspections) by independent auditors contracted to the certification body. This has resulted in a National Technical Agreement (NTA 8080: *Sustainability criteria for biomass for energy applications*), based on the

Cramer criteria.[67] The Global Bioenergy Partnership (GBEP)[68] is an international platform where countries discuss indicators for sustainability. An agreement on a set of crucial indicators would be a first step towards a global agreement on what sustainability entails. The next step would be application of these indicators in relation to criteria.

For biofuel sustainability criteria (such as the Cramer criteria and RSB criteria) it is important to include the indirect effects of land-use changes, but so far it remains unclear how this can be done.[69] Indirect land-use effects are extremely complex to measure, and this implies huge challenges for the design of policies and regulations. After all, individual producers can hardly be blamed for indirect land-use effects of their agrofuel production (Hunt, 2008).

4.5. Land-use planning

The last decade several Round Tables were established, including the Round Table for Palm Oil (RSPO) and the Round Table for responsible Soy (RTRS). NGOs and companies cooperate in these Round Tables to develop sustainability criteria. Experience shows that within these settings it is impossible to discuss expansion. An individual company does not want to limit its growing potential and addressing overall expansion is seen as the responsibility of governments. Governments alone can set the proper regulation of spatial planning, enforce zoning and settle disputes. Therefore, certification of biofuels can not address negative indirect effects of agrofuel production. Direct and indirect effects of biofuel production can only be effectively addressed through an adequate land-use planning framework at the level of local and national government authorities, in a process that involves all stakeholders, including communities and NGOs.[70] This is also the point of departure of the Dutch 'Testing Framework for Sustainable Biomass' (Toetsingskader).[71]

Proper and enforced land-use planning may very well be *the single most important* pre-condition to avoid negative direct and indirect effects, such as land conflicts, social-economic marginalisation of local communities, competition with food production, biodiversity loss and a negative GHG balance. Moreover, in the absence of adequate zoning, unregulated expansion of biofuel plantations will ultimately hinder economic progress in terms of the destruction of natural resource capital (ecosystem functions) and reduced market access due to failure to meet international sustainability requirements. Still, spatial planning is hardly addressed by national and international parties involved in policies and actions related to sustainable biofuel production.

4.6. Future research

We identify several key areas for further research:

1) Empirical data on environmental and socio-economic effects
There have been many forecast studies on the production of biofuels.[72] Forecasts are important and are driving energy policies and civil society movements. However, with the biofuel boom well on its way, and companies and governments investing in expansion of biofuel production, it is high time for empirical research on both the direct and indirect effects of biofuel production, at all scales. Such studies are needed, to identify the real opportunities and threats for the poor. While we found a growing consensus among academics regarding the potential negative effects of biofuel production in terms of biodiversity loss and rising food prices, much less consensus seems to exist on the question whether, and under what conditions, agrofuel production can lead to local economic opportunities in low income countries. Smeets et al (2006) point to the need for research on the effects of large-scale energycrop production on the social conditions of the local population. Thus, holistic impact assessment methods to assess changes on livelihoods and the environment need to be developed and used in the evaluation of the European blending targets.

2) Addressing indirect impacts and standard setting and certification
As mentioned earlier, many agree that certification can be used as a tool to prevent negative effects of biofuel production. Certification initiatives for biofuel production could draw from the lessons learned by other certification and standard-setting initiatives, such as the FSC (Forest Stewardship Council) and the RSPO (Roundtable on Sustainable Palm Oil).[73] Also, there are some promising developments regarding organic energycrop production, e.g., organic sugarcane production in the state of Sao Paulo (Smeets et al 2006). Many challenges remain. Extra attention will need to go to the development of indicators that can capture indirect impacts, valuation approaches on how to assess overall damages and benefits, and monitoring- and tracking systems.

3) Small- versus large-scale production
Many important questions relate to the scale, such as: Do energycrops offer opportunities for production in integrated systems by individual small-scale farmers? What is the actual and potential role of farmers' organizations and cooperatives to compete or cooperate with large scale business? Do large-scale energycrop businesses offer opportunities for small-scale farmers, as in outgrower schemes? Should family farms produce energycrops or rather concentrate on high value food crops?

4) Technologies
Most observers agree that more research is needed on efficient technologies, both for the agricultural sector as a whole, and for the biofuel sector in particular, such as biofuels derived from wastes, switch grass and marine algae. There is an urgent need to develop and implement commercial technologies for conversion of cellulosic materials into biofuel. Knauf et al (2007) draw attention to the need to further explore the possibilities of biogas.[74] More research should also go to technologies for decentralized systems that

can provide local access to energy, from the most realistic and competitive source. The UNEP (2009) also point to the need for research to compare the relative advantages of stationary power generation versus converting biomass into liquid fuels-assessments and to compare the merits of biofuels versus solar power on the same land.

