Embassy of the

Kingdom of the Netherlands

Biofuels in Nicaragua

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The views expressed in this publication are those of the author and do not necessarily reflect the views of the Embassy.

Executive summary

In the worldwide discussion about alternative energy sources biofuels are depicted as both a salvation and the cause of many negative effects. On the one hand biofuels can decrease the dependence on fossil fuels, reduce the emission of greenhouse gases, contribute to the development of rural populations and increase access to electricity. On the other hand they are blamed for the rise in food prices, thereby most affecting the poorest people in the world, and for negative environmental effects like deforestation.

This study is performed for the Royal Dutch Embassy in Managua, Nicaragua and investigates the possibilities for a sustainable and socially inclusive development of the liquid biofuel industry, that is bio-ethanol and biodiesel, in Nicaragua. Its purpose is to recommend whether the goals of the Embassy are reflected in this field and what the Embassy could contribute to the development of the biofuels industry. The focal points reflect the interests of both the Dutch and the Nicaraguan policy: social and economic aspects, such as the creation of employment, the inclusion of small producers and the possibilities for export, as well as environmental aspects are treated extensively. These aspects are investigated by means of the analysis of the value chains of various energetic crops.

Reviewing the present Nicaraguan situation reveals that the biofuel industry is in an initial phase. Only ethanol from sugarcane is being produced. Nonetheless, Nicaragua has large areas of unused, deforested lands that could be used for the cultivation of energetic crops and which will not compete with the production of food. Crops with the highest potential in Nicaragua are sugarcane, African palm and tempate (in other countries knows as *Jatropha*). However, a regulatory framework is needed to create a national market, a favourable business climate and to safeguard the social, economic and environmental sustainability of the development of the industry. While the Nicaraguan government formulated a policy for the development of biofuels, experts doubt if legislation will be approved soon. Nevertheless, Nicaragua signed a regional agreement which sets out goals for the blending of biofuels with fossil fuels in 2020. This underlines the need for the development of a regulatory framework and the production of biofuels.

The analysis of the value chains demonstrates that while ethanol from sugarcane, biodiesel from African palm and tempate all have the potential to substantially generate employment in Nicaragua, in the short term only ethanol from sugarcane can be exported. However, since no small producers are involved, it is not recommended to the Embassy to work in this value chain. Because of the larger possibilities for involvement of small enterprises in the production of biodiesel from African palm and tempate the chances for a direct contribution to poverty reduction of the people involved is greater. But production of biodiesel from African palm and tempate does not exist yet, and will only be successful if its development is instigated by the market players itself.

There is an opportunity to contribute to important fields in the development of biofuels in Nicaragua: sustainability and certification. The opportunity for a sustainable development of biofuels in Nicaragua exists. The policy of the Netherlands attaches great value to and is a pioneer in the development of sustainability criteria for biofuel production. Moreover, the Embassy has the possibilities to directly support governmental institutions and to assist private sector organizations. Hence the Embassy could assist the Nicaraguan government with the incorporation of sustainability criteria in this first phase of the development of the industry. When the regulatory framework is established, the Embassy could support private sector organizations with the improvement of the value chains of various biofuels through capacity building, the development of a certification system, or the facilitation of public-private partnerships.

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Introduction

Biofuels are a 'hot topic' nowadays. Due to the dependence on oil from politically unstable regions, the rising demand for energy in the world and growing environmental concerns especially through the emission of greenhouse gases, biofuels are seen as a possible answer to these problems in both industrialized and developing countries. For developing countries like Nicaragua the potential impact of the production of biofuels is large. It has a lot of unused land, low-cost labour and a favourable climate and may therefore become an efficient producer of biofuels. Moreover, it copes with a continuing energy crisis. Nicaragua is dependent on the import of petroleum for its energy demand. About 70% of the electricity generation in the country was based on petroleum, of which the import cost more than US$ 830 million in 2007.[1] Because of the high crude oil prices, oil imports represented 65% of the money available for exports in 2006.[2] Besides, electricity supply is a problem in Nicaragua. On the countryside, 70% of the population does not have access to electricity.[3] And although other parts of the country have a connection to the national grid, the supply is unstable because of breakdowns. The production of biofuels, which can be turned into electricity with a generator, could increase the amount of people with access to a stable electricity source.

However, increasingly biofuels appear in bad light because they are blamed to be the cause of high food prices. Land, on which food crops used to be cultivated, is used for the production of biofuels. Therefore the prices of food have risen and the poorest people in the world are the ones that suffer most. For developing countries like Nicaragua this is an important political topic. These and other effects of the development of biofuels in Nicaragua will be dealt with in this study. This study is performed in the framework of an internship for the Royal Embassy of the Netherlands in Managua, Nicaragua because of the Embassy's interest to work in biofuels within the framework of one of its key areas 'value chains for sustainable economic growth'. The main goal is to identify the possibilities for development in a sustainable and socially inclusive way of the biofuel industry in Nicaragua. From thereon recommendations will be made whether the value chains of biofuels are a good choice for the Embassy to work with and what the Embassy could possibly contribute to its development. Because the goal of the Embassy is 'to contribute to poverty reduction through support to sustainable development in an inclusive and equitable society', the focus will be on the creation of employment and the involvement of small and medium enterprises (SME's), possibilities for export, and sustainable production methods.

The first chapter will treat biofuels in general and specific for Nicaragua. The current situation concerning biofuels in Nicaragua and the possibilities for development in Nicaragua will be explained. Because the Embassy is focusing on value chains, this will be dealt with in chapter two. In this part the value chains of different energetic crops will be examined to identify the main sustainability problems in the value chain and what can be done to solve these problems. Chapter three deals with the different actors in the field such as government, donors, private sector, and NGO's. The focus will be on possible cooperation in the field of biofuels. Chapter four will explain the policy of the Dutch government and the Embassy. In the last chapter criteria to select a value chain will be formulated, conclusions will be drawn, and recommendations will be made for possible inclusion of biofuels in the private sector development of the Embassy.

[1] 'Anuario de Estadísticas Económicas 2001-2007', Banco Central de Nicaragua, 101.
[2] 'Potencial y perspectivas de los biocombustibles en Nicaragua', Ministerio de Energía y Minas, 11-'07.
[3] Wolfgang Mostert, 'Nicaragua. Unlocking potential, reducing risk. Renewable Energy Policies for Nicaragua', ESMAP, Special Report 003/07, 08-'07.

Chapter 1 –Biofuels in Nicaragua

In this chapter the reader will be guided through the area of biofuels. Firstly, a general overview will be given of biofuels, the different 'generations' of biofuels and there impact on developing countries. Then, the present situation regarding biofuels and their possibilities for development will be described.

1.1 Biofuels

A biofuel is fuel derived from biomass. Biomass includes organic matter available on a renewable basis, such as forest and mill residues, agricultural crops, animal wastes and the organic part of municipal and industrial waste.[4] Biofuels can be used in the transport sector, as well as for electricity and cooking, which is of relevance especially to rural areas in developing countries. Biofuels can be divided into three categories: biodiesel, bio-ethanol, and biogas. While biodiesel is produced with a thermo chemical technology, bio-ethanol and biogas are produced through a biological process.[5] Bio-ethanol is mainly derived from maize and sugarcane. Biodiesel is made from vegetable oils from rapeseed, soy, palm, tempate, cassava, castor-oils plants, etc. In this report the focus will be on liquid biofuels, that is bio-ethanol and biodiesel, which principal use is in the transport sector. Biogas will not be treated.

Another distinction can be made between first-, second- and third-generation biofuels. First-generation biofuels are derived from sugars, grains, or seeds; the prime materials of a crop. An advantage of first-generation biofuels is that they require technology with a relatively low complexity, and can be produced at small or large scale. A disadvantage is the possible competition with the production of food, which leads to high-cost energy feedstock and high cost food. First-generation biofuel crops absorb CO2 as they grow, thus removing it from the atmosphere, but they release CO2 when they are burnt. The net emissions are about half those of fossil fuels.[6]

In recent years criticisms on first-generation biofuels are mounting. Research indicates that biofuels are more damaging to the environment than previously thought. Especially the ethanol production from maize in de United States has a neutral or even negative energy balance[7]. While the production of ethanol from sugarcane in Brazil is more energy efficient (only one unit of fossil fuels is needed for the production of eight units of ethanol), the producers are criticised for cutting down rainforests to expand their sugarcane fields.[8] The problem with first-generation biofuels is that enormous areas of land are required to satisfy the growing demand. This results in competition with food crops which leads to food shortages and thus higher prices. The poorest people in the world, in the developing countries, are the ones that suffer most from this. The Organisation of Economic Cooperation and Development (OECD) and the UN Food and Agriculture Organisation (FAO) expect that the world prices of agricultural products will rise because of the growing demand for biofuels. Higher maize prices have already led to a 'tortilla crisis' in Mexico when the price of maize quadrupled.[9]

A possible solution for these problems can be found in second- and third- generation biofuels. These technologies are under development and should reach commercial scale within 10 years. Second-generation biofuels are derived from lignocellulose which can be found in waste biomass from agriculture and forestry, fast-growing grasses, and woody crops. These biomasses are generally not edible and a larger fraction of the plant is converted to fuel. Besides, the amount of agricultural waste existing is huge, every year billions of tons of vegetable waste are produced. Therefore second-generation biofuels do not compete with the production of food. Disadvantages of the second-

[4] 'The emerging biofuels market: regulatory, trade and development implications', UNCTAD, New York and Geneva 2006, 5.
[5] Eduardo J. Zamora, Presentation 'Biocombustibles', UNI, February 2008.
[6] Koos Dijksterhuis, 'Second-generation biofuels. Driving on organic waste, The Broker, issue 4, 10-'07, 4.
[7] The energy balance is the amount of fossil fuel needed to produce ethanol versus the amount of energy which the ethanol can generate.
[8] Joel K. Bourne jr., 'Biobrandstof', National Geographic voor Nederland en België, 10-'07.
[9] Dijksterhuis, 'Second-generation biofuels', 5.

generation biofuels are that they need large-scale plantations for optimum economics and initial investment costs are high. But they have a higher potential to reduce greenhouse gases, they reduce greenhouse gas emissions by 90% compared to fossil fuels.[10] Third-generation biofuels seek to improve the feedstock by way of genetically modifying the crops, for example to increase their oil production.[11]

So what is the future of first-generation biofuels with the second- and third-generation biofuels in vision?[12] Because of greater potential for favourable economics of second- and third generation biofuels, like the lower costs feedstock (e.g. agricultural waste) and the higher yield[13], they could oust first-generation biofuels from the market. However the International Energy Agency does not expect this to happen for the coming 25 years, although a technological breakthrough which fosters the profitability of second- and third-generation biofuels can not be precluded.[14] First-generation biofuels will only be able to compete if their price is lower than the price of fossil oil. Nowadays only Brazil is able to produce ethanol from sugarcane which is competitive with oil prices around $US 30/barrel, outside Brazil the lowest-cost producers are able to compete with oil prices above $US 50-70/barrel. The recent high oil prices are an incentive to produce biofuels.

