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Discussion paper:

Burning questions – Certainties and uncertainties concerning agrofuels

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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, Leiden University and the Centre for International Cooperation/VU University Amsterdam. A draft version of this paper served as input for an expert meeting between Dutch scientists, NGO representatives and policymakers on 18 February 2010 entitled 'Brandende vragen – zekerheden en onzekerheden in wetenschap en beleid omtrent biobrandstoffen' that was organised by the Agrofuels platform for this DPRN process. With the aim being to stimulate informed debate and a discussion of issues related to the formulation and implementation of development policies, DPRN creates opportunities to promote an open exchange and dialogue between scientists, policymakers, development practitioners and the business sector in the Netherlands and Flanders. For more information see www.DPRN.nl and www.global-connections.nl.

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Acronyms

CDB	Committee for Biomass Sustainability Matters' (in Dutch: 'Commissie Duurzaamheidsvraagstukken Biomassa', also known as the 'Corbey Committee')
CO_2	Carbon Dioxide
DGIS	Netherlands Directorate-General of Development Cooperation
EC	European Commission
EU	European Union
FDI	Foreign Direct Investment
FIAN	FoodFirst Information and Action Network
FQD	Fuel Quality Directive
GHG	Greenhouse gas
IEA	International Energy Agency
IFPRI	International Food Policy Research Institute
ILO	International Labour Organization
ILUC	indirect land use changes
IUCN	International Union for the Conservation of Nature
LNV	Ministry of Agriculture, Nature and Fisheries
MoU	Memorandum of Understanding
NGO	Non-governmental organisation
OECD	Organisation for Economic Co-operation and Development
RED	Renewable Energy Directive
RSB	Roundtable on Sustainable Biofuels
UNEP	United Nations Environment Programme
US	United States of America
VROM	Dutch Ministry of Housing, Spatial Planning and the Environment
WWF	World Wildlife Fund
WTO	World Trade Organization

Burning questions – Certainties and uncertainties concerning agrofuels

1. Introduction

During the last couple of years there has been 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 (EU) promotes biofuels as a measure to reduce Carbon Dioxide (CO_2) emissions and many countries promote biofuels in order 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 the subject of much debate. Proponents – who consider biofuels to be the answer to both rising oil prices and the negative climatic consequences of fossil fuels – find themselves opposed to those who warn about 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. Policymakers and businesses, however, seem to be impatient and may (have to) take decisions on the basis of assumptions. The problem is that these assumptions, and their underlying values and motives, are not always properly communicated. A group of Dutch research institutions and non-governmental organisations (NGOs) created an 'Agrofuels knowledge platform' with the aim being to contribute to an overview of the available scientific knowledge and the perspectives of various stakeholders. On 18 February 2010 the platform organised a discussion between scientists and policymakers to review some of the certainties and uncertainties of the biofuels debate. A draft version of this paper served as input for the meeting. A summary of the meeting outcomes can be found in Appendix 1.

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[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.

1.1. Purpose of the study

The document has three main objectives. First, we attempt to outline the positions of the various stakeholders in order 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 the basis of this analysis we suggest a number of issues for discussion between scientists and policymakers, many of which were touched upon during the debate on 18 February 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 footnotes.

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 referred to as '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 therefore 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 into 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 therefore adds CO_2 to the atmosphere. Biofuels have been widely promoted for their 'carbon neutrality'. Substituting fossil fuels with 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] In the US

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[2] For the Net Energy Balance (NEB), see Hill et al. (2006).

[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

ethanol is mainly produced from corn. At global level the diesel/biodiesel market is smaller than the petrol/ethanol market. The main diesel market is the EU. Biodiesel is particularly important in the German market where it is derived from rapeseed (Peskett et al., 2007). Biodiesel production in Brazil is on the increase, with 80% coming from soy.

A differentiation is needed between first, second and third generation biofuels. The problem is that the definitions 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 adhere to the definitions published by IUCN NL (2008).

First generation biofuels are transport fuels produced using 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; United States (US): corn, soybeans; Brazil: sugar cane; Southeast Asia: palm oil). Currently only first generation biofuels are commercially viable.

Second generation biofuels are produced using 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 the source material is used and organic waste material can also be used. One 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. It is estimated that the technology will be commercially available in about a decade.

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

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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).

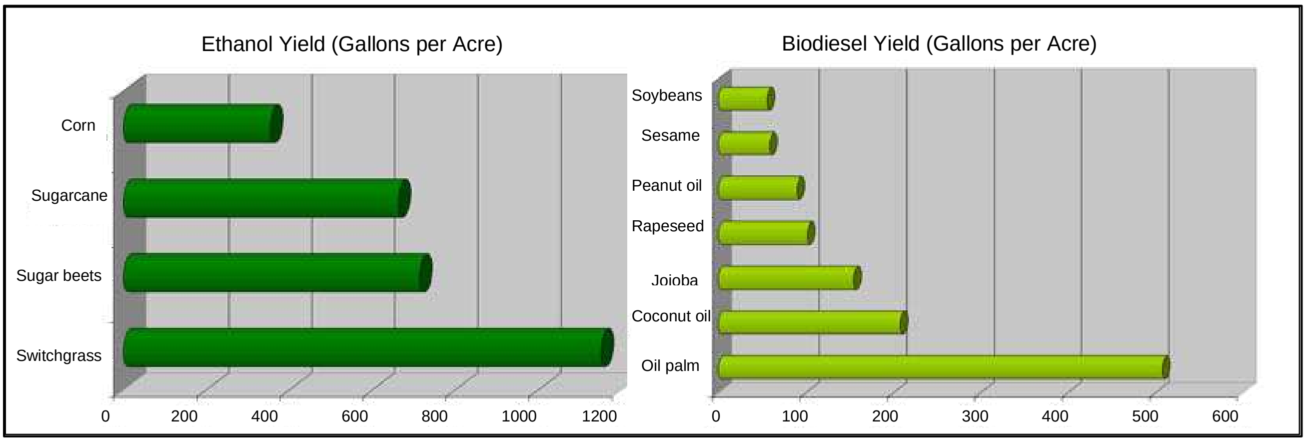
4 Algae provide 30 times more energy per acre than land feedstock and algae fuel is biodegradable. The Dutch company Ingrepro b.v. is the largest industrial algae producer in Europe (http://www.ingrepro.nl/website/about.php). The United States Department of Energy estimates that if algae fuel were to 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.

includes so-called first-generation biofuels made from oil palm and sugarcane, as well as 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 which contain 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 the basic production yield 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 covers 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 is adding to the existing demand for palm oil. Palm oil production is growing in several countries (such as Colombia and Brazil) and planned in other countries (such as DR Congo). 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. Moreover, palm oil plantations are often established at the expense of natural lands (such as tropical forests), leading to biodiversity

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[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 energy crops 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 (De Castro, 2007).

loss and emissions of the stored carbon (from the trees and the soil). If natural lands are converted with the purpose of producing oil palm for biodiesel, 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).

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 EU (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

Bioethanol can be produced from sugarcane (*Saccharum* spp) relatively cheaply and these days in a very energy-efficient way (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 coverage is expected to grow in the future.[8] The sugarcane crop and production technology has advanced over the years, and the residue of the sugar cane – bagasse – is used for energy generation in ethanol factories. As a result, ethanol production from sugarcane on existing farmland has a positive GHG balance. Within Brazil itself the main concern is that the amount of sugar cane will expand and take land away from soy and cattle producers that will, in turn, move to the Amazon region. A recent study of the sustainability of Brazilian bioethanol concluded that its production can be sustainable, but that there are many future uncertainties 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 farmland.

Corn

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

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[7] http://knowledge.allianz.com/en/globalissues/energy_co2/renewable_energy/biofuels_crops.html

[8] Roberts (2007).

Soy

Soy is mainly grown in the US and Brazil. Soy meal is used as cattle fodder and a by-product of this process is soy oil which can be used for biodiesel. Within Brazil itself the production capacity of biodiesel factories is rising fast. Today, 80% of all biodiesel produced stems from soy. As yet, no significant quantities of biodiesel have been exported as Brazil is trying to keep up with domestic demand. The US exports some biodiesel (supported by subsidies) to the EU.

Box 1. Jatropha

Jatropha is another biodiesel crop, but it is not yet produced in commercial quantities. In recent years, the focus on using Jatropha to produce biofuels has intensified. 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 energy crop 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 life 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 in Africa. Many of these 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 cultivating 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 yet been proven. Many pilots are established with government subsidies. The opponents also warn that, even though Jatropha can indeed grow on poor soils, the plant will need sufficient water and nutrients to produce acceptable yields (Asselbergs et al., 2006). Based on the same line of reasoning, some highlight the risk of commercial companies looking for good quality land for large-scale Jatropha production which will result in competition with food crop production and the ousting of small farmers (GRAIN, 2007).

1.4. The expansion of agrofuel production

Although biofuels currently provide only 1.8 percent of transport fuels (UNEP, 2009), global production and the 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 five billion litres were exported in 2008 (UNEP, 2009).

[9] Read about controversies relating to Jatropha in GRAIN (2007).

Many countries, including the poorest ones, are currently developing ambitious plans for agrofuel plantations, both for export and for domestic energy supply (De Castro, 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, the favourable climate, cheap labour and supportive national governments which are keen 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 imports.

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 US and EU states. As a consequence, demand and policy changes in the OECD countries are key drivers for energy crop production. 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 benefit domestic farmers.[11] Moreover, blending targets – targets for the percentage of biofuels to be mixed with fossil fuels in petrol and diesel – are important instruments for the promotion of biofuel production.