5) Tenure, access to land and land-use planning
There is a need to document (conflicts in) land rights and claims to land as an information source for the global agrofuels debate, both as a tool to strengthen the hand of local communities and as a means to capacitate the (local) state in the upholding of property rights. Also, research should be directed to developing and testing spatial planning instruments in relation to sustainability criteria and macro-monitoring schemes. Socio-economic studies are needed on the possibilities and constraints to enforce existing legislation. Methods are needed for using spatial planning instruments in the monitoring of direct and indirect effects of biofuel production.

4.7. Science meets policy: discussion topics

One of the main underlying themes of the meeting on the 18th of February is the striking discrepancy regarding (1) perceived effects of blending targets, and (2) the response to increasing concerns.

Related to the European blending targets, we found that there is a growing consensus among scientists on the fact that these targets lead to significant agricultural expansion, with negative effects on biodiversity and food prices. At the same time, we found that policymakers in the Netherlands tend favour such policy instruments, using the argument that they provide the opportunity to implement strict sustainability criteria, with potential positive effects on the sustainability of agriculture as a whole. We encourage an open debate between scientists and policy makers regarding the perceived **pros and cons of policy instruments** that stimulate the production of agrofuels.

In addition, while most parties acknowledge the potential negative effects of agrofuel production, the **responses differ** greatly, notably between NGOs on the one hand, and governments on the other. NGOs are generally sceptic about developments and assume that expansion will occur business-as-usual. Their point of view is supported by historic developments and still occurring conflicts. While most NGOs, implicitly or explicitly, refer to the precautionary principle, governments tend to emphasize the opportunities (and seem willing to take the associated risks). Policymakers in Brazil, Colombia, Indonesia, Malaysia, Ukraine and African nations emphasize the potential positive effects on economic growth, employment and rural development in producing countries. Such positive effects may occur under conditions of good governance (particularly in the field of spatial planning and land rights). Through the RED, European governments assume that by setting sustainability criteria, the necessary pre-conditions of governance will be met. The question is whether this is justified if producing countries are unwilling to talk about expansion issues.

Other issues that can be discussed at the meeting include:

1. *Availability of biomass*: Perceptions on the availability of biomass and land needed for production differ greatly. How can these differences be explained, and solved?
2. *Marginal lands*: It is often assumed that agrofuels can and will be produced on degraded or marginal lands. What pre-conditions need to be in place to regulate this and to what extent is this assumption justified?
3. *GHG emissions*: Agrofuels were enthusiastically received for their assumed contribution to climate change mitigation. Recent studies have lowered the expectations significantly. How can GHG emissions through Indirect Land Use Change be accounted for?
4. *First generation biofuels*: It is often assumed that production and use of first generation biofuels is a necessary first step on the road towards sustainable and efficient use of biomass in a biobased economy (including energy purposes)**.** But, are 1^{st} generation agrofuels indeed indispensable in the transition process?
5. *Inconsistencies*: The European Union has an ambitious position, but there are some inconsistencies in the European context. For example: (i) European countries protect their own interests, both as a producer and as a processor; (ii) The effects of agricultural expansion within Europe (and whether or not European farmers produce in a sustainable manner) are overlooked; and (iii) Producing countries should produce in a sustainable manner, but sustainability criteria only apply to feedstock used for biofuels and not for fodder or food.
6. *Certification*: It is often assumed that standard setting and certification have the potential to prevent the occurrence of negative effects. To what extent is this justified? What are the major advantages and drawbacks of certification systems? Can indirect effects ever be addressed through the current certification schemes?
7. *Other commodity chains*: Can biofuel sustainability criteria be applied to other commodity chains as well (i.e., to link criteria directly to production, notably soy, cattle ranching, timber and palm oil)?
8. *Spatial planning*: What is the potential role of spatial planning to meet concerns related to land rights, biodiversity and ecosystem resilience?
9. *Small- and medium-scale farmers*: What are potentially positive spin-offs of the increased international demand for biofuels for small- and medium-scale farmers, and how can be assured that these materialise?
10. *Assumptions*: How does the development of policy take into account the certainties and uncertainties in science?