For developing countries best opportunities for the production of biofuels are found in first-generation biofuels, because of the advanced technologies which are needed for second- and third-generation biofuels. These advanced technologies are mainly developed and patented in developed countries. For second- and third-generation biofuels to be produced in developing countries they will need to have a technology innovation system to generate knowledge, to form joint ventures with foreign companies, to formulate technology-informed government policies, etc. Time will be needed before second- or third-generation biofuels will have an impact in developing countries. In Brazil the estimated time before a commercially viable second-generation biofuel industry could be established is 10-15 years, while a competitive third-generation biofuel industry might be founded between 2020 and 2030. Considering Brazils position as the worlds leading producer of ethanol derived from sugar cane, with one of the lowest-costs lignocellulose production systems of the world and an established technology innovation system, the time that will be needed in other developing countries will be likely to be longer.[15]

1.2 Ethanol

Ethanol is an alcohol produced by the biological fermentation of starch derived from plant material. Starch can be derived from various feedstock like sugarcane, corn, maize, potatoes, sugar beets, grains, etc. The different feedstock have multiple production methods, but in all processes the starch is extracted, fermented and distilled into ethanol.[16] It is a clean-burning fuel and can be used directly in cars designed to run on pure alcohol or it can be mixed with gasoline (max. 25%) to make 'gasohol', which will reduce the carbon monoxide emissions of the car. Normally no engine modification is needed. Nowadays Brazil is the only country that uses 100% ethanol in cars. In other countries ethanol

[10] Ibidem, 4; 'The emerging biofuels market', UNCTAD, 5; 'Biofuels, opportunity or threat to the poor?', Swiss Agency for Development and Cooperation, Issue Paper, 07-'07, 2-3; Eric D. Larson, 'Prospects for Second Generation Biofuels Technologies', UNCTAD conference on biofuels, Rio de Janeiro, 4-12-2007, 3-12.
[11] Craig Rubens, 'WTF are fourth-generation biofuels?', 04-03-2008, <http://earth2tech.com/2008/03/04/wtf-are-fourth-generation-biofuels/>,18-06-2008.
[12] 'Biofuel production technologies: status, prospects and implications for trade and development', UNCTAD, New York and Geneva 2008, vii-viii.
[13] The production of biodiesel from micro-alga will be 5,000-15,000 gallons of oil/acre/year. Corn produces 18 and palm 635 gallons of oil/acre/year. Source: Thomas F. Riesing, 'Cultivating Algae for Liquid Fuel Production', <http://oakhavenpc.org/cultivating_algae.htm>, 07-05'08.
[14] 'World Energy Outlook 2006', International Energy Agency and OECD, Paris 2006.
[15] Biofuel production technologies: status, prospects and implications for trade and development, New York and Geneva 2008, 29-30.
[16] Garten Rothkopf, 'A blueprint for green energy in the Americas. Strategic analysis of opportunities for Brazil and the Hemisphere. Featuring: the Global Biofuels Outlook 2007', Inter-American Development Bank, 34; 'The emerging biofuels market', UNCTAD, 5.

is blended with gasoline in different proportions. Compared to gasoline, ethanol provides 30% less kilometres.[17]

The worldwide production of ethanol was or 597 thousand barrels per day in 2005. Since 2000 the production has grown with 95% (see figure 1). The largest ethanol producers are Brazil and the United States, from respectively sugarcane and maize. Expectations are that the world ethanol production will triple in the coming 15 years.[18]

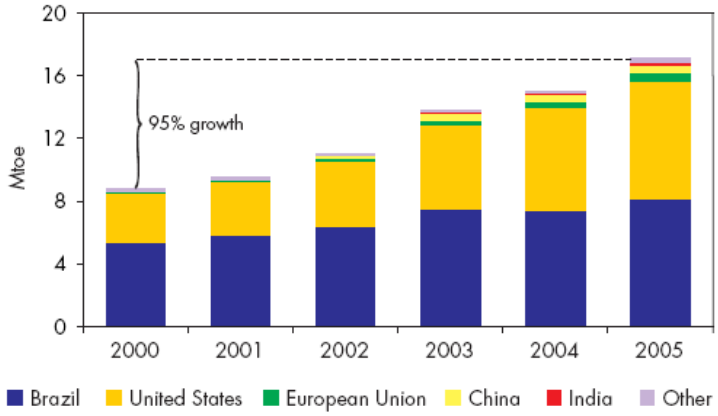

Figure 1. Worldwide ethanol production 2000-2005. Source: World Energy Outlook 2006.

The process to produce ethanol from maize is almost the same as the century-old production of alcohol from grains. The maize is grinded, blended with water, and heated. Added enzymes convert the starch into sugars. In the fermentation tank the ferment converts the sugar slowly to alcohol, which is separated from the water through a distillation process. During the production process large amounts of CO2 are released, through the fermentation process and the fact that many ethanol fabrics use gas or coals to generate steam for the distillation process. Therefore the energy balance for the production of ethanol from maize is neutral. According to various studies there are no gains in terms of CO2 reductions.[19]

Sugarcane produces 5700-7600 litres of ethanol per hectare, twice the amount of ethanol from maize. 20% of the stalk consists of sugar, which is fermented to produce alcohol. In contrast to maize, in which the starch must be converted to sugars with the help of expensive enzymes, the sugar only has to be fermented en distilled. The waste of the stalk, called bagasse, can be burnt to supply the factory with relatively clean energy for the production process. Therefore the CO2 emission from the production and use of ethanol from sugarcane 55-90% less than CO2 emission from gasoline.[20]

Ethanol in Nicaragua

Sugarcane

In Nicaragua bio-ethanol is produced from sugarcane. Sugar production is concentrated around four producers, of which the largest refinery, Ingenio San Antonio, has a market share of 55%. The owner of Ingenio San Antonio is Nicaragua Sugar Estates Limited (NSEL). Sugar Energy and Rum (SER) is the holding company for Compañia Licorera de Nicaragua and NSEL, which is owned by the Pellas Group, the most powerful economic entity in Nicaragua. At this moment it is the only company that produces ethanol in Nicaragua. The Ingenio San Antonio, where the ethanol is produced, has a capacity of 100 thousand litres/day. The company is developing a second distillery which will be

[17] Bourne, 'Biobrandstoffen'.

[18] Sergio C. Trindade, 'Biofuels. Trade and development implications of present and emerging technologies. Global biofuels picture and the prospects for international trade', UNCTAD Ad-Hoc Expert Group Meeting, Division on International Trade on Goods, Services and Commodities, Geneva 19-06-'07, <http://r0.unctad.org/ghg/events/biofuels/Trindade%20presentation%20UNCTADAHEM%20June%202007shorter.pdf>, 08-05-'08.

[19] Bourne, 'Biobrandstoffen'.

[20] Ibidem.

ready in the final quarter of 2008 with an additional capacity of 300 thousand litres/day. The first three million litres of fuel ethanol were exported to Europe in February 2007.

The other sugar producers have plans to install ethanol production capacities. According to executive director of the National Committee of Sugar Producers (CNPA), Monte Rosa, the refinery owned by the Guatemalan company Pantaleón, will build a plant with a capacity of 300-400 thousand litres/day. This plant will probably become operative in 2009.[21] The two smaller refineries active in the sugar market, Montelimar (owned by the company NAVINIC) and Benjamín Zeledón (owned by CASUR) are interested in building smaller plants with a capacity of 60-80 thousand litres/day.[22] Because of the very high entrance barriers because of the high investment costs other firms have difficulties entering the market.

NSEL is planning to expand the volume of ethanol for export dramatically. A part of the ethanol, 20 million litres, is used for rum production in Compañia Licorera de Nicaragua that produces the famous rum *Flor de Caña*. The rest of the ethanol, 80 million litres in 2009, will be exported.[23] There are no domestic sales of ethanol because the lack of a legal framework makes it impossible to commercialize the sale of ethanol in Nicaragua.[24] The so-called 'flexible production process' permits the company to choose the amount of production of ethanol and sugar. Depending on the international prices of sugar and ethanol the production amounts will vary. If the price of sugar falls below $US 10 per kilo, the whole production of sugar will be destined to produce ethanol.[25]

Cassava

Another crop from which it is possible to produce ethanol in Nicaragua is cassava, also known as manioc, casava, or yuca (*Manihot esculenta*). While sugarcane requires very specific lands, cassava can practically be planted everywhere. In Nicaragua 1.5 million hectares are appropriate for the cultivation of cassava of which the Interamerican Institute for Cooperation of Agriculture (IICA) identified 60,000 suitable ha which are unused and deforested. At the moment, about 5,600 ha of land are used for the growth of cassava. From one hectare, between 6,000-7,000 litres of ethanol can be produced from cassava, which means the production of ethanol per hectare is a little higher than from sugarcane.[26] The technology to produce ethanol from sugarcane is more advanced than the technology needed to produce ethanol from cassava. At this moment, no commercial production of ethanol from cassava exists and there are no specific plans for a project. Besides, Nicaragua has no experience with the production of ethanol from cassava, so years of study will be needed before production can be started. Cassava is a crop suitable for small production and therefore the possibilities for small producers are larger than with sugarcane. A problem is however that cassava is a food crop. If it will be used to produce ethanol, the prices of cassava will probably rise.[27]

Jícaro

The calabash tree, called *jícaro* in Central-America, can also be used to produce ethanol. Jícaro grows on poor grounds, produces fruits for 100-200 years, resists all types of weather circumstances, its fruits can be harvested the whole year round and it needs no fertilizers. From the fruit pulp ethanol can be made. The seed is a human food product and the protein-rich residues of the production process can be used as animal food. It has large possibilities for small producers: only 6 ha of jícaro are needed to supply an oil-factory and the cultivation of jícaro can be combined with the production of other crops or with cattle breeding. However, the plant to produce ethanol is costly, about US$ 500,000. With the machinery to produce fuel ethanol the costs will double. This is no feasible option for small farmers.