1.5. A summary of the arguments for and against

The arguments for agrofuels

- 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. In theory, therefore, there is an unlimited and secure supply.
- Certain forms of agrofuels have a positive GHG balance compared to fossil fuels and their use will therefore help to mitigate climate change.
- The production of agrofuels is not restricted to specific countries that can control supply and determine price.
- The production of agrofuels holds economic opportunities for (investments in) the agricultural sector in developed and developing countries, through generating employment and increasing 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).

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[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 industrialised 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.

- Agrofuels offer opportunities for a much-needed local energy provision given that, currently, 1.6 billion people have no access to electricity and 2.4 billion people have no access to modern fuels for cooking and heating.

The arguments against agrofuels

- The GHG emission reduction potential of agrofuels strongly depends on whether or not natural land is converted (conversion of natural areas could lead to a negative balance).
- The production of feedstock for agrofuel competes with (land for) food production, both directly and indirectly.
- The production of agrofuel feedstock has an effect on food prices, with serious consequences for the poor.
- The production of agrofuel feedstock can lead to rising land prices and income inequality.
- The 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.
- The production of agrofuel feedstock and processing causes competition for scarce water resources.
- There is a risk that people will be displaced from their land to make way for 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 as regards assuring (and assessing) the sustainability of biofuels. It should be noted that amount of agricultural land will also increase due to an increasing need for food among a growing world population. Moreover, crops such as soy and palm oil are being planted to meet this need. A producer will try to meet demand and is not concerned about 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 sustainable production (*vis-à-vis* criteria set for certain crops by international Round Tables).

2. Stakeholders' positions

2.1. European Union

The EU communicates that climate change concerns are the main reason for promoting biofuels. There is an underlying need to diversify the EU energy strategy and become 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 entitled '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 RED

'The control of European energy consumption and the increased use of energy from renewable sources, together with energy savings and increased energy efficiency, are important elements 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. These elements also play an important role in promoting security of energy supply, in promoting technological development and innovation and in 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 realise 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 incorrect). Obligatory blending targets may be in place at the level of individual member states (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 (EC) 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

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[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))

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.

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

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 peat land in January 2008, unless it is proven that the cultivation and harvesting of this raw material does not involve drainage of previously undrained soil.

2.2. The Dutch government

The Dutch government wants to make a transition to a more sustainable energy supply (the *EnergieTransitie*).[15] In September 2007, the work programme entitled *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;

[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 programme, 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).

- 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, Foreign Affairs, and Housing, Spatial Planning and Environment (VROM), presented the *Energierapport 2008* which describes 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 report states that the government is going to invest €7 billion and highlights 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 entitled: '*Biomassa, hot issue. Slimme keuzes in moeilijke tijden'*.[20] It concluded that biomass is essential for achieving a sustainable energy supply. The advice was to maintain ambitious goals, subject to 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 and is awaiting publication of 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 reduce the biofuels targets for 2009 and 2010 from 5.75% to 4%.

Below we attempt to show 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 were given an opportunity to respond to earlier versions of the texts, it should be noted that these are not official positions, nor is the overview complete. Our aim is simply to provide a rough outline of some of the main arguments and dilemmas 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 European level. The EU has now defined sustainability criteria for biofuels and is going to draw up a list of reporting obligations, through the RED. As directives are addressed at member states, the member states will have to implement the criteria for

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[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.

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 the sustainability criteria for biofuels to have a positive effect on the wider agricultural sector, not least by triggering the discussion on the need to invest in sustainable agriculture. VROM also stresses the fact that sustainability criteria, as defined in the RED, 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. Biofuels are the only alternative to fossil fuels for this type of transportation. In other words, biofuels are here to stay, at least for a couple of more decades. The Netherlands 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 second generation biofuels and alternative sources. In relation to this, the Dutch government has already introduced an incentive for the production of second 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 all of its 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

The increased production of biofuels has been linked to rising food prices. According to the VROM officials interviewed this is a largely artificial discussion as it tends to overlook the changes in global food consumption and the associated growing production of cattle feed.

In a similar vein 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.

The World Trade Organisation (WTO) regulations are a hurdle to improving 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. WTO regulations are a significant obstacle to the development of strict

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21 See: http://www.senternovem.nl/gave_english/netherlands_biofuels_policy/index.asp#7 and: http://www.senternovem.nl/gave/dubbeltelling/index.asp#4

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 EC 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 crops for biofuels should not be produced 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 for classifying such areas, but this is unlikely 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 agreements is a very serious omission in the context of international 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 the 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 capitalise 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 of Dutch Official Development Assistance (ODA).

Implementation in Europe needs more attention
Besides being 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 practising what they preach. The policies that Europe develops, including the sustainability criteria, also concern the farmers in Europe. What does it mean for the 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 therefore start making changes themselves. This will require more attention for coherent policies related to the climate, agriculture and nature.

2.2.3. Ministry of Economic Affairs and the Memorandum of Understanding (MoU) with Brazil

The Ministry of Economic Affairs signed an MoU with Brazil, 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, and given that it is the most important biofuel provider for the Netherlands, Brazil is a crucial player. Even though the Dutch Ministry of Economic Affairs 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, in principle, concerns all biofuels. 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 a key element in 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 dating from April 2008 by Van der Ham, who demanded that work to be performed within 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 number of them can indeed be traced back to the Cramer Criteria. From the point of view of the Ministry of Economic Affairs, the MoU is relevant to Brazil because a greater emphasis on sustainability increases the marketing possibilities in Europe.

By its nature the MoU with Brazil does not include any obligations, nor does it identify any targets or measurable criteria, other than the exchange of information. Regarding the design of, and compliance with, sustainability criteria, the Ministry of Economic Affairs highlights the European directive and stresses that, ultimately, the responsibility for meeting sustainability criteria lies with the producers themselves.

During the last meeting the discussion focused on possible negative effects of biofuel production on land use on a macro scale and indirect land use changes (ILUC). The main problem with such ILUC 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 Ministry of Economic Affairs has included ILUC in her criteria, but the question remains how it should be implemented. As the Ministry of Economic Affairs stresses, this issue requires more scientific research.

For the Ministry of Economic Affairs the main interest is to make Rotterdam a biofuel hub
As far as the Ministry of Economic Affairs is concerned, the main interest is in stimulating trade and the development of opportunities for an important logistic function for Dutch ports and 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 Western Europe. So far this seems to be working out well. Imports of bio-ethanol into Rotterdam amounted to 1.2 million tonnes in 2007 and have been increasing every year. The Swiss company Biopetrol is also building the second largest biofuel plant in the world in Rotterdam.[24]

2.2.4. Ministry of Agriculture, Nature and Fisheries (LNV) and the 'Bio-based Economy' programme

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 utilising post-harvest losses, and by

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[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'.

improving the productivity per hectare. Scientific efforts should therefore be directed towards helping 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 bio-based

LNV expects an explosion of new possibilities for using biomass in the near future, in various sectors of the economy. The so-called bio-based 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 bio-based economy, LNV initiated an interdepartmental programme

LNV sees biomass as the key replacement for oil-based and gas-based products and services, and as aiding the transition from a fossil-based to a bio-based economy. LNV therefore initiated an interdepartmental programme on the 'Bio-based Economy', which included the other relevant ministries (VROM, Economic Affairs and DGIS). LNV established the programme on the basis of the explicit recognition that the bio-based economy should be addressed in an interdepartmental way, thereby ensuring coherence between the ministries, given that issues pertaining to the production and use of biomass are not confined to the agricultural sector but also relate to the environment, energy, business and international cooperation sectors. The aim of the programme is to initiate a dialogue with knowledge institutes, the private sector and civil society within the Netherlands and then link up with the discussion at European level. The programme has created its own committee for research and is trying to help the private sector in its endeavours to find biomass-related business opportunities. Currently, for example, the programme is focusing on collaboration with the chemical industry and on the building of a pilot bio-refining factory in Delft. According to the programme head, the integrated interdepartmental approach towards the bio-based economy is unique in Europe.

Energy from biomass is the last stage in a system of co-production

The Bio-based Economy programme 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 bio-based economy. The programme promotes co-production, which means that one unit of biomass is used for various 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' [*Commissie Duurzaamheidsvraagstukken Biomassa* or CDB] was asked by VROM to advise the government on issues related to the use of biomass and sustainability. The CDB was made up of experts with various backgrounds from different stakeholder groups and was chaired by Dorette Corbey (and was therefore also known as the 'Corbey Committee'). The committee recently published the first of its three advisory reports.[25] It stated that the large-scale use of biomass can help reduce 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 RED and the FQD) identify sustainability criteria for the production of transport fuels and impose an obligation on member states to report on this. The directives do not, however, 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 since this will allow consumers to opt for sustainable fuels.

2. Biorefining enables the production of various products from the same biomass. 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 the bio-chemical industry).

3. Addressing indirect land use change (ILUC) is a huge challenge for which 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 ILUC). 2) The ILUC factor can be lowered to allow for biofuel derived from yield increase or the allocation of CO_2 emissions in co-products. Put simply, if a producer produces the same amount on half the acreage, it will also have halved the possible ILUC effect. 3) In acknowledgement of 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 immediately addressed. Therefore, the CDB proposes the introduction of a small levy on fuels to generate money that is earmarked for biodiversity worldwide. Furthermore, the Commission recommends minimising the effect of ILUC by prioritising 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.