Box 12. Some facts derived from this study

- Some biofuel crops can lead to a reduction of GHG emissions if they would substitute fossil fuels under the pre-condition that no natural lands are converted, which would affect the GHG balance negatively;
- The blending targets and growing demand for transport fuels will lead to agricultural expansion if biofuels are used as part of the energy strategy;
- If 1st generation biofuels will constitute a large percentage of the demand for transport fuels, this will compete with other uses such as food and fiber;
- Because crops currently used for biofuels are already used for other purposes, expansion of these crops will occur anyway, and biofuels cannot be discussed in isolation of expansion for other purposes.
- Commercial investors are not likely to invest in biofuel production on marginal or degraded lands;
- Food prices are likely to be affected by biofuel expansion;
- Under a 'business-as-usual' scenario of agricultural development and expansion, there is a high potential for negative effects on local communities’ access to lands and biodiversity.

Endnotes

[1] The price of fossil fuels on the world market is rising at rates and to levels unprecedented since the ‘oil crisis’ years that commenced in 1973. Much as was the case in the 1970’s, the rapid rise in the price of oil is generating concern in western countries with regard to their dependence on fossil fuels, leading to a diversification of energy sources. Combined with the exceptionally high price of crude oil in 2006 and 2007 this created a market for substitutes such as bioethanol and biodiesel. Prices for fossil based crude oil have reached record levels above $ 92.- per barrel. Production costs of agrofuels differ strongly between countries; generally agrofuel production becomes economically viable at above $ 39.- a barrel.
[2] For the Net Energy Balance (NEB), see: Hill, J., Nelson, E., Tilman, D., Polasky, S. and Tiffany, D. (2006). Environmental, economic, and energetic costs and benefits of biodiesel and ethanol biofuels. PNAS 103(30), 11206–11210. See http://www.pnas.org_cgi_doi_10.1073_pnas.0604600103
[3] Bio-ethanol production from sugarcane in Brazil is relatively cheap and economically viable at oil prices of US$ 25 – 30 per barrel. However, the production of most other biofuels is more expensive than production of fossil fuels. Demand for these biofuels thus depends on policies like tax exemptions and blending quotas. See: Dufey (2006); Peters and Thielmann (2008).
[4] Algae provide 30 times more energy per acre than land feedstock and algae fuel is biodegradable. The Dutch company Ingrepro b.v. is the largest industrial algae producer in Europe (http://www.ingrepro.nl/website/about.php). The United States Department of Energy estimates that if algae fuel were to replace all fossil fuel in the US, this would require 40.000 square kilometres, about the size of the Netherlands (E. Hartman, A promising oil alternative: algae energy, Washington Post, January 6, 2008.) Companies like Shell and HR Biopetroleum have started cultivating algae on Hawaii for the production of biofuels. Essent too, together with AkzoNobel, is involved in cultivating algae.
[5] In Benin 2.8 million tonnes of cassava are used per year for the production for ethanol/ gelfuel per annum.
[6] Sweet Sorgum is the main source of energycrops in Zambia. In comparison with sugarcane, it is easier to grow and handle, at about one third of typical cultivation costs, and also uses significantly less water (BZOS, 2007).
[7] http://knowledge.allianz.com/en/globalissues/energy_co2/renewable_energy/biofuels_crops.html
[8] Roberts (2007)
[9] Read controversies over Jatropha in Seedling (2007)
[10] In addition to energy related measures it is important to recognize that currently export of agricultural commodities from developing countries, in general, is constrained by protectionist measures by industrialized countries.
[11] According to Knauf et al (2007) further development of bio-energy production in the EU and the US will reduce local surplus production and will stop dumping of agricultural produced, which will lead to better opportunities for small farmers in developing countries.
[12] See: http://ec.europa.eu/energy/green-paper-energy/index_en.htm
[13] European Parliament legislative resolution of 17 December 2008 on the proposal for a directive of the European Parliament and of the Council on the promotion of the use of energy from renewable sources (COM(2008)0019 – C6-0046/2008 – 2008/0016(COD))
[14] Directive 2009/28/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (23 April 2009)
[15] See the ‘Nederlandse Energienota 2008’, presented on 18 June.
[16] The work program, as well as an evaluation by Energieonderzoek Centrum Nederland (ECN) and the Natuur en Milieu Planbureau (NMP) can be downloaded from: http://www.vrom.nl/pagina.html?id=32950.
[17] According to the Kyoto Protocol and the EU agreements, the Netherlands needs to reduce its emissions by 6% between 2008 and 2012 (compared to its 1990 emission levels).
[18] The full ‘Energierapport 2008’, as well as a summary, can be downloaded at: http://www.ez.nl/Actueel/Kamerbrieven/Kamerbrieven_2008/Juni_2008/Energierapport_2008.
[19] See pp. 76-78 in the Energierapport 2008.
[20] A copy of the report can be ordered or downloaded at: http://www.senternovem.nl/energietransitie/Nieuws/biomassa_hot_issue_slimme_keuzes_in_moeilijke_tijden.asp.
[21] See: http://www.senternovem.nl/gave_english/netherlands_biofuels_policy/index.asp#7

And: http://www.senternovem.nl/gave/dubbeltelling/index.asp#4

[22] In the Netherlands, the 'Cramer Committee' in 2006 produced a list of criteria for sustainable biomass, which was the outcome of comprehensive expert consultation by different stakeholders from university, government and business (but without stakeholders from producer countries).