[21] Interview Sr. Martínez S., SER., 28-04-'08.
[22] Gustavo Alvarez, 'Tres ingenios más entrarán al negocio. Ampliarán producción de etanol de caña de azúcar', El Nuevo Diario, 16-08-'07, <http://impreso.elnuevodiario.com.ni/2007/08/16/economia/56416>, 23-04-08.
[23] 'Projected volumen of ethanol production of Nicaragua Sugar Estates Limited', presentation Nicaragua Sugar Estates Limited and Compañía Licorera de Nicaragua, S.A, 08-'07.
[24] Interview Alvaro Martínez S., SER., 28-04-'08.
[25] 'Nicaragua exportará etanol', El Nuevo Diario, 25-11-'08, <http://www.sucre-ethique.org/Nicaragua-exportara-etanol>, 23-04-08.
[26] See Annex 1.
[27] Interview Sr. Saénz, IICA, 06-05-'08.

However, the plant is very rentable and the investment will be recovered in five years. The company Jícaro S.A., owned by the German Karsten Jochims, owns a plant to process the fruits of the jícaro in León. At the moment some two to three thousand farmers are producing jícaro on a very small scale in Nicaragua. They sell the seeds to merchants who sell them to El Salvador. From there the seeds are exported to the United States. The small farmers wash the fruits by hand to obtain the seeds, whereby the valuable pulp is lost. The only company which buys the whole fruit from the farmers is Jícaro S.A. It also has its own jícaro plantation. This company is producing ethanol for alcoholic drinks. The company does not yet produce fuel ethanol, but is interested to do so. The obstacle is needed investments, therefore the company is looking for financing possibilities with the NGO SNV in Nicaragua.[28]

1.3 Biodiesel

The chemical name for biodiesel is *fatty acid methyl ester* (FAME) or *fatty acid ethyl ester* (FAEE). Biodiesel is a synthetic diesel-like fuel and it can be used in a mixture not exceeding 10% with diesel oil in diesel engines, or pure in modified engines. First-generation biodiesel is produced from vegetable oils, animal fats or recycled cooking grease. Examples of crops from which biodiesel can be produced are rapeseed, soybeans, sunflowers, tempate, coconut, and palm. Biodiesel is 4% less efficient than diesel from fossil fuels.[29]

The biodiesel industry is growing. From the worldwide total production of biofuels, 85% is ethanol, and 15% biodiesel. From the worldwide production of biodiesel, 87% is produced in Europe. The production of biodiesel increased with 295% from 2000 to 2005 (see figure 2). The production of biodiesel in 2005 was 64 thousand barrels a day.[30] As of 2005, Germany leads the world production with about 2.3 billion litres produced, primarily from rapeseed and sunflower. Biodiesel production in the United States, primarily from soybeans, rose from an estimated 284 million in 2005 to 950 million litres in 2006.[31]

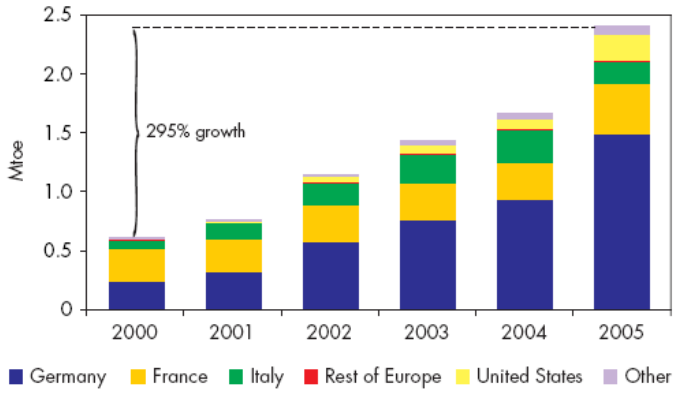

Figure 2. Worldwide production of biodiesel 2000-2005. Source: World Energy Outlook 2006.

Biodiesel in Nicaragua

The production of biodiesel in Nicaragua at this moment is very little or zero. No official data exist about it, but experts say that the production of biodiesel in 2008 was minimal. Biodiesel can be made from a large number of crops. The crops with the largest potential in Nicaragua will be treated here.

[28] Interview Dr. Jochims, general manager, Jícaro, S.A., 22-05-'08.
[29] Interview MSc. Ing. Zamora, Laboratory Biomass UNI, 23-04'08.
[30] Emiel Sanders, 'Rapport Ethanol', Royal Dutch Embassy in San José, Costa Rica, 4.
[31] 'Biofuel production technologies', UNCTAD, 8.

African palm

African palm (*Elaeis guineensis*) is a perennial crop. New plantations start producing after three years, after six or seven years the yield of the harvest is stable. The tree can be exploited for 25-30 years. The two most important commercial products of the palm are crude oil and the palm nut. The palm nut produces palm kernel oil and palm kernel meal. The palm kernel meal can be used as food for pigs. The oil-rich fibrous residues and the palm nut shells can be used as sources of energy for the factory. From one hectare of african palm 5,550 litres of biodiesel can be produced.[32]

The history of the cultivation of african palm in Nicaragua started in 1945. Various projects for the cultivation of african palm were founded involving cooperatives of small farmers. These project largely failed because of organizational problems with the producers and low international prices for vegetable oils.[33] At this moment african palm is cultivated in two regions in Nicaragua: in the southern region of the Atlantic Coast and in the region Río San Juan. The company PALCASA (*Empresa Palmares de El Castillo*) exploits 2,500 hectares of african palm, produces oil and is testing the possibilities to produce biodiesel.[34] In the Cukra Hill region the company Cukra Development Corporation cultivates 6,300 hectares of african palm. COMEPA (*Cooperativo Multisectorial Empresarios Palmeros*), a cooperative of small farmers, is cultivating 500 hectares in Río San Juan.[35] So while various plantations of african palm in Nicaragua exist, there is no plant to produce biodiesel from the palm oil. The companies are using the oil to produce electricity for their own internal use, but are not commercializing the production of biodiesel. The first reason for the lack of biodiesel production is that there exists no national policy and regulative framework for the production of biofuels. The production and consumption of biofuels in Nicaragua have to be stimulated through laws and regulations which create a national market. Without this framework it is difficult to commercialize the production and sale of biodiesel. Therefore the producers are waiting for this to be implemented before they invest in biodiesel production technologies.[36] The second reason are the high international prices of vegetable oils. Because of this the producers have no incentive to produce biodiesel.[37]

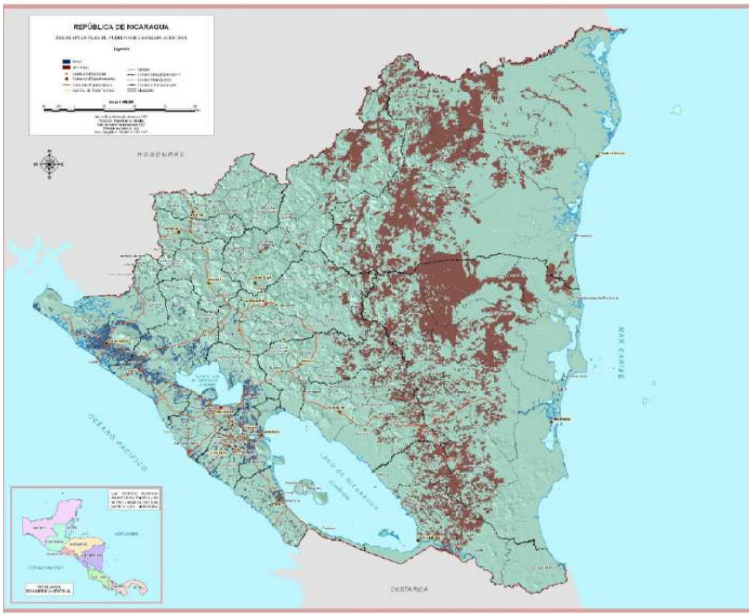

Figure 3. Suitable areas for the cultivation of african palm in Nicaragua. Source: 'Situación Petrolera Mundial y Producción de Biocombus-tibles', IICA, 64.

[32] Interview sr. Sáenz, IICA, 06-05-'08; see annex 1.
[33] See annex 2 for the history of African palm in Nicaragua.
[34] 'Diagnóstico Agro Socioeconómico del Municipio El Tortuguero. Instrumento de Análisis para valorar la viabilidad de un proyecto agroindustrial de Palma Africana para la producción de Biodiesel', IICA and JICA, 02-2007.
[35] 'Política Nacional de Agro Energía y Biocombustibles', Ministerio de Energía y Minas, Comisión Inter-institucional de Biocombustible MEM, MIFIC, MARENA, MAGFOR, INAFOR, AMUNIC, IICA, 19-12-'07. Dates are adjusted to the opinion of expert in the field sr. L.E. Sáenz Mejía, consultant at IICA in Managua.
[36] Interview sr. Baldizón, Austrian Development Cooperation, 28-04-'08; Interview sr. Sáenz, IICA, 06-05-'08.
[37] Interview sr. Baldizón, Austrian Development Cooperation, 28-04-'08; Interview sr. Sáenz, IICA, 06-05-'08.

Nicaragua has a great agro-ecological potential to cultivate African palm sustainably (see figure 3). In the Atlantic RAAN and RAAS regions more than two million hectares are appropriate to grow the palm. From these two million hectares 978 thousand hectares are deforested and have a right climate and soil.[38] Cultivation on these grounds will have the positive effect of reforestation and will not compete with the production of food. But a legal framework is needed to found a production system which is environmentally friendly and sustainable. In the first place this means that woods must be not chopped for the construction of plantations. Also the water resources would have to be reinstated and protected. Moreover, the rights of the workers and rural population must be safeguarded. These laws need to be enforced, which can be difficult in parts of the RAAN and RAAS regions because of the lack of (good) infrastructure.