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

2.3. Biofuel planning in low and middle income countries

The following information is not based on interviews, but was derived from literature.
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 (FDI) 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 affects 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 recognise the advantages of biofuel production for the economy. For example, both the Tanzanian and the Ethiopian governments have declared that 20% of their country's land may be allocated to biofuel production. Foreign companies have been invited to start plantations and production. Other countries, such as Mozambique and Liberia, have also set ambitious national targets for energy crop 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 is partly going to 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 provides an indication of the plans to expand agrofuel production for a selection of southern countries. All countries shown in Table 1 are planning to at least triple their existing production of energy crops, and most are planning for between a fourfold and fivefold increase in production.

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[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.

Table 1: Examples of planned agrofuel expansion

Country	Energy crop	Planned expansion
Brazil	Sugar Cane	From 6 million ha currently to 30 million hectares.
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); GRAIN (2007).

2.4. Large-scale plantation holders and transnational companies

Published 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 very risky.

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 all manner of opportunities for new entrants, geared to the production of an increasingly wide range of different energy crops 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 energy crops and downstream industries

Country	Energy crop	Examples of recent investments
Brazil	Sugar Cane /ethanol	U.S. $ 9 billion in 2006 in sugar production and alcohol refinery.
Brazil	Whole agrofuel sector	U.S. $ 8.1 billion investment expected over 2007-2011.27
Indonesia	Palm Oil / bio diesel	U.S. $ 5.5 billion in palm oil in 2005 and $4 billion in 2007 in palm oil and refineries.28
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); GRAIN (2007).

In various countries, especially in Africa, large investors have indicated their interest in large tracts of land and have sometimes already obtained leases. Many investments, however, are still either in the planning phase or early pilot stage. 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 car and they are selling very well. Flex-fuel cars are now being developed and produced by various car manufacturers (e.g. Toyota and Volkswagen). In the US, executives from various automobile brands (GM, Ford and 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 offering biofuels 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 of negative side effects could potentially be harmful to their business. For example, Abengoa Bioenergy, which is involved in the production of biofuels in the US, Europe and Brazil, actively disputes

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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.

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 opposed to 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 emphasise the fact that growing agricultural feedstock for agrofuel competes with food production for human consumption. The price spike of prime commodities is considered to be pushing millions of people worldwide into further poverty. The catchphrase used is: ‘The fuel dollar of the rich competes with the food dollar of the poor.’[31] Development NGOs also highlight the risk of pastoralists and farmers becoming displaced when agrofuels are produced on supposedly ‘idle’ or ‘marginal’ lands.

Oxfam International strongly opposes the promotion of agrofuels. They emphasise the point that agrofuels can neither replace global fossil fuels nor curb climate change. They also point out the food price effect, which they consider disastrous for the poor. Oxfam International has called for a freeze on biofuel mandates and measures to effectuate vehicle-efficiency. They advocate obtaining the free prior and informed consent of communities in which biofuel projects are planned. They stress that indirect effects cannot be contained by standards.[32]

Environmental NGOs are also 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 is, for example, one of the more outspoken NGOs (see, e.g. Friends of the Earth, 2008).

The World Wildlife Fund (WWF) is one of the less critical environmental NGOs. Unlike Oxfam, WWF believes in the possibilities of containing the direct and indirect effects of agrofuel 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 regard stopping deforestation and carbon capture as crucial elements in any positive

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[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.

climate-energy scenario, and refer to wind, hydro, solar and thermal energy and low-carbon natural gas as good alternative options in addition 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:

1. *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 energy crop (preferably through intercropping) and sharing the costs of processing with neighbouring farms. Such a model would require investments to provide local producers and processors with training and technical assistance.

2. *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.

3. *Large-scale export-oriented plantation agriculture.* This is currently the most common model. According to Cordaid, large investors generally benefit from this model, while small farmers are all too often marginalised.

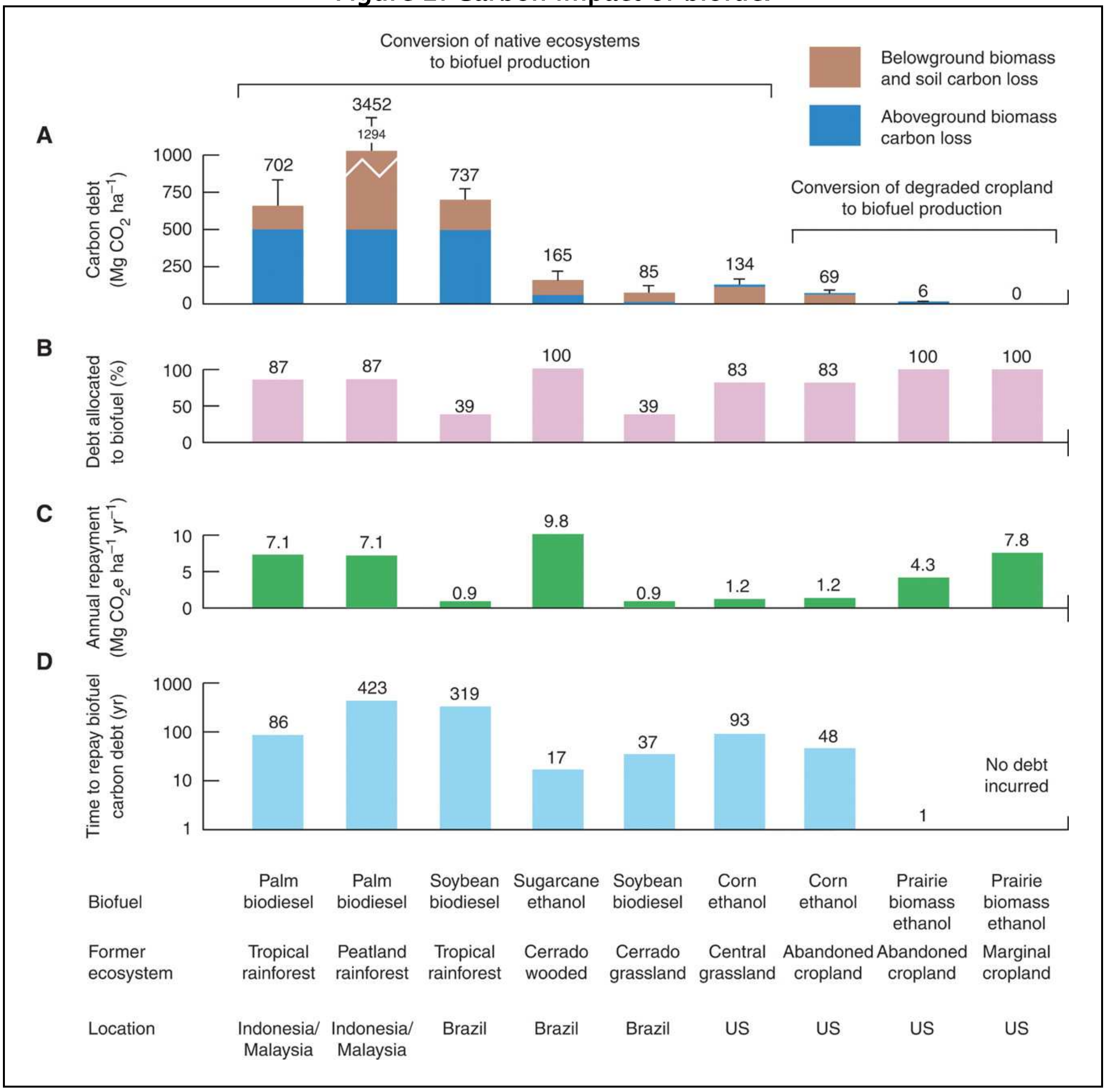
Cordaid (2009) stresses that the opportunities for small-scale producers will come mostly from the second model, based on small farmers operating in commercial markets outside their immediate region.

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 to combat climate change. The reasoning was that, theoretically, agrofuels are carbon neutral: when burned the carbon they release is 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, if the full life cycle of biofuel production is taken into account (i.e. land use change, tilling, harvesting, refining, transport and consumption), only certain agrofuels actually have a favourable GHG balance.

Figure 2: Carbon impact of biofuel



Source: Fargione et al. (2008).

Life cycle studies on the GHG balance usually show that ethanol from corn performs poorly when it comes to reducing GHG emissions, while the 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 which takes place in order to increase the production levels of energy crops and during which much of the carbon that was stored in plants and soils is released. 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 peat lands 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. Using peat lands in Indonesia and Malaysia for palm oil production leads to huge amounts of CO_2 being released that was previously stored in these soils.[34] 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 peat land conversion (Danielsen et al., 2008).[35]

Converting rainforest, peat lands, savannas, or grasslands to produce energy crops is not a wise thing to do if your aim is to reduce GHG emissions. The United Nations Environment Programme (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 were to 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 peat land – for agrofuel production to mitigate climate change is counterproductive.**

Agrofuels can also be produced on existing agricultural land. In that case 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 International Energy Agency (IEA, 2003) – carbon emissions would be reduced by 66 million tonnes (Ceq) per year. For this to be possible, another 30 million hectares of land are needed (Goldemberg, 2006).

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[34] Riau province in Sumatra, Indonesia, 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).