[23] On 15 December 2009 the embassies of Argentina, Brazil, Colombia, Indonesia, Malaysia, Mauritius and Mozambique sent a letter to the Commissioner of Transport and Energy expressing their concern on ILUC.

[24] See NRC 10 April, 'Biodieselbonanza in Rotterdam-Botlek'.

[25] The reports can be downloaded from: http://www.corbey.nl/index.asp?page_id=150

[26] See Letter to the EU from the African Biodiversity Network which calls on EP's to reject the 10% biofuel target. See: http://www.africanbiodiversity.org/resources.php.

[27] Source: Dow Jones newswires

[28] Including for instance a U.S. $ 5.5 billion investment by China national offshore oil company, $ 3 billion by Malaysian Genting and a $ 1 billion investment by Samsung. Source: International Herald Tribune (16/08/2006): Indonesia counting on biofuel.

[29] For more information, see http://www.biotanken.nl.

[30] See www.abengoabioenergy.com

[31] See NRC 3/4 mei 2008, 'Het recht op leven gaat voor een volle tank'.

[32] See, e.g., www.oxfam.org/en/campaigns/agriculture/biofuels

[33] Oft-cited argument by environmental NGOs: In Indonesia and Malaysia palm oil production for biofuel causes clearing of rainforest; in Brazil the Amazon forests are threatened by displacement effects of sugar plantations for bioethanol production and soy used for biodiesel.

[34] see also more general studies by Wicke et al (2007 & 2008) And: Hooijer et al (2006)

[35] http://www.becitizen.com/pdf/biofuels_euractiv_en.pdf

[36] In the Brazilian sugarcane sector the ratio of jobs per unit of energy is much higher than for other energy sources.

[37] FIAN (2008) found that expansion of sugarcane plantations hampers the demarcation of indigenous lands in the state of Mato Grosso do Sul. In the same state, FIAN associates expansion of sugarcane production with a dramatic increase of murders of indigenous people. In the Cerrado and the Amazon region, FIAN (2008) reports that local communities are pushed off their lands as a result of the expansion of sugarcane plantations. They mention that local people are not only directly threatened by the establishment of sugarcane plantations on their lands, but also indirectly, as expansion of sugarcane in the mid-southern Brazil pushes soybean and cattle production to the Cerrado and the Amazon region. On the basis of a fact-finding mission they write: "… *systematic and multiple violations of the human rights of workers, indigenous peoples and small-scale peasant producers have been committed and these violations are either directly or indirectly connected to public policies that encourage the production of agrofuels.*" And: "*Energy production from agricultural products is based on a raw material monocropping production model that concentrates land and production, with major social and environmental impacts. The accelerated expansion of agrofuel production worsens, in this context, the most harmful elements of this model. In addition to the aforementioned labour and environmental problems, there is a process of land concentration, increase in land prices, an unchecked process of land purchase by foreigners and the non-enforcement of land use planning rules*."

[38] See, e.g., cases documented by Cotula et al 2008).

[39] See also: http://www.landaction.org/spip/spip.php?article361

[40] http://allafrica.com/stories/200912240491.html

[41] http://www.iied.org/pubs/pdfs/12556IIED.pdf

[42] For a study on the effects of bioenergy on the waterfootprint, see Gerbens-Leenes et al (2008).

[43] Cotula et al (2008)

[44] See the expert meeting on biofuels organised by BothENDS:
http://www.bothends.nl/uploaded_files/2Report_Agrofuels.pdf.
Also see the publication by the African Biodiversity Network a.o. 'Agrofuels and the myth of the marginal lands', September 2008. And the article 'Boeren Kenia verliezen geloof in biodiesel' at:
http://www.afrikanieuws.nl/site/list_messages/21317.