Another problem which hinders the development of African palm in Nicaragua are land property rights. In Nicaragua, and especially in the RAAS and RAAN regions, very often it is unclear who owns a certain piece of land. Some areas have multiple owners. To develop the region and to attract investments this problem must be solved. This should be done by way of a national legal framework which establishes land property rights.

Tempate

Jatropha curcas linn, in Nicaragua known as tempate, is an oleaginous plant which can reach a height of six metres. It produces for 30-50 years and the origins of the tree are found in South-America. The crop can grow from sea level until an altitude of 1000 metres. It is resistant against hostile circumstances like drought, an excess of water, high temperatures, etc. Tempate grows on very poor grounds where other species succumb and will therefore not affect food production.[39] A quarter of the weight of the fresh tempate fruit are seeds. From these seeds oil can be produced, and the residues from this process are seedcake and waste material. These residues can be used as fertilizers to the plant. In addition of being a fertilizer, the seedcake can produce biogas for cooking or can be used, in briquette form, as a fuel in ovens. The seedcake needs to be detoxicated to be able to be used as animal feed. The most important end use of the oil from the perspective of this study is biodiesel. But the oil can also be used in soap, oil lamps and cooking stoves.[40] From one hectare of tempate 3,850 litres of biodiesel can be produced.[41]

Biodiesel from tempate is suitable to be produced on a small-scale. The highest costs for the production of biodiesel from tempate is labour, because the fruits have to be picked by hand. Therefore economies of scale are not possible. Small-scale production of biodiesel from the oil is possible because of the relatively low complexity of the production process. Therefore the factory is relatively cheap. The locally produced biodiesel can be used for electricity generation, through the use of a generator. Because the cultivation of tempate can be combined with the production of other crops or cattle breeding, it will not compete with the production of food and will be a supplementary source of income. In several African countries the small-scale cultivation of tempate is successful.[42]

There is a relatively large amount of knowledge present in Nicaragua concerning the production of biodiesel from tempate. In 1989 the Austrian Development Cooperation (ÖEZA,) started a project in collaboration with the state-owned company Petronic (*Petróleos de Nicaragua*) and the UNI (*Universidad Nacional de Ingeniera*) to investigate the possibilities to exploit tempate, focusing on the production of biodiesel. After four years of research, in 1993 three cooperatives of farmers started with the growth of 1.2 million plants on 913 has. 192 producers in León, Telica and Quezalguaque were involved. The industrial plant to produce oil and biodiesel from the tempate seeds was opened in 1997, but due to various problems Austria stopped the financial help in 1998. The project had cost almost $US 15 million.

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[38] 'Diagnóstico Agro Socioeconómico del Municipio El Tortuguero', 59.
[39] 'Evaluación 1999 del Proyecto Tempate. Sintesis', Project Nr. 930 ÖEZA, KEK CDC Consultants, 05-'99, 13.
[40] Janske van Eijck and Henny Romijn, 'Prospects for Jatropha biofuels in Tanzania. An analysis with Strategic Niche Management', *Energy Policy* 36 2008, 314.
[41] Interview met sr. Sáenz, IICA, 06-05-'08; see annex 1.
[42] E.g. in Tanzania and Mali: 'Mali-biocarburant winnaar European Environmental Business Award', press release Trees for Travel, Dieren 04-06-'08; Van Eijck and Romijn, 'Prospects for Jatropha biofuels in Tanzania'.

Reasons for the stop were the problems and strikes which contended the project from the beginning. Points of disagreement were the price of the fruit, the resale of fertilizers which the farmers received from the project, and the lack of commitment of the farmers to maintain the lands. Moreover, the farmers did not completely receive the financing from the Union of Cooperatives who acted as intermediary of the credit. The yield from the land was too low, and there was no clarity about the production costs of biodiesel during the project although it was clear that it was not rentable, since the fossil oil prices were low in the 1990's. Therefore the plant did not produce biodiesel. But the project as a whole was economically viable because of the sale of by-products. While there is disagreement about why the project failed, multiple causes can be found. A very important reason is the lack of cooperation and division of responsibilities between the research institutions, the Austrian leadership of the project, the Nicaraguan counterpart Petronic, a state-owned enterprise and the farmers. There was no adequate selection of the farmers that participated in the project. Moreover, the government did not give the project the priority that was needed.[43]

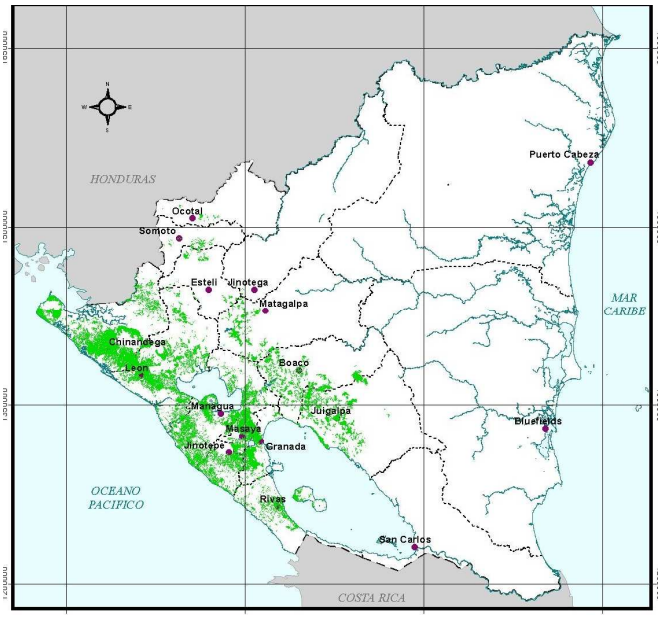

Figure 4. Potential areas for the production of tempate. Source: MAGFOR.

At the moment there is no commercial production of tempate in Nicaragua. The reasons are the following. First, farmers are reluctant to cultivate tempate because the failed Austrian project is the only experience with tempate in Nicaragua. The second reason is the high prices of food which stimulate producers to grow food crops. The third factor is the lack of information and capacity in Nicaragua about the cultivation of tempate.[44] But Nicaragua has many possibilities for the cultivation of tempate. In the Pacific region of Nicaragua 740 thousand hectares are suited to grow tempate.[45] The various research activities of the Austrian project all indicated the economic viability of the cultivation of tempate and the production of biodiesel on an industrial scale. But because of the uncertainty about production costs, it is not clear what the future of the production of biodiesel from tempate is. However, the price of petroleum increased rapidly the last years. The price of one barrel fluctuated around $US 130 in June 2008. In comparison, the oil price in the 1990's was between US$ 20-30. This implies that the production of biodiesel from tempate will be rentable if the prices of petroleum remain high. But this dependence of the success of a biofuel project on the international oil prices is a disadvantage, because it makes it vulnerable.

[43] See annex 3 for a more extensive description of the causes of failure from this project.
[44] Interview sr. Baldizón, Austrian Development Cooperation, 28-04-'08.
[45] 'Política Nacional de Agro Energía y Biocombustibles', 11.

Marango with pigs[46]

The Biomass Laboratory from the UNI is researching another type of production of biodiesel, namely from the fat from pigs which are fed with vegetal proteins from the marango tree (*Moringa Oleifera L*). The pig is very efficient in the transformation of carbohydrates to fat. To grow it needs alimentation of carbohydrates, proteins and minerals. But because the proteins for animal food are expensive the development of the pig industry in Nicaragua is hindered.

The Biomass Laboratory developed a new technology for the production of vegetal proteins by means of the marango tree that decreases the costs of the proteins by a factor of ten. The marango is a fast growing tree which can grow under a high density. In combination with the feeding of carbohydrates the pigs will produce meat for direct consumption and fat. From the fat biodiesel can be produced. Biogas can be produced from the excrements of the pigs and the waste from the slaughterhouse.

Ten hectares of marango, 20 hectares of cultivation of carbohydrates produce alimentation for 5,000 pigs. The annual production of meat is 270 ton and biodiesel 500,000 litres. This amounts to 17,000 litres of biodiesel/ha/year. For comparison: African palm produces 6,000 litres of biodiesel /ha/year.[47] The Biomass Laboratory of the UNI is still investigating this type of production of biodiesel. There are no actual plans for the realization of the project.

Micro-alga

Two Nicaraguan businessmen have written a business plan for the production of biodiesel from micro-alga. If the company is founded, it is going to be the first alga-biofuel project in Central-America. The company is at the moment searching for finance. The company will, after multiple years of research, develop photo-bioreactors for the mass production of alga. Some micro-alga culture can produce 60% of its own weight in oil. Therefore the amount of oil extracted from alga per hectare is far more than with the production of crops like African palm or tempate (5,000-15,000 gallons/acre/year from alga, 635 gallons/acre/year from African palm). The oil from which biodiesel can be produced will be sold to refineries in Central America. Eventually they will produce the biodiesel themselves, but because of the huge investment to build a refinery that will not be feasible for the first years.

The two great advantages of biodiesel from alga in comparison with African palm and other crops are that the impact on the environment is minimal and the land use is relatively small (about ten times less than other crops which produce oil for biodiesel). If the company can start with the production of alga it will use 280-700 hectares of land. Therefore there will be no competition with the production of food. The estimation is that there will be about 100 people employed in the company. Indirectly the creation of jobs will be larger, for example jobs in the oil refinery.[48]

[46] Leonardo Mayorga, 'Un cerdo en su tanque?', Laboratorio Biomasa UNI.
[47] 'Energía renovable una necesidad para nuestro desarrollo', Laboratorio Biomasa UNI, 19.
[48] Interview sr. Ramírez, Bionica S.A., 22-04-'08.

Chapter 2 – Value chains for sustainable economic growth

This chapter tries to construct various value chains from ethanol and biodiesel in Nicaragua. In the case of ethanol from sugarcane this is relatively easy because the production and export of ethanol already takes place. However, at the moment there is no production of biodiesel in Nicaragua. The sketch of the value chains from biodiesel from African palm and tempate will therefore be based on past and international experiences. The aim of this is to identify the main obstacles for development in the chain, with a focus on the possibilities for the creation of employment, the involvement of small and medium producers, export and environmental sustainability. If the Embassy decides to work with the value chain of one or more types of biofuel, it can try to improve the working of these value chains, for example through the Value Chain Approach.[49] A start of the analysis is made here. But first the possibilities for export will be treated.