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

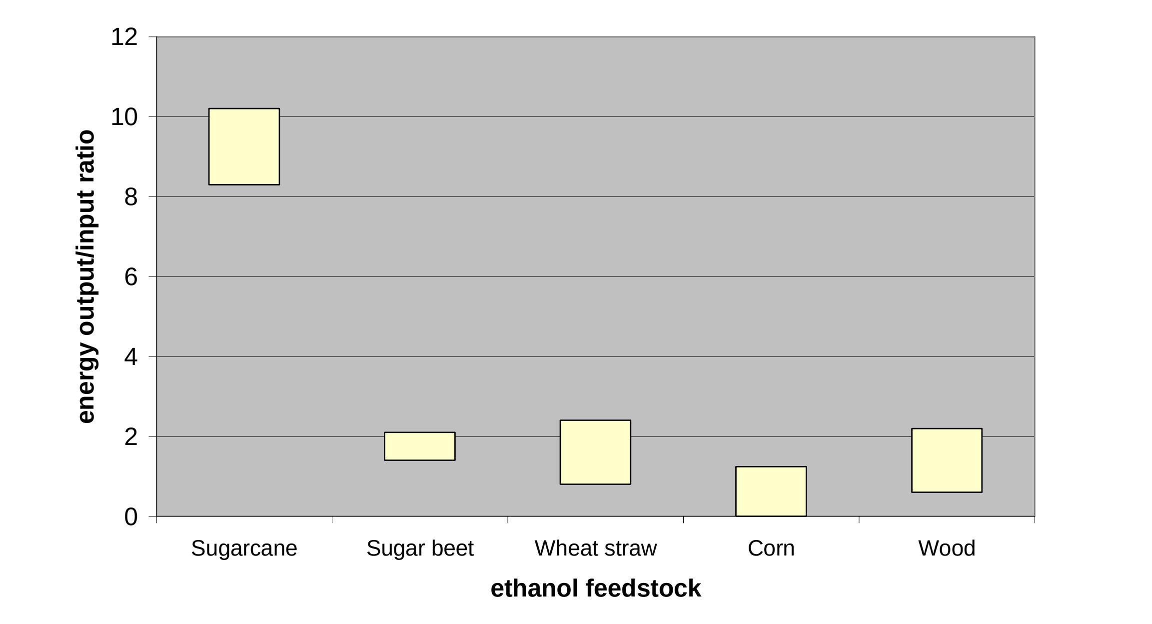

Figure 3: Energy balance of ethanol crops, with commercially available technologies.
Source: Goldemberg (2006)

The net energy balance of biodiesel is even more complex. 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 and Peru). Regions such as Para in Brazil have partially degraded land (low productive cattle ranches) where production could take place. However, 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 (IULC). Based on an analysis of ten major biofuel reports, Searchinger (2008) reiterates that the GHG benefits of biofuel production depend largely on direct and ILUC. 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 achieved more effectively in other ways, for example by conserving energy (Searchinger, 2008).

BeCitizen, a French consultancy bureau, analysed five existing methods to calculate the impact of ILUC on GHG emissions. The methods were all analysed according to the assessment criteria identified by the EC, 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 ILUC. They found large differences when they applied the various methods to different biofuel production processes. They used these findings to conclude that the methods they analysed are not robust and are therefore a poor basis for policymaking. BeCitizen stresses that there is an urgent need to develop a more robust method to measure the GHG effects of ILUC.[36]

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 ILUC of natural lands is real. 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 revenue for the state and as a way of increasing 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 to employment. Production expansion mainly takes place by converting natural lands and by establishing large monoculture plantations.

There are some concerns related to this agricultural expansion. NGOs and researchers have been highlighting the (potential) negative effects of energy crop production on local people's access to land and natural resources. A key issue in this regard is the degree to which the (local) government 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.

In the case of 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).

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

Box 5. Direct and indirect employment

Large-scale biofuel production can have a variety of effects on local livelihoods – both positive and negative. On the positive side agrofuel production may provide significant employment opportunities in rural areas, in both the production and processing sectors, and thereby potentially drive up rural incomes and improve access to health and education.

Some research has been carried out into the employment effects of ethanol production from sugarcane in Brazil. De Castro (2007) found that the sector generates a large number of jobs and has many indirect employment effects.[37] The Brazilian sugarcane sector provided 700,000 direct and 3.5 million indirect jobs in 2004. However, the number of jobs generated per hectare 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. Nevertheless, the sector is characterised by poor working conditions, especially in relation to the burning of sugarcane and manual cutting work. The FoodFirst Information and Action Network (FIAN, 2008) reports not only on poor working conditions on Brazilian plantations (e.g. exposure to pesticides and excess heat and sun) but also on cases of slavery and child labour.[38] The current trend towards mechanical harvesting of sugarcane will solve the bad working conditions but will also result in a net loss of jobs.

In Africa there are several examples of international companies investing in energy crop plantations (mostly Jatropha, but also other crops like sugarcane).[39] Reportedly, this is leading to the displacement of smallholders (GRAIN, 2007). In Ethiopia, the government embarked on an ambitious plan to stimulate energy crop production – the Ethiopian Biofuels Development and Utilization Strategy. However, there is no land inventory which can serve as a basis for the proper planning of plantation development. This is expected to lead to both

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

[38] 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*."

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

biodiversity loss and local people losing access to land (GRAIN, 2007). Lakew and Shiferaw (2008) studied energy crop production in Ethiopia and found the requirements for investors in large-scale energy crop production to be minimal. At the time of the study, the authors estimated that about 1.65 million hectares were assigned to investors, with much of this land also being used by local people. Similar experiences have been recorded in Tanzania (ABN, 2007) and Ghana (Nyari, 2008). [40]

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[41] and the location of plantation. According to Procana, the land allocation process had taken place correctly and land rights had been respected (based on 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 Procana did not respect the land boundaries ceded to them[42] 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 6. Will biofuel production be beneficial for Africa?

As far as OECD countries are concerned, the production of biofuels is having clear benefits. It helps them to meet their 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 wherever large-scale plantations can be established, and where land and labour are cheap. In this light, Africa is an attractive continent to invest in. However, predictions on the net effects for Africa differ because they are based on different assumptions. The International Food Policy Research Institute (IFPRI), for example, predicts important benefits for Africa, assuming that infrastructure in Africa will improve rapidly, thereby enabling Africa to benefit from rising prices for agricultural commodities. On the other hand, the Food and Agricultural Policy Research Institute (FAPRI) 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, given that the latter is a net importer of food (based on interview with Dr Ir. Prem Bindraban).

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

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

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

Box 7. Access to water

The effect of energy crop production on access to (clean) water is a key aspect that needs special attention. Energy crops such as sugarcane consume enormous amounts of water, both as a crop and during the processing into ethanol. This can have huge effects on local water availability. Effects of chemicals on water quality also need to be taken into account. AidEnvironment performed a study for Wetlands International on the potential environmental impacts of energy crop production on Wetlands in Africa (Sielhorst et al., 2008). They compared sugarcane, oil palm, Jatropha, cassava and sweet sorghum as regards their requirements and their potential impact on wetland conversion, water availability and water quality. The study revealed that special attention needs to be paid to the water needs of biofuel production, especially in drought-prone areas and stressed the need for careful land use planning.[43]

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 hectares. Historically, the process of land concentration is associated with the expulsion of small farmers and to date this has led to land-related conflicts. Soybean production (which has grown enormously since the 1970s for its use as feed) has led to the massive displacement of small farmers who did not have official proof of land tenure. Employment on soybean plantations is low and displaced farmers are therefore forced either to 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. Wherever land tenure is unclear and legal frameworks are disputed, industries looking for land to cultivate energy crops may choose to use aggressive land seizures. In the 1990s such cases were reported involving oil palm companies in Indonesia. More recently, worrisome stories have emerged from Colombia, where expansion of oil palm plantations on the Caribbean

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

coast is reportedly carried out by armed groups who drive local communities off their lands (Balch and Carroll, 2007 cited in Cotula et al., 2008).

Land inventories and secure property rights are key to ensuring 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 for preventing industrial interests from pushing smallholders from their lands. Likewise, a study by the International Institute for Environment and Development (IIED) and the Food and Agriculture Organization (FAO)[44] found that the potential of bioenergy production to contribute to an 'agricultural renaissance' depends largely on the security of land tenure.

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 (first and second 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 (e.g. livestock farming). Environmental and development organisations therefore warn that using degraded or idle lands is too easily proposed as the ideal 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. He also argued that, "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." [45]

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[44] Cotula et al*.* (2008).

[45] 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.

The UNEP (2009) has called 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 subsidise 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 energy crops, 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 from environmental NGOs. The main worry is that the expansion of energy crops is taking place at the expense of previously uncultivated areas (forest, savannah, grassland) and as such is leading to habitat destruction and biodiversity loss (e.g. Zah et al., 2007; Sielhorst et al., 2008).[46] In addition, ill-planned conversion can lead to 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 level, 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, energy crops 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 therefore seems safe to say that biodiversity loss is not caused by energy crop 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 between 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

[46] 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.

European RED are likely to lead to agricultural production expansion into sensitive lands such as forest and peat land areas.

Louise Fresco (2006) emphasises 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 is also used (e.g. switch grass, and fast growing trees) for the production of biofuels, even less land is needed. Fresco (2006) proposes using the savings from avoided oil import and income from energy production for investments to increase agricultural productivity.

Box 8. Physiological limitations

In relation to the increasing demand for agricultural products, some scientists point out the limited availability of water and nutrients which form the 'basic physical and physiological limitations' of the natural environment. For example, the crop physiologist Thomas R. Sinclair 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 awareness of the scarcity of phosphor – or 'the next inconvenient truth' as it was called in the Broker (issue 15, August 2009). Phosphor is an essential nutrient for plants and animals. Increased agricultural production is leading to a rising demand for phosphor, while it is estimated that global phosphor supplies will be exhausted within 100 years.[47]

Bindraban et al. (2009) note that most studies on the potential global biomass production do not take account of the ecological limitations.

Considering the biodiversity impact of agrofuel production, a distinction needs to be made 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. Such 'leakage' effects also take place at regional and global levels, 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 (e.g. Birur et al., 2007). Similar

[47] See http://phosphorus.global-connections.nl

replacement effects can take place at global level. 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 therefore cause agricultural expansion in Indonesia at the expense of natural forest.[48]

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 (entitled '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.