[45] See Danielsen et al (2008) for a meta-analysis of faunal studies comparing forest with oil palm in Indonesia. They found that the majority of plants and animals in oil palm plantations belonged to a small number of generalist species of low conservation concern.
[46] Note that rapeseed production is increasing in Europe and some 300.000 ha of former agricultural lands are taken back into production (in the recent history, farmers were subsidized not to use the lands). The associated biodiversity loss is on these lands is discarded.
[47] See http://phosphorus.global-connections.nl
[48] http://www.sprep.org/att/IRC/eCOPIES/Global/155.pdf
[49] Food Outlook, November 2008: (http://www.fao.org/docrep/011/ai474e/ai474e00.HTM)
[50] A brief perusal of the news provides an illustration. In Yemen, food riots broke out in the face of the government's inability to maintain low process for foodstuffs (from Al Jazeera). In Mexico, food riots broke out as a result of the recent quadrupling of the price of maize as the result of a shortage of cheap US corn which has been diverted into bio-ethanol production (from the BBC). In Italy, urban areas face a 'pasta strike' as a result of the rapid increase in the price of wheat. And the European commission proposed to scrap the rule requiring EU farmers to leave 10% of their land fallow, which would enable them to grow more grain and offset recent poor harvests and soaring food prices (From Dutch online news).
[51] From a historical perspective, current food prices are not outrageously high. For the 40 years previous to this recent price spike, the prices of prime agricultural commodities decreased. The real price of agricultural products (worldwide) in 2000 was no more than 45% of that in 1973 (EnergieTransitie 2008)
[52] See for instance the 7th Brussels Development Briefing (16 October 2008) titled: 'Rising food prices: an opportunity for change?', organized by CTA in partnership with the European Commission-DG Development and EuropeAid, the EU Presidency, the ACP Secretariat, Euforic and Concord (European platform of development NGOs), at: http://brusselsbriefings.net/past-briefings/october-16-2008/.
[53] Aid to farmers in developing countries halved since 1980 to around $4 billion, which equals 3% of total subsidies given to farmers in rich countries. The World Development Report (WDR) 2008 'Agriculture for Development' has set the tone for renewed interest in agriculture and rural development. The EU has committed to making more resources available for agriculture in developing countries. On 21 November 2008 the EU budget ministers and MEPs reached an agreement to budget €1 billion for developing countries' farmers. This agreement will need the formal approval of the European Parliament at its plenary session on 16 December. In 2008, the Dutch ministers for Development Cooperation (Koenders) and Agriculture, Nature and Food Quality (Verburg): presented their joint policy paper 'Landbouw, rurale bedrijvigheid en voedsel zekerheid' (8 May 2008).
[54] Don Mitchell, renowned World Bank economist, came with a figure of 65%. The World Bank, however, did not endorse this as its official standpoint.
[55] Many countries have adopted subsidies for biofuels including tax credits, investment incentives, blending mandates and trade restrictions. Total OECD subsidies, for example, amounted to US$11 billion in 2006 and are expected to rise to US$27 billion per year between 2013 and 2017 (Searchinger 2008).
[56] According to the International Energy Agency (IEA 2008) using energycrop biomass for heat and power provides twice the energy per hectare as using it for biofuels.
[57] http://www.vpro.nl/programma/buitenhof/afleveringen/37384065/items/38803719/
[58] See NRC 10/11 mei 2008, 'Geloof niet in het gevaar van bio-energie of andere ficties rondom de voedselcrisis'.
[59] See NRC 19/20 April 2008, 'Genoeg eten voor iedereen'; and FD 12 April, 'Landbouw was kind van rekening'.
[60] There is also disagreement on the potential effect of bioenergy use on GHG emissions (Kim et al. 2009)
[61] Biofuelwatch (2007), for example, claims that bio-crop production is devastating for the world's poor.
[62] See for instance: http://www.biorefining.com/
[63] http://www.ft.com/cms/s/0/b9aadc38-0f9b-11df-b10f-00144feabdc0.html
[64] The potential role of family farms to meet concerns regarding food security for a growing world population tends to be underestimated
[65] In Africa, some countries such as Mozambique and Tanzania have gas reserves.
[66] see also Cotuala et al (2008) for some more examples of small-scale bioenergy production from Jatropha.
[67] http://biopec.net/index.html.
[68] http://www.globalbioenergy.org/

[69] This has been one of the criticisms of NGOs on the Cramer criteria. Zie gezamenlijk persbericht van Stichting Natuur en Milieu, Milieudefensie, Both Ends, Greenpeace, Oxfam Novib: Cramer Criteria geen garantie voor duurzame bio-massa. URL: http://www.snm.nl/page.php?pageID=88&itemID=2681target=
[70] Inadequacies in land-use planning are mentioned as the largest bottlenecks by RSPO member companies which strive towards certified sustainable palm oil.
[71] http://www.vrom.nl/docs/20070427-toetsingskader-duurzame-biomassa.pdf
[72] See, e.g., BZOS (2007); UNF (2008)
[73] The Roundtable on Sustainable Palm Oil (RSPO, including a "Taskforce on smallholders"' was set up to address environmental and social concerns associated with palm oil production. But the principles expressed in the RSPO are not always put in practice. See, for example, a case study on irregularities in the practices of Wilmar, a company operating oil palm plantations in West Kalimantan. see: Milieudefensie et al (2007).
[74] Recent studies seem to indicate that biogas (biomethane) is more efficient (in terms of energy yield per ha and CO2 balance) than biofuel (Knauf et al. 2007).