2.1 Production for the national market and export opportunities

Whether a country has the market potential to become a biofuel producer with the ability to export will be a function of the energy supply situation and the feedstock availability. Countries that are currently importing fossil oil and petroleum and exporting biofuel feedstock have the most potential to become an important biofuel producer. Nicaragua is an importer of petroleum and an exporter of the feedstock for ethanol production (sugarcane). It is not yet a biodiesel-feedstock exporter and the development of this will take time. Because biomass feedstock is found in almost all countries in the world, international trade is relatively small compared to domestic consumption. Besides, international trade in biofuels historically has been relatively small because biofuels were more expensive than petroleum fuels. Therefore the national producers were supported by the government, while foreign producers did not receive this support.[50]

Considering the abovementioned, the national market is more important for the development of biofuels than with most other commodities. Because Nicaragua is no crude oil producer and an importer of petroleum, the potential national market for biofuels is large. This underlines the necessity for a legal framework to establish a national market. Instead of the prohibition to blend biofuels with gasoline and diesel, laws have to stimulate the blending to that the sale of biofuels on the national market can be commercialized. There are not yet technical and quality standards available, but Central American countries are collaborating on the development of such standards, relying on existing standards in the EU and US.[51]

Expectations are that the worldwide demand for and trade in biofuels will grow in the coming decades, due to the increasing energy demand in developing countries and the obligation for the blending of fossil fuels with biofuels in, among others, the European Union. The export of biofuels at this moment is focused on the European Union. The reason is the strong euro with regard to the US dollar, which makes export to the EU more attractive. NSEL is already exporting 100% of their ethanol to Europe. Because Nicaragua is one of the countries that fall under Generalised System of Preferences *plus*, GSP+, it can export ethanol duty-free to the EU. There are low EU tariffs on biodiesel and feedstock for biodiesel production. The import duty on biodiesel is 6.5% and on vegetable oils between 3.1 and 5.1 %. Oilseeds have duty-free access to the EU market. For GPS-countries a tariff preference exists on vegetable oils.[52] Obstacles for the export of biodiesel to the European Union are technical standards. The European Commission published a set of guidelines in

[49] There are many studies and experiences in Value Chain Analysis. See Annex 4 for a description of a few of these methods.

[50] 'Issue paper on Biofuels in Latin America and the Caribbean', IDB Environmental Division, Sustainable Development Department, (S&T)² Consultants Inc, Washington DC, 18-09-'06.

[51] Lucas Assunção et al, 'Prospects for a biofuels industry in Guatemala. Main findings and results of the mission undertaken by the UNCTAD Biofuels Initiative', UNCTAD, 26-10-'07, 14.

[52] Marcos J. Jank et al, 'EU and U.S. policies on biofuels: potential impacts on developing countries', The German Marshall Fund of the United States (GMF), Washington DC 2007, 21-22.

compliance with the CEN-Standardization (EN 14214) with the aim of ensuring the quality and performance of biodiesel. For palm oil a limitation is temperature. Palm oil is not as adaptable to cold weather as other oils because of its high cloud point. Therefore the biodiesel industry in the EU limited the use of palm oil. However, with technological advances this problem can be overcome. Because ethanol is a relatively simple product concerning product requirements and only large companies are exporting ethanol, which have the knowledge and technological expertise to produce according to the requirements of the markets of destination, this issue is of less importance.

Export from Nicaragua to the USA falls under the Central America Free Trade Agreement (CAFTA) and the Caribbean Basin Initiative (CBI), so it benefits from preferential tariff treatment. Under CBI ethanol may be imported duty-free and quota-free to the USA, if produced from at least 50% local feedstock, until a maximum of 7% of the United States market. There are no tax exemptions on biodiesel in the United States.[53] The product norms for biodiesel are established in ASTM D6751, for mixture less than 20% (B20). There is no norm for blends with a higher percentage.[54]

Certification

At the moment no label for certification of biofuels that assesses the value chain exists. However, the worldwide attention for certification of biofuels is substantial. Nowadays at least 16 organizations worldwide are involved in the development of standardization guidelines, sustainability criteria and consultation with stakeholders. Examples are the Roundtable on Sustainable Biofuels (RSB), the Bioenergy Agreement of the International Energy Agency and the FAO/Global Bioenergy Partnership (GBEP).[55] The Roundtable on Sustainable Biofuels (RSB) is an international initiative bringing together the companies and organizations concerned with sustainable biofuel production. It has formulated principles for sustainable production and is in the process of formulating criteria.[56] Besides, the Roundtable on Sustainable Palm Oil (RSPO) is an association of companies, governments, NGO's and other players in the palm oil market. The RSPO set up a certification scheme for the supply chain from the producer to the end product. It does not include biodiesel. Another example is the Better Sugarcane Initiative (BSI). The mission of BSI is to promote measurable improvements in the key environmental and social impacts of sugarcane production and processing. Members are companies, NGO's and research institutes. BSI aims to stimulate the adoption of verifiable performance-based measures with the aim to maintain or enhance the economic position of the farmers. It is no certification system but rather a forum for voluntary commitment to corporate responsibility.[57]

The European Commission presented in January 2008 a proposal for a new directive on climate change and renewable energy. The proposal states that biofuels must be produced sustainably, but formulates few criteria. The conditions stipulated are a minimum level of 35% of greenhouse gas saving, and a ban on the conversion of areas with a high carbon stock or a high biodiversity value.[58] Several countries and organizations take the lead in concretizing the initiatives in sustainability criteria with the goal of creating a labelling scheme such as the Netherlands, the United Kingdom (UK), the World Wildlife Fund and the Energy Centre of the *École Polytechnique Fedérale de Lausanne* (EPFL), which also is the founder of the RSB. The testing framework of the Netherlands is very similar to the framework used in the UK because of close collaboration. The framework proposes a general type of certification system for biofuels but its implementation is dependent on other organizations and countries.

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[53] Ibidem.

[54] Waldyr Luiz Ribeiro Gallo, 'Perspectivas para el biodiesel en Centroamérica. Costa Rica, El Salvador, Guatemala y Honduras', United Nations Economic Commission for Latin America and the Caribbean (CEPAL), 07-08-'07, 20.

[55] See annex 5 for an overview of other certification initiatives.

[56] 'The Roundtable on Sustainable Biofuels. Ensuring biofuels deliver on their promise of sustainability', <http://cgse.epfl.ch/page65660-en.html>, 12-06-'08.

[57] 'Better Sugarcane Initiative', <http://bettersugarcane.org/index.htm>, 05-06-'08.

[58] 'Document accompanying the Package of Implementation measures for the EU's objectives on climate change and renewable energy for 2020', Commission Staff Working Document, Impact Assessment, Commission of the European Communities, Brussels 23-01-'08, 13.

In Nicaragua various institutes are active in supporting producers to be able to comply with international product requirements, like the Chamber of Industries of Nicaragua (CABIN), the Association of Producers and Exporters of Nicaragua (APEN) and the Centre for the Promotion of Exports in Nicaragua (CEI). Others, such as the Centre for Cleaner Production (CPML), help enterprises to improve their production processes. There are no organizations that supply certificates in the country.

2.2 The value chains of ethanol and biodiesel

The value chain of ethanol from sugarcane

The value chain of ethanol from sugarcane starts with the production of the prime material. The cane is harvested and transported to a factory. There the stalk of the sugarcane is grinded, whereby juice is produced. From the best quality juice both sugar and ethanol can be made, therefore the company has to choose which product it will make. If it chooses to produce ethanol, the sugar is fermented and distilled. The product of these processes is hydrated ethanol. To use the ethanol as a fuel, the hydrated ethanol must be dehydrated. The dehydration of ethanol is an extensive transformation process that requires large investments in the processing plant. The technology for the production of ethanol is far more complex than the production of biodiesel due to the distillation process to reach 96% alcohol in the ethanol.[59] The dehydrated ethanol is ready to be used in a blend with gasoline until a maximum of 25% for normal car engines.

After this the ethanol has to be transported to the buyer. If it is exported, it has to be transported to a harbour. This can be done either with a pipeline or by road. A pipeline in Nicaragua does not exist. If it is sold for the national market, the probable buyer will be an oil-refinery or a petroleum-company that will blend the ethanol with gasoline.

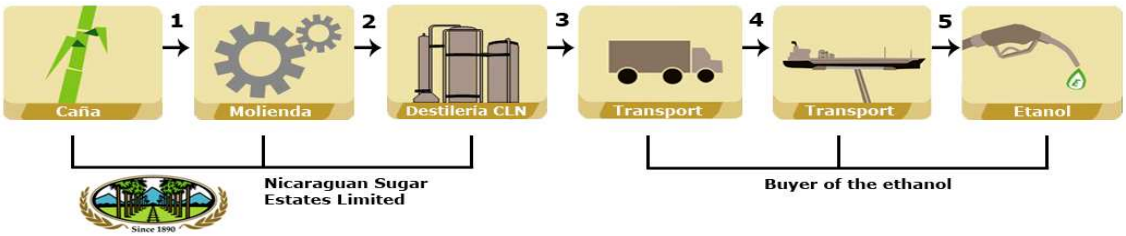

Figure 5. Value chain of ethanol from sugarcane. Source: own design based on presentation Nicaraguan Sugar Estates Limited and Compañía Licorera de Nicaragua, S.A, 08-'07.

To safeguard the yields of the processing plant the company needs to secure the delivery of the prime material, the sugarcane. Therefore backwards integration in the value chain is needed. Equally it will be important for the company to safeguard the selling of the product, which can imply forward integration within the value chain.[60] This integration of the value chain to safeguard the profitability of the expensive plant is also the case in Nicaragua.