For example, the giant reed (Arundo donax) is a proposed biofuel crop from West Asia which is already invasive in parts of North and Central America. Being 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 consumes 2,000 litres of water per standing metre of growth, thereby threatening water security for the nation's growing human population.

The report warns that many of the plant species being considered for biofuels have the potential to become invasive if introduced to new areas. 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.[49]

3.4. Food security

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

[48] 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 subsidised not to use the lands). The associated biodiversity loss is on these lands is discarded.

[49] http://www.sprep.org/att/IRC/eCOPIES/Global/155.pdf

[50] Food Outlook, November 2008: (http://www.fao.org/docrep/011/ai474e/ai474e00.HTM)

[51] 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).

that the production of energy crops on the same agricultural fields as food or feed has led to competition for land and rising prices for agricultural commodities.[52]

Nevertheless, the question is whether rising prices are a good or a bad thing? Some stress the idea that the current rise in prices may actually provide opportunities.[53] In the first place, rising agricultural commodity prices will have positive income effects for farmers who are net producers of agricultural commodities. Furthermore, for the first time in years, strong calls are being made for renewed attention for the long-neglected agricultural sector in developing countries (see, e.g. The World Development Report, WDR, 2008).[54] 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 therefore vulnerable to food price rises, while a much smaller number of households, those that are net producers of food, may benefit from increased crop prices.

Estimates of the impact of biofuel production on food prices vary widely. This is hardly 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 energy crop 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 disregarding the importance of other factors, there is a 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

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52 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)

53 See for instance the 7th Brussels Development Briefing (16 October 2008) titled: 'Rising food prices: an opportunity for change?', organised 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/.

54 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 Members of Parliament 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).

rising food prices, and the World Bank (2008) concludes that the significant increase in biofuel production from grains and oilseeds in the US and EU was the primary cause of 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 IFPRI, which holds biofuels responsible for 30% of price increases.[55] It should be noted that such statistics generally reflect only global market prices and that 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 price increases, such as the rising 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, and this has influenced the prices of both. This, plus the fact that corn production was subsidised by US government, has led Mexican farmers to switch to other crops, with Mexico becoming dependent on imported corn. When the US government started to promote the use of corn for ethanol, the supply of US corn dropped and this led 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 where corn is a dominant grain for food consumption (including Sub-Saharan Africa an Latin America) will experience the largest increase in food prices ('at least 10%'), while regions where rice is the main food grain will show modest food price increases ('less than 2.5%').

3.5. Recent overview studies 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), analysed eight studies that estimated the global potential of biomass for energy purposes (Lysen and Van Egmond, 2008). The study found huge variations in estimations of between zero in the pessimistic scenario of Wolf et al. (2003), up to 1500 EJ in an optimistic scenario by Smeets et al. (2007). The study specifically addressed factors that affect the potential, such as food production, water use, biodiversity, energy demand and agricultural economic. However, none of the reviewed studies provided a complete analysis of all relevant parameters. Unresolved issues that require more research

[55] Don Mitchell, renowned World Bank economist, came with a figure of 65%. The World Bank, however, did not endorse this as its official standpoint.

include 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 address the effects of biomass on biodiversity, or only do so to a very limited extent.

Taking account of 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) energy crops. 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 respect they believe (sustainably produced) agrofuels can play a limited role and with wastes and residues fulfilling an important role. The study emphasises the fact that annual crops are not suited as important source for energy as their potential is relatively small, while their effects are potentially large (Lysen and Van Egmond, 2008).

Another study by the Dutch Netherlands Environmental Assessment Agency (Eickhout et al., 2008) found that meeting the biofuel targets 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 a review of 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 Programme (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 worldwide. The report concludes that, if current mandates[56] 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 be sustainably 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 energy crops. 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.

Searchinger (2008)

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

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[56] 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).

- Liquid biofuels will make only a limited contribution to world energy supplies and GHG reduction;
- Direct and indirect land use effects are likely to reduce the GHG benefits greatly;
- Biofuel production has been a major cause of rising food prices;
- The expansion of energy crop 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[57] from organic (agricultural, forestry and urban) waste is more promising than the production of biofuels from energy crops.

Just like the UNEP (2009) Searchinger (2008) recommends reconsidering biofuel mandates that are currently in place, including the 10 percent mandate of the EC. Instead, money should be spent 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 a reference. The study is based on a broad review of literature and consultation with experts. The authors emphasise 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 any effect. They also stress the fact 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 any great potential for increasing production in 'marginal' areas, as these require huge external inputs (water and nutrients) and lack the necessary infrastructure. Hence, agricultural production in marginal areas would require large investments, while yields will be limited. Agricultural production (for both food and fuel) will therefore concentrate on fertile areas, where sufficient water is 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. They also argue that it is unlikely that

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[57] According to the IEA (2008) using energy crop biomass for heat and power provides twice the energy per hectare as using it for biofuels.

biofuels will contribute to the objectives of the Convention on Biological Diversity, the UN Framework Convention on Climate Change and the Millennium Development Goals (MDGs).

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.[58] 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, given 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 makes discussions even more complex. The proponents present a rosy picture of energy crop production rehabilitating degraded lands that were previously unused, providing watershed protection, decreasing dependence on imported fossil fuels, and providing local access to energy and employment with decent wages to people that would otherwise be unemployed. According to President Lula of Brazil, for example, bioenergy production is key to fighting 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.[59]

The level of disagreement found – both among academics and activists and practitioners – is daunting. As Knauf et al. (2008) state, the current debate is dominated by extreme viewpoints. The question is how informed policy choices can be made when the effects of bio-energy production are still so unclear? The Gallagher Review chooses the middle ground and advocates increasing 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 same review – from a precautionary principle point of view – proposes slowing 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.

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[58] There is also disagreement on the potential effect of bioenergy use on GHG emissions (Kim et al. 2009).

[59] Biofuelwatch (2007), for example, claims that bio-crop production is devastating for the world's poor.

4.1. Second generation biofuels?

Second generation plants that are currently being developed are either ethanol plants using lignocellulosic feedstock or Fischer-Tropsch diesel plants. The advantage of producing biofuels from lignocellulosic materials is that it can be integrated into first generation biofuel plants. Fischer-Tropsch diesel plants require particularly high investments, without there being any guarantees in terms of economic competitiveness. 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. 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 minimising 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. However, 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. In addition, when the residues of food crops are used for the production of biofuels, this implies that these residues can no longer be used as organic fertiliser, and this may therefore have an indirect effect on food production.

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 balance. 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 GHG balance, because chemicals are usually synthesised and this uses up a lot of (fossil) energy.[60]

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 made 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. To them the blending of biofuels is a relatively easy task. After years of commitment to second generation biofuels, Shell announced on 2 February 2010 a US$12 billion investment in first generation sugarcane ethanol in Brazil.[61] In addition, 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).

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[60] See for instance: http://www.biorefining.com/

[61] http://www.ft.com/cms/s/0/b9aadc38-0f9b-11df-b10f-00144feabdc0.html

What is more, 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 lead to increased employment opportunities, but they may also lead to the 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). The problem is that 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 which limit their ability to negotiate fair prices or manage their lands as they see fit. While companies – including transnational companies – might increase their profit margins because of the high rise in the price of palm oil on the world market, smallholders may hardly benefit. 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. As regards export purposes, the advantage of large-scale production is that it is easier to achieve consistent quality standards, while small-scale production could very well provide the resources for decentralised 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 and farmer partnerships 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. Securing land rights for small landholders is an important condition for large, medium and small-scale energy crop production to co-exist (Cotula et al., 2008).

The Brazilian Biodiesel Programme 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 in 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 achieve 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.[62]

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 burden on their foreign currency reserves. This situation is aggravated if countries subsidise petrol at the pump. Furthermore, future access to affordable oil is uncertain because demand for oil is going to continue to rise in the future (particularly in China and India), while oil production is in the hands of a limited number of countries.[63] In theory, domestic bioenergy production offers opportunities to become less dependent on oil imports and improve the trade balance (Dufey, 2006).

The question is whether domestic energy crop production will also lead to local access to energy? Some are sceptical and point out that energy crop 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 but whose population mostly lack access to energy from fossil fuels (GRAIN, 2007). Others stress the opportunities for local decentralised biofuel systems, especially in remote, off-grid rural areas. Biomass that can be converted to energy with simple technologies offers potential as regards the decentralised production of biofuel. Some communities in Mali, for example, use Jatropha to power generators that provide electricity to households (Hasan, 2007).[64] Moreover, lessons can be drawn from the Brazilian experience with its special programme for small farm biodiesel production (Knauf et al., 2007). Actual experiences are scarce, however, as many initiatives are in a pilot phase. Ethanol production is not feasible at 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. The question is why a household would buy technology when fuel

[62] The potential role of family farms to meet concerns regarding food security for a growing world population tends to be underestimated

[63] In Africa, some countries such as Mozambique and Tanzania have gas reserves.

[64] See also Cotuala et al. (2008) for some more examples of small-scale bioenergy production from Jatropha.

wood is free? Biogas installations have proven to be competitive as regards cooking with biomass (poor urban households generally buy charcoal, which is relatively expensive), but in urban areas LPG tanks would probably be cheaper and generate fewer 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. In addition, the costs of (simple) biofuel technologies are likely to be a huge barrier, as current energy in the form of fuel wood is generally available for free. Therefore, credit schemes will play a key role in getting such decentralised 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 highlights the possibilities within the WTO regulations for countries to refuse market access for bioenergy on the basis of environmental criteria.