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Bijlage 1. Verslag interview met dr. M. (Martha) Bakker - Wageningen Universiteit – groep Land Dynamics

Dr. Martha Bakker is expert op het gebied van drijfveren achter landgebruikveranderingen.

Telefonisch interview gehouden op 24 December 2009.

Q: Wat zijn de meest recente inzichten met betrekking tot de bio-based economy?
A: De hoge voedselprijzen van 2008 hebben voor veel mensen de ogen geopend dat er geen overschot is aan voedsel, zoals dat voorheen wel vaak verondersteld werd. En men is het er doorgaans toch ook wel over eens dat de vraag naar biofuels een belangrijke rol heeft gespeeld in de plotselinge schaarste. Ja, er waren natuurlijk ook andere oorzaken: tegenvallende oogsten, onzekerheid over voorraden, speculatie, maar dat neemt niet weg dat biobrandstoffen ook een rol hebben gespeeld bij het opdrijven van voedselprijzen.

Q: De vraag is dus of de voedselcrisis een incident is geweest of dat zich een nieuwe trend aan het ontwikkelen is.
A: Dat laatste denk ik.
Kijk, de afgelopen decennia is het zo geweest dat de gewasproductiviteit steeds iets harder steeg dan de vraag naar voedsel, wat leidde tot een overschot aan productie, een overschot aan landbouwgrond en te lage voedselprijzen. In Europa en de VS dan vooral. Het landbouwbeleid van de EU en de VS is de laatste jaren dan ook vooral gebaseerd geweest op deze situatie, vandaar die quota, set-aside, enzovoorts. Dat was allemaal bedoeld om de productie in te dammen. Daarom vond iedereen biofuels zo’n goed idee! Je sloeg er als het ware twee vliegen in een klap mee: het klimaatprobleem werd aangepakt, en de boeren hadden ook weer iets te doen.
Maar nu begint langzaamaan het besef te groeien dat die situatie niet lang meer zal opgaan in de toekomst: Enerzijds zie je dat men terugkomt op eerdere vraagprojecties. Die werden tot voor kort min of meer direct geëxtrapoleerd vanuit het verleden. Zo heeft de FAO lange tijd geen rekening gehouden met veranderende eetpatronen in opkomende economieën en daarmee de vraag naar graan enorm onderschat. Ook IPCC heeft door fouten en simplificaties nogal optimistische voorspellingen gedaan over de toekomstige vraag naar voedsel. Die zijn inmiddels wel hersteld, maar het duurt weer even voor dat dat ook doordringt tot alle modelstudies naar biofuels.
Ten tweede heb je de optimistische inschattingen van de productiecapaciteit. Ook hier zie je weer dat bijvoorbeeld toekomstprojecties van gewasproductiviteit lineair geëxtrapoleerd zijn uit het verleden. Of je dit werkelijk mag verwachten is twijfelachtig. Het zou kunnen, althans voor de komende 20 jaar, maar dan moet je wel blijven investeren in onderzoek, en die investeringen blijven de afgelopen jaren wel wat achter. Met een toename aan misoogsten in belangrijke graanproducerende landen door klimaatverandering lijkt ook weinig rekening gehouden te worden.
Verder is het zo dat de hoeveelheid beschikbare grond ook vaak nogal is overschat. Veel economische modellen corrigeren onvoldoende voor gronden die ongeschikt zijn om iets

op te verbouwen. Daarnaast wordt ook vaak geen rekening gehouden met het feit dat het areaal dat je daadwerkelijk kan oogsten altijd kleiner is dan het totale landbouw areaal. Alleen dat laatste al kan zomaar oplopen tot een overschatting van 10% van het beschikbare areaal. En dan heb je het dus alleen nog maar over land: Over tekorten in water en fosfaten hebben we het dan nog niet eens gehad.