In Nicaragua only one company is producing ethanol as a biofuel, NSEL. This is a large company that owns the entire value chain from the production of the prime product until the production and sale of the ethanol (number 1 until 4 in figure 5). NSEL sells its ethanol on an FOB-Corinto basis. This means that the buyers are responsible of transporting the product from the harbour in Corinto, Nicaragua to the end-user in Europe. The transportation typically involves a vessel from Corinto to a port in Europe (Rotterdam and/or other ports in Europe). The ethanol is unloaded in these European ports and temporarily stored in storage tanks to be further transported via land to other European cities. The buyers include major international trading houses in the sugar and ethanol business. 100% of the fuel ethanol produced is exported, because the selling can not be commercialized in Nicaragua. Empirical experiences in other countries demonstrated the need for

[59] Interview sr. Zamora, Laboratorio Biomasa, UNI, 23-04-'08.
[60] 'Cadena agroindustrial de etanol. Análisis de estudios de cadena etanol', IICA, MAGFOR and JICA, 2004, 6.

government policy to develop this market.[61] A regulatory framework must be implemented which stimulates the use of biofuels, for example to obligate oil companies to blend fossil fuels with biofuels.

NSEL is no member of the Better Sugarcane Initiative, but as a large company has the financial ability to become one. It fulfils the product requirements of ISO 9001. Ingenio San Antonio has a positive energy balance, it produces more energy than it needs and this is sold to the national grid. NSEL has, as part of the Pellas Group, a vision of Social Corporate Responsibility. It's supports health, education, sports and cultural activities for its employees and families. Part of its environmental program is a reforestation project. However, recently a shocking complaint was issued by community members from León and Chinandega and former employees of NSEL against the International Finance Cooperation (IFC).[62] IFC approved a US$ 55 million loan to NSEL to finance the expansion of the production and processing capabilities of sugar production NSEL and is accused of the failure to comply with its social and environmental sustainability policies. The complainants seek redress for injuries to their health, environment, and livelihoods resulting from operations of NSEL. A selection of the most shocking accusations:

- NSEL used chemicals and pesticides that contaminated drinking water wells and possibly caused a epidemic of a kidney disease under sugarcane field workers;
- NSEL caused air pollution and respiratory illnesses through the burning of the sugarcane prior to the harvest;
- NSEL retaliated against workers who tried to establish a independent workers union and harassed people who raised concerns about their activities;
- NSEL depleted groundwater as a result of the irrigation of sugarcane fields;
- NSEL employed children, aged 15 of younger, in dangerous work on the fields where they were exposed to intense heat and pesticides.

At the moment of writing the CAO Ombudsman of the IFC is assessing the complaint and will begin working with the various parties to discuss options for a resolution. Further research to the connection of the environmental and health problems to the activities of NSEL will be needed.

Another possible threat is that the sugar harvest will be largely or completely devoted to the production of ethanol when the price of ethanol rises. The consequence will be a rise in the price of sugar. If the production of ethanol will be most rentable, the producers can decide to expand their sugarcane plantations at the expense of land for food production. Nevertheless the Ministry of Energy and Mines (MEM) thinks the expansion of the production of ethanol will not compete with food production.[63]

Implications for employment, SME's and export opportunities:

Because the value chain of ethanol is owned by one large company, there is no involvement of small and medium enterprises. Moreover, the sugar production is completely in the hands of the four big companies. Because of this there are no chances for small and medium producers to enter the market, not even in the production phase. Because of the large barriers to entry, due to high investment costs, it is not likely that they could play a role in the value chain in the future. Therefore the Value Chain Approach can not be employed to improve the position of the poor in the value chain of ethanol, because they are not involved. Moreover, because the value chain only includes large companies and is already completely developed, there is no need for involvement of third parties which try to improve it by means of the Value Chain Approach.

This does not mean that ethanol production has no potential to reduce poverty in Nicaragua. The production of fuel ethanol does have potential to attract further private investments, examples of which are the plans of other sugar producers to build a plant to produce ethanol. Moreover, taking in consideration the expected increase in worldwide biofuel demand, the growth potential of the sector is

[61] For example experiences in Brasil, Colombia and the USA. Source: 'Cadena Agroindustrial de Etanol', 10-12.
[62] 'People of León and Chinandega's complaint regarding the operations of Nicaragua Sugar Estates Limited S.A. International Finance Corporation Project 253311', submitted to the Office of the Compliance Advisor Ombudsman of the International Finance Corporation, 31-03-'08.
[63] 'Potencial y perspectivas de los biocombustibles en Nicaragua', Ministerio de Energía y Minas, 11-'07.

large, which would create employment. At the moment NSEL has 5,000 employees. Moreover, 100% of the ethanol produced in NSEL is exported. In this way it has a positive influence on the trade balance and income is generated for the country. The production of ethanol from sugarcane is internationally very competitive in comparison with the production of ethanol from maize and other biofuels like biodiesel. Additionally, when the government establishes a regulatory framework which stimulates the national consumption of biofuels, the ethanol will also be sold to the national market. In this manner is has the potential to decrease the dependence on petroleum.

The value chain of biodiesel from African palm

The cultivation of the palm is the first step in the value chain. After this the fruits have to be harvested and transported to a processing plant where the oil from is extracted from the nut. The technological process of extracting the oil consists of three steps. In the first step the dirt is separated from the fruit bunch. The next step is sterilization to inactivate certain enzymes which reduce the quality of the oil. The final step is the extraction of oil in which the crude oil is separated from the fibrous-like material in the nuts. The crude oil is then pumped into the purification section.[64] The plant can have the technology to produce biodiesel as well, if not, the oil must be transported to a biodiesel factory. To produce biodiesel a process called transesterification is applied to the refined oil, which consists of the reaction from the palm oil with methanol which generates biodiesel and glycerine.[65] The biodiesel can be sold to the national market, that is an oil company to blend it with fossil diesel, or it can be exported. Therefore it has to be transported to a harbour.

In Nicaragua at this moment there are two large companies active in the cultivation of African palm, namely PALCASA and Cukra Development Corporation. Besides, a cooperative of small farmers is growing African palm, COMEPA. This cooperative has 43 farmer families as members, and exists of 129 farmers (sons and daughters which have there own production). PALCASA and Cukra Development Corporation own a factory to produce oil from the fruits. The cooperative COMEPA does not own a plant to produce the oil, but has plans to build one in the following two years. COMEPA is looking for sources of finance, nationally and internationally. At this moment the members of the cooperative transport the harvest to the factory of PALCASA which processes the fresh fruits.[66]

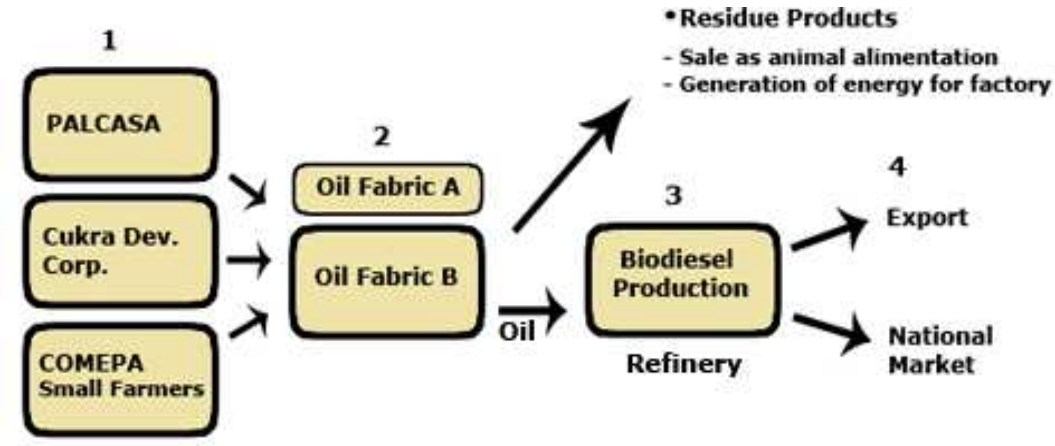

Figure 6. Value chain of biodiesel from African palm. Source: own design.

None of the companies have the capacity to produce biodiesel. Nowadays the high prices of palm oil in the export markets hinder the production of biodiesel from palm oil, since 75-85% of the production

[64] Rena Peréz, 'Feeding pigs in the tropics', FAO Animal production and health paper 132, Rome 1997 <http://www.fao.org/docrep/003/w3647e/W3647E04.htm>, 28-04-2008.
[65] 'Diagnóstico Agro Socioeconómico del Municipio El Tortuguero', 61.
[66] Interview with Juan Zeas, president of COMEPA, 16-05-'08.

costs of biodiesel are costs of the prime material.[67] But the rising petroleum prices are an incentive to invest in biofuel production. It is likely that when the companies decide to build a biodiesel plant the biodiesel will be exported. This is because of the same problem with ethanol: nationally it can not be commercialized and sold because of the lack of a regulatory framework.[68]

Besides legislation, infrastructure is needed for the development of African palm production in the RAAN and RAAS region. A major part of these autonomous areas are disconnected to the rest of the country because there is no electricity and there are very bad or no roads. The construction of this infrastructure is the basic necessity for the development of the region. The problems with land property rights need to be solved as well (see chapter 1).

Although no official data exist, the cultivation of African palm is accused of having many negative environmental and social effects in the region Río San Juan. The Fundación del Río, an NGO which works in this region, points to the negative effects of the cultivation of African palm in the area. According to them, valuable woods are being chopped for the construction of palm plantations. Besides, (illegal) toxic pesticides are used which are very harmful for the health of the workers on the plantations and the neighbouring peoples. The workers have no protective cloths and according to eye-witnesses are 'high' of the pesticides. The pesticides contaminate the soil. Moreover, irrigation systems are built to water the palms which affect the water supply of the surrounding villages. A further negative effect of the palm plantations is the fact that the plantation owners buy out small farmers, which will therefore have no chances to cultivate their own land but are obliged to work on the plantations. Small children are said to work on the plantations. The owners of the plantations pay their employees bad and do not help with the development of the local economy. If these accusations are true, the cultivation of African palm has many negative effects on biodiversity, the ecosystem and the living conditions of the inhabitants of the region.

The producers of African palm in Nicaragua are not part of the Roundtable on Sustainable Palm Oil. In view of the environmental and social risks connected to palm plantations the producers should be stimulated to become part of the RSPO and the certification scheme. To comply with the certification requirements the companies (especially the small farmers) will need training and probably financial support for the administrative tasks.