Certification clearly has its 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 in relation 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 were to be applied to fossil fuels and the negative effects on the environment were to 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). The fifth point to make is that, while the aim should be to create one comprehensive global certifying scheme, developing internationally agreed criteria and monitoring systems for certification schemes is a hugely complex undertaking. Finally, and importantly, one of the main criticisms of 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. Moreover, 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 and 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.[65] The Global Bioenergy Partnership (GBEP)[66] is an international platform in which 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 to apply these indicators to criteria.

As regards biofuel sustainability criteria (such as the Cramer criteria and RSB criteria) it is important to include the indirect effects of land use changes although, so far, it continues to be unclear how this can be done.[67] 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

During 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 it is impossible to discuss expansion within these settings. 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 cannot address the negative indirect effects of agrofuel production. The 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.[68] This is also the point of departure of the Dutch 'Testing Framework for Sustainable Biomass' [*Toetsingskader*].[69]

Proper and enforced land use planning may very well be the single most important pre-condition for avoiding 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

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65 http://biopec.net/index.html.

66 http://www.globalbioenergy.org/

67 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.
http://www.snm.nl/page.php?pageID=88&itemID=2681target=

68 Inadequacies in land-use planning are mentioned as the largest bottlenecks by RSPO member companies which strive towards certified sustainable palm oil.

69 http://www.vrom.nl/docs/20070427-toetsingskader-duurzame-biomassa.pdf

terms of the destruction of natural resource capital (ecosystem functions) and reduced market access due to failure to meet international sustainability requirements. Nevertheless, 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 have identified 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.[70] Forecasts are important and drive energy policies and civil society movements. However, with the biofuel boom well on its way, and companies and governments investing in the expansion of biofuel production, it is high time for empirical research on both the direct and indirect effects of biofuel production, at all levels. Such studies are needed in order 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, a much smaller consensus seems to exist with regard to the question of whether, and under what conditions, agrofuel production can lead to local economic opportunities in low-income countries. Smeets et al*.* (2006) stress the need for research on the effects of large-scale energy crop production on the social conditions of the local population. As a consequence, 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).[71] In addition, there have been some promising developments regarding organic energy crop production, e.g. organic sugarcane production in the state of Sao Paulo (Smeets et al*.* 2006). Many challenges remain and extra attention will need to be paid 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-scale versus large-scale production*

   Many key questions relate to scale. Examples are: Do energy crops offer opportunities for production in integrated systems by individual small-scale farmers? What is the actual and potential role of farmers' organisations and cooperatives to compete or cooperate

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[70] See, e.g. De Castro (2007); UNF (2008).

[71] 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).

with large-scale business? Do large-scale energy crop businesses offer opportunities for small-scale farmers, as in outgrower schemes? Should family farms produce energy crops or concentrate instead 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 the conversion of cellulosic materials into biofuel. Knauf et al*.* (2007) draw attention to the need to further explore the possibilities of biogas.[72] More research should also focus on technologies for decentralised 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 enable the (local) state to uphold property rights. Research should also be directed towards 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

This report reveals a striking discrepancy between (i) perceived effects of policies to stimulate the use of biofuels and (ii) the response to increasing concerns.

As regards the European blending targets, there is a growing consensus among scientists about the fact that these targets lead to significant agricultural expansion, with negative effects on biodiversity and food prices. At the same time, policymakers in the Netherlands tend to 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. There is, therefore, a need for an open debate between scientists and policymakers 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 sceptical about biofuel developments and assume that expansion will occur automatically. Their point of view is supported by historic

[72] Recent studies seem to indicate that biogas (biomethane) is more efficient (in terms of energy yield per ha and CO_2 balance) than biofuel (Knauf et al., 2007).

developments and ongoing conflicts. While most NGOs refer, implicitly or explicitly, to the precautionary principle, governments tend to emphasise the opportunities (and seem willing to take the associated risks). Policymakers in Brazil, Colombia, Indonesia, Malaysia, Ukraine and African nations emphasise the potential positive effects on economic growth, employment and rural development in producing countries. Such positive effects may occur in conditions of good governance (particularly in the field of spatial planning and land rights). Through the RED, European governments assume that the necessary pre-conditions of governance will be met by setting sustainability criteria. The question is whether this is justified if producing countries are unwilling to talk about expansion issues?

Other discussion topics that emerge from this report are:

1. *The 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 preconditions need to be in place to regulate this and to what extent is this assumption justified?

3. *GHG emissions*: Agrofuels were greeted enthusiastically due to their assumed contribution to climate change mitigation. Recent studies have lowered the expectations significantly. How can GHG emissions through ILUC be accounted for?

4. *First generation biofuels*: It is often assumed that the production and use of first generation biofuels is a necessary initial step on the road towards the sustainable and efficient use of biomass in a bio-based economy (including energy purposes). The question is, however, whether first generation agrofuels are indeed indispensable in the transition process?

5. *Inconsistencies*: The EU has adopted an ambitious position, but there are some inconsistencies in the European context. For example: (i) European countries protect their own interests, both as producers and as processors; (ii) The effects of agricultural expansion within Europe (and whether or not European farmers produce in a sustainable manner) are being overlooked; and (iii) Producing countries should produce in a sustainable manner, but sustainability criteria only apply to feedstock used for biofuels and not to 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 as regards meeting concerns related to land rights, biodiversity and ecosystem resilience?

9. *Small-scale and medium-scale farmers*: What potentially are the positive spin-offs of the increased international demand for biofuels for small-scale and medium-scale farmers, and what assurances are there that these will materialise?

10. *Assumptions*: How does the development of policy take account of the certainties and uncertainties in science?

On 18 February 2010, a group of Dutch scientists, NGO representatives and policymakers met in The Hague to discuss a number of these issues. Appendix 1 provides a summary of the discussions that took place during that meeting.

Box 11. Some facts derived from this study

- Some biofuel crops can cause a reduction in GHG emissions if they were to substitute fossil fuels under the precondition that no natural lands are converted which would have a negative effect on the GHG balance.
- 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 first generation biofuels were to constitute a large percentage of the demand for transport fuels, this would compete with other uses such as food and fibre.
- Because crops currently used for biofuels are already being used for other purposes, expansion of these crops will occur anyway, and biofuels cannot be discussed without taking account of expansion for other purposes.
- Commercial investors are unlikely 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 for agricultural development and expansion, there is a high risk of negative effects on local communities' access to lands and biodiversity.

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Appendix 1– Summary expert meeting 'Burning questions. Certainties and uncertainties concerning agrofuels' 18 February 2010, The Hague

This expert meeting was organised by the Dutch Agrofuels Platform which has the following members: Both ENDS, Natureandpoverty.net/IUCN NL, AISSR/UvA, Cordaid, Mekon Ecology, Alterra, ETC, Law and Governance Group/Wageningen University, the Institute of Environmental Sciences (CML)/Leiden University and the Centre for International Cooperation/VU University Amsterdam.

1. Introduction

Within the framework of the Development Policy and Review Network (DPRN), the Dutch Agrofuels Platform organised a meeting between scientists, NGO representatives and policymakers in The Hague on 18 February 2010. The purpose of the meeting was to bring scientists and policymakers together, whereby scientists could present and discuss the status of science, and discuss uncertainties and assumptions related to agrofuels with policymakers. The central question was:

What are the certainties and uncertainties related to agrofuel production and its effects, and how can policymakers deal with these?

During the morning session, the discussion focused on the scientific findings, while the afternoon session focused on their implications for Dutch and European policies. The meeting was closed and was held under Chatham House Rule, encouraging all participants to speak freely and from a personal and professional perspective. The 25 participants (see Appendix 2) included 11 scientists, 10 NGO representatives, 1 consultant and 2 senior policymakers. Some participants are also member of the Committee for Biomass Sustainability Matters (Committee Corbey). This report summarises the main discussions that took place during the meeting.

2. The scope of the discussion

Although the discussion also touched on the use of biomass for other purposes (e.g. electricity generation and production of bioplastics), it focussed primarily on agrofuels, i.e. liquid fuels produced from agricultural commodities. This was because the RED of the EU is the main driver for the production and use of agrofuels. The reasons for Dutch and European governments to stimulate the use of agrofuels are: (i) to meet the policy objectives of reducing GHG emissions in the transport sector; and (ii) the need to become less dependent on fossil oil reserves. An underlying motivation for this policy is related to the assumption that agrofuel production will revitalise the agricultural sector in various European countries (e.g. the Netherlands, UK, Germany and France).

The debate was organised around three key themes: (i) The necessity of agrofuels from a GHG reduction and energy scarcity perspective (ii) Opportunities and risks; and (iii) Governance and governability. Appendix 3 presents the key questions that were used to structure the discussion.

2.1 The necessity of agrofuels

Demand

Even though electricity is likely to become more important in the transport sector, the demand for liquid fuels is not going to disappear in the short or medium term (vis-à-vis current engines used). The demand for energy in the transport sector is still growing fast and the dependency on fossil fuels is high. Moreover, energy diversification is a policy goal of the Dutch and European governments, which implies that biofuels will be part of the energy mix, especially in the transport sector. First generation biofuels (mostly agrofuels) are not indispensable in theory, as the alternatives are electricity and hydrogen. However, at the moment battery-based vehicles have a limited range and are therefore unsuitable for long distance transport by trucks. For the moment, biodiesel would be necessary.

Reference was made to the Scientific American (November 2009), which outlines a scenario whereby 100% of global energy needs can be met using wind, solar, geothermal and hydro power in 2013 at costs competitive in relation to current price levels of fossil fuels. This would solve our electricity needs, but not the need for transport fuels. Moreover, in practice there are considerable vested interests in the production and processing of first generation biofuels (e.g. biodiesel and ethanol plants throughout Europe and in the Netherlands in the ports of Rotterdam and Amsterdam). This creates a so-called 'lock-in effect', which makes a shift to second and third generation biofuels more difficult.