Q: Maar er zijn toch ook optimisten die denken dat de vraag naar grondstoffen voor energie (biobrandstoffen) juist een enorme impuls kan geven en investeringen in de landbouw (die jaren zijn achtergebleven) juist stimuleert.
A: Ja, het is zo dat er in veel gebieden nog veel te behalen valt op het gebied van productiviteit, maar de grote vraag is hoe je dat wil aanpakken. Je kunt ter plekke proberen de productiviteit in die achterblijvende landen op te krikken, maar dat gaat alleen gebeuren als voedsel structureel duurder wordt. Anders zou dat namelijk al wel eerder gebeurd zijn. Maar het probleem daarmee is dat je dan toch niet kan tegenhouden dat het landbouw*areaal* dan ook gaat toenemen, over het algemeen ten koste van natuur. En juist in landen waar je nog veel kunt winnen op het gebied van productiviteit, is de bescherming van natuur verre van optimaal geregeld.
In plaats van beter management ter plekke kun je trouwens ook de productiviteit proberen te verhogen door nieuwe gewasvariëteiten te ontwikkelen. Ook daar valt zeker nog wel wat winst te behalen. Het is alleen jammer dat de EU zich tegen de ontwikkeling van GM gewassen lijkt te keren, want daarmee sluit je al op voorhand een belangrijk productie-verhogend proces uit.

Q: Zie je mogelijkheden om deze impasse te doorbreken?
A: Nee eigenlijk niet. Iedereen kan op zijn vingers natellen dat grootschalig gebruik van grond voor biomassa voor energie concurreert met óf voedselproductie óf natuur. Daar ontkom je gewoon niet aan. Nou, welke van de twee wordt het?

Q: Hoe zie je in dat verband dan de argumenten die veelgehoord zijn dat biobrandstoffen juist kansen biedt voor opkomende economieën?
A: De enige biobrandstof die op dit moment min of meer duurzaam te noemen is, is ethanol uit Braziliaans suikerriet – tegelijkertijd is dat ook de enige met een handelsbeperking. Dus waar hebben we het dan over als we over kansen spreken?
En ook: Als je dan hoort dat bepaalde ontwikkelingsinstellingen zeggen dat de consequenties van de productie van onze biofuels een soevereine kwestie van ontwikkelingslanden zelf is, dan is dat toch wel een wat opportunistische uitspraak. Ik begrijp goed dat ontwikkelingsinstellingen in eerste instantie geïnteresseerd zijn in economische groei voor ontwikkelingslanden, maar als de consequentie is dat je die landen er vervolgens toe gaat verleiden om voor een appel en een ei hun eigen natuurlijk erfgoed om zeep te helpen, dan ben je niet goed bezig.

Q: Maar wat vind je dan van de verwachting dat er veel 'spare' land is die prima voor biobrandstoffen kunnen worden gebruikt?
A: Maar wat is dan dat zogenaamde 'spare' land? Er zit altijd wel een of ander eco- of agrosysteem dat moet wijken voor de energiegewassen. En vrijwel iedere

landgebruikverandering resulteert in eerste instantie in een netto CO_2-uitstotend effect, wat pas na aanzienlijke tijd weer is terugverdiend. Deze initiële conversie wordt overigens ook vaak niet meegenomen in de CO_2-balans. Hoe je het ook wendt of keert: de productie van gewassen speciaal voor biofuels of biomassa gaat altijd ten koste van voedselproductie of van natuur. Van 'spare' land kun je zeggen dat dat dan laagwaardige natuur is, maar vaak hebben we toch te weinig verstand van de complexiteit van ecosystemen om daar echt een zinnige uitspraak over te doen.

Ook als je zegt: we importeren alleen maar duurzaam geproduceerde biofuels: prima, dan reserveren ze voor jou een paar hectare waar een en ander duurzaam geproduceerd wordt, en verplaatsen ze de onduurzame praktijken die er wellicht eerst plaatvonden gewoon naar het nabijgelegen oerwoud. Over regulatie hebben we het al gehad, het is naïef om te denken dat zulke indirecte landgebruikveranderingen wel gereguleerd zullen worden in de productie-landen. Het stimuleren van de productie van gewassen voor energie gaat hoe dan ook gepaard met een grote kans op onherstelbare vernietiging van natuur, en/of verdere stijging en volatiliteit van voedselprijzen.

Q: Wat zeggen de landdynamiek modellen eigenlijk over 'spare' land i.r.t biofuels?
A: Er zijn er verschillende aannames. De simpelste zeggen: alles wat niet water of stad is is beschikbaar. Er zijn er ook die uitgaan van alleen het huidig landbouwareaal. Maar het grootste probleem met al die modelstudies is dat dit soort programma's altijd heel lang duren, vooral al die Integrated Assessment studies, die draaien allemaal nog met die optimistische projecties van vraag en productie. Een na-ijl effect dus. Op dit moment rollen nog resultaten uit die programma's die nog die achterhaalde projecties als input hadden. En daar baseert veel beleid zich dus op.