Implications for employment, SME's and export opportunities:

The possibilities for small producers in the production of African palm are larger than in the production of ethanol from sugarcane, where the chances are practically zero. However, there are a number of problems with the involvement of small producers in the cultivation of African palm. First, it requires large investments, especially in the first year. Moreover, he technological process is relatively complex and therefore expensive. The investment needed to build a plant to process the harvest of 10.000 hectares of African palm would be about $US 300.000. The costs to produce African palm for 25 years for one hectare are almost $US 14,000 from which $US 3,000 are spent in the first five years.[69] Small farmers have to be financially supported, or the consequence will be that only large companies will be involved in the growth of African palm.[70]

Second, small producers have to be united to be able to buy a factory which can produce the oil, because large investments are needed. Often these projects fail because of organizational problems, for example the African palm project in 1982 in the municipality of El Castillo. If the small producers are not able to collectively buy a plant they will have to sell their products to a factory owned by a large company. This company is likely to have a monopsony position and therefore can establish the selling price of the prime material. As a consequence the small farmers will receive a low price for their harvest. Third, it is possible that the construction of large plantations and fabrics will cause the expulsion of small farmers which produce with traditional means of production. Driven by efficiency needs, the company which owns the plant will try to buy up the lands of the small farmers.

So if the cultivation of African palm in the future will be increased through the involvement of small farmers, precautionary measures should be taken to safeguard their position in the value chain.

[67] Ribeiro Gallo, 'Perspectivas para el biodiesel en Centroamérica, 67.
[68] Interview Sr. Saénz, IICA, 06-05-'08.
[69] See Annex 1.
[70] Interview sr. Baldizón, Austrian Development Cooperation, 28-04-'08.

The IICA and the Japan International Cooperation Agency (JICA) investigated the suitability of the municipality El Tortuguero in the RAAS region for the cultivation of African palm. In the report the IICA formulated an intervention model which would have to solve abovementioned problem. The first requirement to safeguard the position of small producers in the value chain is an inclusive agricultural model which focuses on the small and medium agricultural producers. Large enterprises are the key to this inclusive model, for they have the technology and financial and organizational capacity to involve small and medium producers. They will buy products from the small producers for a fair price, and support them with technical assistance, training etc. In addition, an action plan must be formulated which generates a better quality of life in the short term for the beneficiaries. A long term project, like the cultivation of African palm, carries the risk of being financial unsustainable for small producers because the first few years the plants can not yet be harvested. In other experiences this led to the selling of the plantations of the small farmers. To solve this problem complementary income must be sought from the initiation of the project, for example the production of cassava, beans or maize. The producers will have to receive help with the production and commercialization, because in the RAAN and RAAS regions many farmers have little experience with the cultivation of these crops.[71] The government is needed in this model because they have to provide a legal framework with clear rules and incentives (for example fiscal) which stimulate the grand enterprises.

The possibilities for export of the biodiesel are unclear. An UNCTAD study to the prospects for a biofuel industry in Guatemala considers the large-scale utilization of palm oil for the production of biodiesel unlikely because of the high palm oil prices.[72] Besides, a recent project of the government of Honduras to expand the production and consumption of biodiesel from African palm is threatened because of the high international palm oil prices. This is an important consideration if one decides to stimulate the production of biodiesel from African palm. If the prices of palm oil remain high, instead of producing biodiesel the vegetable oil will be exported. The biodiesel plant will be unused and the value added from the biodiesel production is lost. However, the federation of palm producers in Honduras says the production of biodiesel is competitive when the price of fossil oil is above $US 60 per barrel.[73] With the high oil prices in 2008 the production should be very profitable. Further research on the production costs in Nicaragua is needed.

The cultivation of African palm is an opportunity for the creation of employment, considering the huge amount of suitable lands available. IICA calculated that the cultivation of 200,000 ha of African palm, 30,000 ha of sugarcane, 20,000 ha of tempate and 60,000 ha of cassava will create 165,000 jobs. The investments needed from the government will be US$ 25 million, while the needed private investments will be US$ 917 million.[74] So if the production of biofuels is stimulated on a large scale, this will create employment and attract investments. But legislation is needed to safeguard the health and social rights of the workers.

The value chain of biodiesel from tempate

At this moment no commercial production of tempate in Nicaragua exists. Therefore, a sketch of the value chain is based on past experiences. The first step in the chain is the production of the fruits from tempate. The fruits have to be harvested by hand, therefore the major part of production costs is labour. Economies of scale are not possible and therefore the cultivation of tempate is most suitable for small-scale projects. The second step is the transportation to a plant where the seed has to be peeled and pressed to produce the oil and the seedcake. The seedcake needs to be detoxicated to be able to be used as animal feed. The oil is filtered and sent to a chemical process which converses the oil into biodiesel.[75] This production process of biodiesel from tempate is relatively simple and therefore the factory relatively cheap. A small industrial plant costs about $US 30,000. The cultivation of one hectare tempate for 25 years costs $US 6,000.[76] Therefore the chances for small and medium

[71] 'Diagnóstico Agro Socioeconómico del Municipio El Tortuguero', IICA and JICA, 02-2007, 66.
[72] 'Prospects for a biofuels industry in Guatemala', UNCTAD, 26-10-'07, 15.
[73] Ribeiro Gallo, 'Perspectivas para el biodiesel en Centroamérica, 152-154.
[74] Interview sr. Sáenz, IICA, 06-05-'08.
[75] Eduardo J. Zamora, 'Biocombustibles', Laboratorio Biomasa UNI, 02-'08.
[76] Interview met sr. Sáenz, IICA, 06-05-'08; see annex 1.

producers to be involved in a larger part of the value chain (not just production of the prime material) are greater than with African palm. There already exists a plant for the production of oil and biodiesel from tempate, the fabric built for the Austrian project in León. This fabric is owned by the state-owned enterprise Nicaraguan Basic Food Company (ENABAS). At the moment it not used. During the tempate-project it successfully produced oil and seedcake from tempate, however, no biodiesel was produced due to the low international oil prices in the 1990's.

If the small farmers collectively own a factory to produce biodiesel, they have three selling options. One, the biodiesel can be used for self-consumption in vehicles or in a generator to produce electricity. Two, when a regulatory framework is established it can be sold nationally to oil companies which blend it with fossil fuels. Three, it can be exported. This means that the oil has to be transported to a harbour for which infrastructure is needed. It also implies that the biodiesel must satisfy the quality and product requirements of the export market which can be quite complex. Because tempate is less suited to large-scale biodiesel production self-consumption and sale for the local market will be the most obvious options.

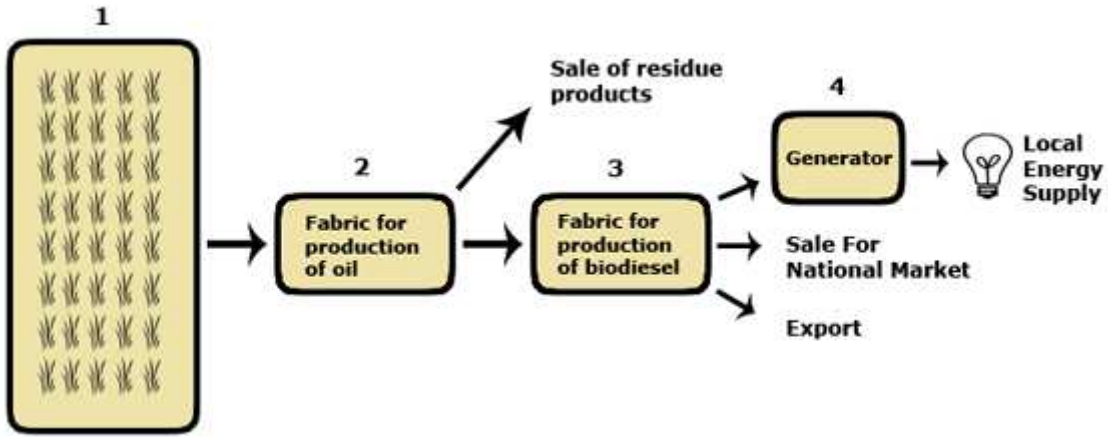

Figure 7. Value chain of biodiesel from tempate. Source: own design.

Implications for employment, SME's and export opportunities:

Because 740 thousand hectares are suited to grow tempate in Nicaragua, the potential for the creation of employment is great. The growth of tempate will create opportunities for small farmers to earn additional income because the residual products are commercially viable, and the technology to produce biodiesel from tempate is relatively simple. Because the cultivation can be combined with the other crops it will not endanger food production.[77] However, only when it is safeguarded that tempate will be cultivated on poor grounds, it will not compete with the production of food. Because tempate is more productive on moist, fertile agricultural or forest soils farmers will prefer to grow it on better lands if the cultivation is economically attractive.[78]

An advantage of small-scale production is that farmers can use the biodiesel to generate electricity. This is important in Nicaragua because only 55% of the country (and 30% of the rural areas) is connected to the electricity grid.[79] So tempate has many advantages to be produced by small farmers. But the lesson learned from the Austrian project is that small producers should be treated as private economic actors. This implies in the first place that in future projects farmers should be chosen on productive culture, and not just their political or social position. In this way the market system is able to work. Second, the prices they receive should be fair but economically determined. Farmers have to be stimulated to reach high yields. A possible stimulation for the small farmers is to be the co-

[77] 'Evaluación 1999 del Proyecto Tempate', 20; Interview sr. Sáenz, IICA, 06-05-'08.
[78] The yield per hectare of tempate is 1.2-2.77 ton/hectare without irrigation during initial years of development compared to 5.25-12.5 ton/hectares on high quality land with irrigation. Source: Andrea Rossi and Yianna Lambrou, 'Gender and equity issues in liquid biofuels production. Minimizing the risks to maximize the opportunities', FAO, Rome 2008, 22.
[79] Mostert, 'Nicaragua. Unlocking potential, reducing risk', xv.

owner of a processing plant. Another necessity to stimulate the involvement of small producers in the cultivation of tempate is training because most farmers in Nicaragua have no experience with the production of tempate. Besides training about the cultivation of tempate, the farmers also have to be stimulated to grow other crops simultaneously. This will make them financially less vulnerable and safeguard the food production. To stimulate production of biodiesel for national or international markets the producers will need assistance to require knowledge about quality norms, export opportunities, certification, etc.