In addition to biofuels, biomass is used for co-firing in electricity production. Furthermore, demand for biomass for the production of higher value products, such as bioplastics, is expected to grow. Consequently the agrofuel debate should also be discussed in the wider context of a bio-based economy, i.e. including purposes other than energy.

Various countries (both in the North and in the South) pursue their own bio-based economy with a view to becoming less dependent on the import of (expensive) fossil fuels. Currently, however, most agrofuel producing countries tend to focus on export, rather than using agrofuels for their own domestic purposes. The demand for agrofuels is artificially triggered by policy measures. However, as soon as the price of fossil fuels increases, demand will naturally increase as well. The question is how much additional demand is triggered by EU countries – for which the import of agrofuels is necessary – and is this additional demand desirable from a land use perspective? Another question is to what extent can the Dutch government realistically envision having a positive influence on agrofuel developments?

During the discussion it was mentioned that the FAO estimated that an additional 70 million hectares will be converted in 2050 into agricultural production to meet the demand for food, based on 120 million ha in the South and minus 50 million in the North. This raises the question of why the North would take 50 million ha out of production given the rising demand for food, fuel and fibre and given the concern about triggering negative social and biodiversity impacts in the South. A recent WAB study by WUR estimates that replacing 10% of all liquid fuels (globally) with biofuels would require between 100 and 170 million ha. There is serious doubt as to whether such an amount is or will become available without endangering food production or causing a loss of biodiversity.

In general, participants are not against the 'bio-based economy' to reduce dependence on oil, but point out that smart choices will need to be made (i.e. for which end uses are we going to use what type of biomass), considering the fact that the amount of biomass that can be sustainably produced is limited. Multiple uses of biomass sources will be indispensable. However, the RED – even though it is unique as an obligatory standard for biofuels at EU level – does not appropriately control undesired effects and therefore risks not attaining its goal, namely to reduce GHG emissions.

Reduction of GHG emissions
Although the main economic reason for agrofuel demand is to diversify the energy strategy, the use of agrofuels is also meant to reduce GHG emissions in the transport sector. The question is whether the use of agrofuels actually contributes to reducing GHG emissions? Scientists highlight two problems with the methods that are currently used to calculate GHG emissions. First, when calculating the GHG balance of direct land use change there is no accepted method to include changes in N_2O emissions from the soil. Second, there is no unambiguous and widely accepted method to measure the GHG effects of indirect land use changes (ILUC). The scientists present at the discussion expect virtually all agrofuels with a direct land claim (mainly the first generation agrofuels) to have a negative GHG balance if all the effects of ILUC were to be taken into account. The use of waste and residue streams (to produce agrofuels and generation of electricity) has more potential to contribute to climate change mitigation. Participants agree that, while the bio-based economy is here to stay, most first-generation agrofuels are not GHG efficient, given that they trigger ILUC. This leads to the question of opportunities and risks.

2.2. Opportunities and Risks

Models
The outcomes of models concerning the potential of global biomass production vary enormously. Models differ in the type of information they aim to present. Models that assess the maximum biomass potential examine land suitability and find a theoretical maximum, but do not include information on whether it is realistic and within what time frame. For example, such models seldom incorporate one of the main drivers of expansion, namely infrastructure. Moreover, these models may not include actual or expected land use and social factors, and may not exclude protected high biodiversity areas. In general, the potential is strongly overestimated. Basing policy decisions on such models is considered risky.

In order for models of the global potential of biomass production to become realistic, a wide range of considerations would need to be included, like those mentioned above. Moreover, including more considerations generally means downsizing the outcome. This is not to say that there is no potential for agricultural growth. Globally, an estimated 18% of the land is used for agriculture, while 10% is protected and no less than 72% lies somewhere in between.[73] Participants agree that there is (at least some) room for both agricultural

[73] In the future, some lands may become more or less suitable for agricultural production due to climate change.

intensification and agricultural expansion without threatening biodiversity or livelihoods. The key question is how to regulate this. At various moments participant remarked that 'good governance' and 'strong governments' are crucial factors for a sustainable agricultural intensification or expansion.

Other, effect models examine the implications of current demand and trends. These models are based on calculated trends in the global increase of demand for food and feed and assume a certain increase in agricultural productivity. Outcomes are very sensitive to small changes in predictions of agricultural intensification or changing diets. Basically, models are used to describe IF-THEN relationships. However, most of the models currently used were not set up, or suitable, to answer policy questions related to ILUC. Many models seem to rely on overly optimistic trends, using predictions of food demand based on linear extrapolations of outdated data (FAO have adjusted their predictions, but models are still based on the old FAO data). Scientists emphasise the fact that models should not be perceived as predictions of the future - they do not present a certain truth. Many of the parameters put into models are in some way or another related to policy decision making and scientists urge policymakers to read these studies more carefully as it would help them base their policy decisions on more solid ground and take uncertainties into account. Policymakers, in turn, stress that they need scenarios that clarify the options.

A major disadvantage of effect models is that they seldom take account of short-term socio-economic impacts such as a rise in food prices. This could lead to an underestimation of such impacts. Another flaw is that some models assume agricultural expansion on 'marginal or degraded' lands. Given the commercial realities of investors this is highly unlikely (as they require huge inputs to become productive). Inputs - such as fertilizer (i.e. nitrogen) - may have strong GHG emission consequences. Furthermore, such lands are often used for other purposes such as temporary pasture lands, or may contain unique biodiversity (e.g. Brazilian cerrado).

Agrofuel production in the wider agricultural context

The extent to which increased future demand for agricultural products will ultimately lead to an expansion of agricultural lands depends strongly on technological improvements (intensification) and land use regulation, including the protection of natural areas.

Some participants stressed that the importance of agrofuel production is limited when seen from the perspective of total global agricultural production. Using the argument that crops grown for biofuels presently account for only 2% of the global agricultural acreage, they claim that the production of energy crops "plays only a minor role, when compared to, for example, global meat consumption". However, while acknowledging the huge effect of meat production, virtually all scientists present at the meeting agreed that the use of crops for biofuels is likely to contribute significantly to the growth of the global agricultural acreage in the near future, and warned against downplaying the potential impacts.

Some participants questioned the usefulness of distinguishing between the production of crops for biofuels and crops grown for other purposes: "For a farmer producing oil palm, it makes no difference whether the raw material is used for food or fuel." The production systems are part of the same agricultural realities and impact on each other. Therefore, all purposes should be taken into account and brought into a wider debate on the implications and sustainability of agricultural development and, if you wish, a bio-based economy. Other participants argue that a distinction between energy crops and other crops is necessary in order to understand that the production of crops for energy purposes is flawed in relation to its objective, i.e. reducing GHG emissions. "The production of biofuels results in extra agricultural expansion, which leads to extra GHG emissions through, among others, deforestation and release of greenhouse gasses from soils, and it thus fails to meet its objective."

Increased production of agricultural crops for biofuels may lead to a further increase in food prices. While this would mean higher incomes for net food producers, it would have negative effects on the food security of the majority of people, as most people in the world are net food consumers. When talking about food security a distinction needs to be made between short-term effects on food security in developing countries and food security of the world population in the long term. Furthermore, whether or not agrofuels pose a direct threat to food security clearly depends on technological developments. Some claim that increased demand for biofuels triggers agricultural innovations. Others note that the demand for agricultural commodities is rising spectacularly anyway and stress that the possibilities of intensification are not endless, especially because of the limited availability of essential inputs (nutrients, water) .

2.3. Governance

Governability and sovereignty

To what extent are effects controllable and/or is there a political will to control effects to begin with? When considering this question, it is important not just to focus on production in the South, but to address production in Europe as well. Europe should not take land out of production and shift the burden to the South. Neither should Europe impose demands on Southern countries which it does not apply for its own member states. For example, the Netherlands refuses to dictate what crop is grown where and leaves that to the commercial farmers. In addition, short-term economic profits mostly prevail over the protection of biodiversity (reference is made to the Prime Minister who stated that the protection of Natura 2000 areas is hindering economic development).

Worldwide there tends to be a significant gap between rules and realities. We can develop norms and criteria, but the reality is that implementation is more difficult and takes place too slowly. In fact, we are still only just beginning to put sustainability standards into practice. This issue becomes even more relevant in countries that have no properly functioning government. Many agreements and rules cannot be implemented due to unforeseen situations such as disasters, failing governments and wars. In some countries the juridical framework is paralysed as a result of thousands of land conflicts. Governments of producing countries do not always act in the interest of their citizens.

Our discussion on criteria then bypasses the land use and political realities in producing countries, not least because it is impossible to oblige non-EU producing countries to adhere to criteria meant to control ILUC, as it directly touches on countries' sovereignty. It is argued that the principle of national sovereignty is often tabled (by political-economic elites from both producer developing countries and OECD importing countries) for self-serving reasons, for example as an argument in favour of non-interference in complex issues such as trade regulation (non-trade concerns), land rights and land use planning. The current (RED) criteria used for biofuels are straightforward and acceptable when they relate directly to the product and direct land use change. Under the WTO rulings a direct demand on product quality and sustainability like this is permitted if it applies to all countries and producers. However, certification is more complicated as soon as ILUC criteria are introduced, as these will touch on a country's wider agricultural policies and therefore its sovereignty. This creates a dilemma. ILUC concerns are considered legitimate but demands relating to ILUC might not be acceptable under WTO rules. Including spatial planning requirements (e.g. making an enforced zoning system mandatory to protect areas mentioned in RED, but not stating what to produce, where and how) in sustainability criteria might be a way of solving the dilemma of sovereignty, sustainability and GHG reduction.