Maar je hebt zoveel soorten modellen. Eigenlijk zijn er grofweg drie typen: de *economische,* die zeggen je bij welke prijs en hoeveelheid vraag en aanbod met elkaar in evenwicht zijn. Nou, dat is feitelijk gewoon een theoretische exercitie met weinig voorspellend gehalte. Zo onvoorspelbaar als de olieprijs is, nog onvoorspelbaarder is de hoeveelheid biofuels die geproduceerd zou moeten worden.
Dan heb je de meer *agronomische modellen* die de input/output verhoudingen bekijken voor het produceren van een bepaalde hoeveelheid energie. Daarbij is de hoofdvraag natuurlijk wat je allemaal meeneemt als input. Onlangs is er een grote herzieningsslag geweest waarbij er dus veel meer is meegenomen dan voorheen. En dan blijkt dat als je alle bewerking en bemesting meeneemt je plotseling veel minder rendement hebt. Als je bijvoorbeeld de N_2O emissie meeneemt die door bemesting plaatsvindt, blijkt dat sommige gewassen, zoals biodiesel uit koolzaad en ethanol uit mais of suikerbieten, meer broeikasgassen opleveren dan dat ze wegvangen.
En dan heb je nog de locatie, of *regionale disaggregatie*, modellen. Die vertellen je op welke locatie je optimaal kunt produceren. Dat is een functie van ruimtelijk variabele productie factoren. Het nadeel van dat soort modellen is dan weer dat het ook weer optimalisatie modellen zijn. Om een voorbeeld te geven: Voor de houtachtige gewassen (biomassa) geldt dat ze het relatief goed doen op de wat marginalere gronden, dus plaatst zo'n optimalisatie model die gewassen braaf op de marginale gronden. Maar natuurlijk

groeien ook die houtachtige soorten doorgaans beter op goede dan op slechte gronden, en de kans is groot dat als de voedselproducenten de smallholders zijn, en de biomassaproducenten de grote bedrijven zijn, niet de houtachtige biomassa gewassen maar juist de voedselgewassen op de slechtere gronden terechtkomen. Waar ze dan ook meteen een veel groter areaal nodig hebben om weer dezelfde hoeveelheid te kunnen produceren. Dat soort processen kunnen dit soort modellen dus niet meenemen.

Maar eigenlijk heb je deze complexe modellen helemaal niet nodig, ze draaien de mensen eerder een rad voor de ogen omdat ze zo complex zijn, en het helemaal niet transparant is wat voor veronderstellingen eraan ten grondslag liggen. De belangrijkste conclusie blijft gewoon dat er altijd concurrentie optreedt met voedsel of natuur. En de kwestie van ‘spare’ land: dat gaat om kennelijk ‘inferieure’ natuur of landbouwgrond waarvan we het goed vinden dat we die gaan gebruiken voor biomassa productie. Over die definitie van wat inferieur dan is valt natuurlijk wel te twisten.

Q: Eigenlijk zeg je: het is dus een politieke keuze?
A: Dat is het zeker. Het in gebruik nemen van extra landbouwgrond ten koste van natuur, het intensiveren van de landbouw met de nadelen van de intensievere productie, het wel of niet willen investeren in verbeterde gewasvariëteiten – het zijn allemaal politieke keuzes. De constatering is: het reguleren van landgebruik buiten eigen landsgrenzen is heel lastig, en zo beschouwd is het eigenlijk onbegrijpelijk dat de EU een consumptie verplichting instelt in plaats van een productie verplichting. Met dat eerste verplaats je feitelijk je ecological footprint gewoon weer naar de ontwikkelingslanden. Bovendien: de perspectieven voor ontwikkeling van productie van bio-energie zijn nou eenmaal beter in landen als Nederland. Nederland is eigenlijk gek als je bedenkt dat hier niet veel meer gebeurt op het gebied van bio-energie. Als je kijkt naar de intensieve veehouderij met al z'n mestproblematiek, dan is het toch verwonderlijk dat daar niet op grotere schaal wat meer mee gebeurt. Mij lijkt dat de toekomst voor biomassa sowieso veel meer op het gebied van residu-verwerking ligt dan in het verbouwen van speciale gewassen. Maar in Nederland zou bijvoorbeeld teelt van wilgen op veen om verdere oxidatie te voorkomen ook een prima alternatief zijn. Wat betreft ontwikkelingslanden: beloon ze liever voor het behoud van hun natuur dan voor het verbouwen van biobrandstoffen. Daar is het klimaat waarschijnlijk meer bij gebaat.

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