Certain questions need to be answered, for example whether sovereignty implies that the Netherlands cannot take a clear stand? Does it mean that the Netherlands should not get involved in trying to improve governability of effects? Some stress that WTO rules are not the only governing principle because they allow for international and bilateral agreements. Reference is made to existing agreements such as those relating to climate change, nature conservation (e.g. the Convention on Biological Diversity), human rights and labour (e.g. International Labour Organization (ILO)). The question is then to what extent agreements (at global, European, or bilateral levels) can be used to address the negative effects of land use changes. The Global Bio-Energy Partnership (GBEP) might lead to an international agreement between nations on what sustainability entails. In addition the Netherlands might facilitate – through the EU – bilateral agreements with non-EU producing countries (similar to the 'Everything but Arms' – agreement).

Pros and cons of blending targets
Pro: According to some, legally defined blending targets offer a unique and unprecedented legal opportunity to implement obligatory sustainability criteria for agrofuels. This, in turn, should have positive effects on wider agricultural production. Proponents of the blending targets therefore hope that (elements of) the biofuel regulation will spill over to the wider agricultural sector, i.e. setting sustainability criteria for the bio-based economy. The question therefore is how similar arrangements can be used for other commodities. Moreover, proponents of the blending targets note that the regulations can be adjusted to create extra incentives for second generation biofuels (as has already happened in the Netherlands). Finally, it is argued that the unwanted effects of current import of biofuels in the Netherlands should not be exaggerated given that most of the ethanol imported in the Netherlands comes from Brazilian sugarcane (which is performing relatively well in terms of its GHG balance) and that about half of the biodiesel used in the Netherlands is derived from residual fats.

Con: Other participants are of the opinion that the current blending targets form a poor policy tool, as the sustainability criteria are weak and risks associated with agricultural expansion are large. Some participants argue in favour of abolishing the blending targets all together. They are not convinced by the argument that blending targets provide an entry point to implement sustainability criteria. “Why would you want to increase the demand for agricultural products artificially if you know that the use of agrofuels will not contribute to significant GHG emission reductions, has unacceptable social implications in terms of human rights and land rights violations, while it will inevitably lead to extra agricultural expansion, possibly at the expense of biodiversity, food security and smallholder agriculture?” They argue it is better to invest in productivity and sustainability of the agricultural sector as such, and in various initiatives that are already in place to pursue sustainability of trade chains.

The need to make adjustments
All participants agree that, within the European context, it is necessary (and possible) to adjust the current regulations. The Netherlands should play an active role in improving the RED criteria and guidelines (even if this implies confronting WTO regulations), as they are currently insufficient. There is an urgent need to include the following in the RED sustainability criteria: (i) ILUC; (ii) Nitrous Oxide (N_2O) emissions; and (iii) social criteria (e.g. ILO related). In addition, incentives for second/third-generation biofuels can be developed in more detail. Some participants note that member states are currently not allowed to set higher sustainability criteria than the EU RED (for biofuels and bioliquids), which translates into a lack of incentives for producers to raise their standards.

Though everyone agrees that ILUC needs to be included in the criteria, scientific models to measure ILUC have not yet been agreed upon and are therefore inappropriate. Some insist that currently the variations in methods are simply too large, making it impossible to implement them in the short term. Others urge the rapid implementation of ILUC criteria, leaving room to improve the method along the way. With stricter criteria, it becomes questionable whether national blending targets can be attained. A serious evaluation is therefore required in a couple of years. Empirical fact finding on the ground is also needed in order to assess the effects of the policies. A possible outcome of the evaluation could be that the blending targets are lowered or abandoned.

Beyond the targets
As soon as the production of agrofuels becomes commercially more profitable compared to fossil fuels (oil price), the blending targets will become irrelevant. The question is then how sustainable agrofuels should be promoted? Some find that, ideally, the Netherlands should stop the import of uncertified agrofuels through the Port of Rotterdam. However, this is considered a trade barrier and is not allowed by WTO regulations. Many participants agree that the Netherlands should take a bold and clear position concerning social and environmental principles in discussions on WTO regulations. The Netherlands could decide only to import certified biofuels, regardless of the blending targets. This would be opposed by economic parties and so far there is no political will to take this step. On the contrary, the Netherlands promotes the port as the main gateway to Europe and wants it to become a biofuel hub.

3. Some points of concern raised at the meeting

Bearing in mind current social and political conditions in producing countries (notably in the South, but also in the North), experiences so far show one cannot be overly confident about the potential to mould current modes of biofuel production towards sustainability. In addition, ‘producing countries’, ‘governments’ and ‘societies’ are not homogenous entities. The key questions that need to be addressed in order to achieve sustainable biofuel development are: Who decides? Who represents who? and Who wins and who loses? There is a need to address the position of smallholders, indigenous people and women since they are most likely to receive the blows of possible negative effects (deforestation, land grab, dismal labour conditions and social tensions) in anonymity. One option could be appropriate and enforced spatial land use planning as a pre-condition for preventing negative effects of agricultural expansion for local livelihoods and biodiversity. However, this cannot be enforced by the importing countries. One cannot rely too much on certification if accompanying pre-conditions such as good governance and appropriate land use planning in producing regions are not being met.

It is regrettable that no-one from the ministries of LNV (responsible for the bio-based economy) and Economic Affairs (responsible for domestic energy use) attended the discussion. Their presence would have enriched the perspectives on the discussion. Several participants feel that the Dutch government is insufficiently coherent and does not take the risks of biofuel production seriously enough. Could the Netherlands calculate what its biofuel policy implies for its ecological footprint? In addition, the EU should look at its evaluation milestones and create earlier opportunities to review the impacts – both positive and negative – of the EU RED, allowing for timely measures.

The biofuel dossier should be approached within the wider context of a bio-based economy which includes the use of biomass for purposes other than energy and which will result in additional pressure on land. There is a need to reconsider biomass in the light of opportunity costs: it is crucial that investment choices promote energy options and technological routes which are truly future proof and help avoid lock-in effects.

We should ask ourselves what is holding back the development of a truly sustainable energy sector using solar and wind energy? In the face of a growing population and its consumption levels, land is increasingly scarce. Even when good governance is in place, potential negative indirect effects of agricultural expansion are not fully controllable. The need to invest in alternatives that are not land use intensive is emphasised by several participants in order to relieve pressure on the world’s scarce resources. It can be argued that, as a matter of principle, biological substance should not be used for energy. Instead, all our energy needs should be met with the physical energy that is available in huge quantities (solar, wind, hydro). However, if biomass for energy is still needed, as most experts expect, its use for energy could be combined with various other uses, such as pharmaceuticals, plastic, and energy would then probably be last in the list.

Scientists should join together to discuss each other’s methods and assumptions, since this would allow for greater consensus and clarity. At the same time, policymakers should take account of the assumptions made – and often explained – in studies before using them as a basis for policy without further discussion.

4. Final remarks

While some believe ‘the train (i.e. policy-induced agrofuel production) should be stopped’, others argue that the ‘train should be steered in the right direction’. Although the discussion clearly revealed these two different positions, there is a consensus that sustainability criteria urgently need further improvement, and that blending targets will need to be re-evaluated based on their actual effects on the ground. Existing sustainability criteria will need to account for ILUC. The Netherlands and the EU should put achieving quality before quantity and, if it appears that quality does not allow quantity to be raised, the blending targets should be adjusted.

Appendix 2 – List of participants DPRN expert meeting 18 February 2010

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Appendix 3 – Guiding questions DPRN expert meeting 18 February 2010

1. What determines the need for biofuels?

1.1. GHG emission reduction:

a. Is the balance positive or negative?

b. Are the RED criteria on the GHG balance sufficient?

1.2. Growing demand:

Do we need biomass alongside fossil fuels, or are there alternatives like wind, solar and biogas?

2. Opportunities and Risks

2.1. Assumptions in models

a. Are models dependable?

b. Are they sensitive to large margins? Is the precautionary principle applicable?

2.2. Land potential

a. Nine billion people need food. Can biomass production expand on only marginal or fallow land? To what extent do these crops pose a threat to food security?

b. Is production on marginal land feasible and realistic?

2.3. Income for countries, farmers.

a. Does the agrofuel industry stimulate the agricultural sector, is it profitable for countries, farmers, in non-OECD countries and small farmers?

b. Are foreign investments in agrofuel industry economically advantageous for countries, (tax of FDI) and farmers (access to land, market etc).

c. Prices: what effect does the agrofuel industry have on prices of food and land? Who are the winners and losers?

3. Governance

3.1. Sovereignty and free market

a. Has corporate responsibility in development countries improved enough to guarantee sustainability or are inequality and conflicts over land and resources the guiding principles?

b. Is good governance attainable in the global competition over agrofuels?

3.2. Governance:

a. Is the RED sufficient for agrofuels or are there other solutions for GHG ambitions, social criteria, sustainability and macro-effects of biofuel production?

b. What is known about controlling through reporting, certification, land use planning and bilateral agreements?

Appendix 4 – Verslag interview met Dr. M. Bakker

Dr. Martha Bakker (Wageningen Universiteit – groep Land Dynamics) is expert op het gebied van drijfveren achter landgebruikveranderingen.

Telefonisch interview gehouden door Danielle de Nie (IUCN NL) 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 deze 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 was dat vooral het geval. 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. Ten eerste 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 productieverhogend 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 productielanden. 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 maïs 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 residuverwerking 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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