2.3 Necessities for an environmental sustainable development

The above made clear that the first and most important requirement to stimulate the development of a biofuel industry in Nicaragua a national regulative framework is to create a national market. The biofuel that is actually produced in Nicaragua, ethanol from sugarcane, is 100% exported because there exists no national market. From other parts of the world the lesson can be learned that to stimulate the consumption and investments in biofuels a national energy strategy must be implemented. This can be laws with the obligation to blend petroleum with a certain percentage of biofuels, subsidies, a framework of incentives, research to alternative energy sources, etc. If no national market exists the advantage of using biofuels as a substitute for petroleum to decrease the dependence on foreign energy sources will not apply.

In addition to a national energy strategy, the problems with *tenencia de la tierra*, land property rights, must be solved. If it is unclear who owns a certain piece of land, or if there are multiple owners of one piece of land, this will inevitable lead to conflicts when the land is cultivated. The problem with land rights in Nicaragua must be solved to attract investors and to protect the lands of small farmers. Besides, to stimulate research activities intellectual property rights and patents have to be safeguarded. The communication structure between governments, universities, companies and other institutions must be improved and coordinated on a national level. At this moment there is a lack of a network of specialists in biofuels in Nicaragua. Specialists in the field should be trained and an information network maintained.

The second step is to safeguard the environmental sustainability of the development of the biofuel industry in Nicaragua. There are numerous possibilities for an environmentally and socially friendly production of crops for the production of biofuels in Nicaragua because of the availability of deforested lands on which food crops can not grow, but some biofuels crops do. However, this does not ensure that the energetic crops will only be cultivated in these areas and will be produced in a sustainable way. Very concerning in this respect are the accusations made against the producer of ethanol from sugarcane in Nicaragua, NSEL, and against owners of African palm plantations in Río San Juan. The suspected negative environmental and social effects through the use of (illegal) pesticides and fertilizers, the employment of children and the chopping of woods for the construction of plantations can not be tolerated. In this area laws and regulations do exist; the problem is that they are not enforced.

Small-scale production of biofuels, for example from tempate, carries less environmental and social risks. The farmers can produce the fruit, oil and possibly the biodiesel by themselves, because small-scale plants are economically viable. In this way they are not dependent on a large enterprise. Another advantage is that the production of oil and biodiesel can be used for self-consumption to produce electricity and therefore will improve the access to electricity. A disadvantage from the small-scale production of biodiesel is that the production costs are high and it is therefore not certain that it can compete with international prices. Another disadvantage of the production of biodiesel in small-scale fabrics is that they have the tendency of not investing in quality control measures to the same degree as larger plants. Therefore the chances of the production of an inferior product are larger and this can create engine problems for the consumer.[80]

The problems with land use which are encountered in other parts of the world with the production of biofuels, namely the chopping of forests to plant energetic crops, or the use of lands

[80] 'Issue paper on biofuels in Latin-America and the Caribbean', 20-21.

where formerly food was produced, must be avoided.[81] Therefore laws are needed to prohibit the chopping of forests for the production of biofuels. The advantage of Nicaragua is that is has an enormous amount of land which is already deforested. But it is not investigated yet whether the soils in these areas store greenhouse gases which will be released if they will be cultivated. Research is needed. It should be a priority of the government to make sure only lands which are already deforested and do not store a large amount of greenhouse gases are going to be used. The enforcement mechanisms have to be improved.

Moreover, it must be avoided that farmers switch the use of land on which they formerly grew food to produce crops for biofuels. If biofuels are going to be the most rentable crop in the future, lands will be used to grow these crops instead of food and the food prices will rise. However according to classic economic theory this problem solves itself: if food prices rise, it will be more attractive to produce food and so the lands will be re-devoted to the production of food crops. But the poorest will suffer most from the rise in food prices.

In conclusion, in order to ensure the environmental sustainability of the development of biofuel production in Nicaragua detailed legislation is needed. Alongside legislation, a certification system is a method to safeguard the sustainability of the value chain of the production of a biofuel. Nicaragua could join international initiatives for the sustainable development of a biofuel industry and learn from their experiences. However, no international certification label for biofuels exists yet.

[81] See for example: 'Losing ground. The human rights impacts of oil palm plantation expansion in Indonesia', Friends of the Earth, LifeMosaic and Sawit Watch, 02-'08.

Chapter 3 – Actors

In this chapter the various actors involved in biofuels in Nicaragua will be treated. The focus will be on government legislation and policy. Hereafter a survey is made of which embassies, development organizations, non-governmental organizations and companies are working with the value chains approach or in biofuels.

3.1 Government

Regulatory framework

The ministry in charge of matters concerning energy, and more specifically of biofuels, is the Ministry of Energy and Mines (*Ministerio de Energía y Minas*, MEM). With the change of the government in 2007, MEM replaced the National Energy Commission (CNE). The regulatory framework concerning biofuels is still in the initial stage.

The relevant law is approved in 2005, under the presidency of Enrique Bolaños. It is the law for the promotion of electricity generation with renewable sources (*Ley para la promoción de generación eléctrica con fuentes renovables*[82]) which includes electricity from hydropower, wind, geothermal, solar and biomass sources to produce energy in a sustainable way. The definition of biomass is broad and includes residuals from agriculture, forestry and industry, energetic crops, municipal waste and biogas produced from these sources. In the law the development and utilization of the renewable energy sources is declared a national interest. A set of fiscal incentives to stimulate investment in electricity generation from renewable sources was founded. These include the exemption of VAT taxes on the import of machines and equipment, the exemption for seven years of income taxes beginning with the start of the project, the partial exemption of municipal taxes for ten years over sales and assets, and the five-year exemption of taxes over natural resources. Moreover it is determined that the contracts for the sale of the energy should have a minimum period of ten years. Additional relevant legislation for the stimulation of investment is the *Ley de inversiones extranjeras*.[83] This law permits the repatriation of investments until three years after the investment is fulfilled, the total repatriation of returns, and in the case of confiscation a 'quick and adequate compensation'.

There are two relevant laws for the protection of the environment. Law no. 217 establishes the obligation to obtain an environmental permit for every activity that can have an impact on the environment.[84] And the law for the municipalities assigns power to local authorities to regulate the use of lands and to designate projects which involve the use of natural resources.[85] Under the presidency of Enrique Bolaños a Presidential Decree was issued which treated biofuels specifically.[86] This Decree declared the production of biofuels and bioenergy a national strategic interest and the instructed the Ministry of Agriculture and Forestry to formulate a National Biofuels and Bioenergy Program which had to focus on the stimulation of private investment. However, with the alteration in government in 2007, the Presidential Decree has little lasting value. Under the presidency of Daniel Ortega, the MEM was created, the CNE disappeared, and this new Ministry is responsible for the formulation of policy. In the new development plan of the government, Plan Nacional de Desarrollo Humano 2008-2012, a paragraph is devoted to energy. Herein it is stated that the government wants to impulse the development of biofuels in Nicaragua by way of ethanol from the sugar fabrics and the production of African palm in the RAAS region. The MEM is responsible for the formulation of a policy for biofuels that will be used for the elaboration of a law proposal to regulate biofuels in Nicaragua.

[82] LEY No. 532, Ley para la promoción de generación eléctrica con fuentes renovables, Asamblea Nacional de la República de Nicaragua, 2005.
[83] LEY No. 127, Ley de inversiones extranjeras, Asamblea Nacional de la República de Nicaragua, 1991.
[84] LEY No. 217, Ley general del medio ambiente y los recursos naturales, Asamblea Nacional de la República de Nicaragua, 1996.
[85] LEY No. 261, Ley de municipalidades, Asamblea Nacional de la República de Nicaragua, 1997.
[86] Decreto No. 42-2006, Presidencia de la República, Enrique Bolaños Geyer, 2006

Future Nicaraguan biofuel policy

Nicaragua is part of the Mesoamerican Biofuels Group from which 10 states are member. The goal of the Group is the interchange of experiences, the facilitation of decision-making and the promotion of regional initiatives in the field of biofuels.[87] Moreover, Nicaragua signed a regional treaty for the use of biofuels, the '*Estrategia Energética Sustentable para el año 2020*', which the Ministers of Energy of the Central American countries signed in November 2007. The goal is to reduce in 2020 the consumption of derivatives of petroleum in public and private transport with 15% by means of the incorporation of 10% bio-ethanol and 5% biodiesel. To realize this goal laws and instruments have to be created.

In the past year the MEM did formulate a policy concerning biofuels, the *Política Nacional de Agro Energía y Biocombustibles* (PNAB).[88] However, this policy yet has to be approved by the president and after that it can be send to the National Assembly. The goal of this policy is to promote a sustainable way of developing infrastructure to promote biofuels, by way of the formulation of legal instruments which takes into account the conservation of the environment. Additionally, the policy includes a social component to safeguard the production of the prime material in a socially inclusive way. This means the generation of alternatives, opportunities and income for the poorest segments of the rural areas, especially in the Atlantic Region of Nicaragua.

One of the goals of the PNAB is to stimulate the cultivation of agro-industrial crops that do not endanger the quality and costs of basic food crops. Therefore the plan stresses the need to diversify both the sources of energy and the amount of crops produced in the country. The PNAB wants to develop the production of ethanol from sugarcane and cassava, and the production of biodiesel from African palm, tempate, and possibly other crops that do not compromise national food safety. Although sugarcane and cassava are food crops, the policy states these crops will not interfere with the food production.

The PNAB states a broad strategy is needed to develop the field because the biofuel industry is still in its infancy in Nicaragua. Therefore agricultural research should be stimulated, investment promoted, the organization of value chains supported through the provision of seeds and machines, and cooperation contracts between interest groups and investors promoted. Besides the juridical framework, fiscal incentives must be developed to stimulate investments in plantations for the production of biofuels, herein prioritizing small and medium producers, cooperatives and agricultural companies.

The policy includes the creation of a fund to channel government funds for the development of biofuels, to promote an information and training program, to create incentives for investment and for national consumption of biofuels. The national demand will be stimulated through a partial exemption of fuel taxes for biofuels and the total exemption of import taxes for cars equipped with technologies that can use biofuels. Also a national action plan is formulated for the following five years to coordinate the generation of knowledge about biofuels between the various institutions and organizations in the country.

A positive aspect of the PNAB is that it takes into account many different facets of the development of biofuels in Nicaragua: social, environmental, fiscal, economic and agricultural. This means that the Ministry, with the formulation of an inclusive policy, tries to prevent beforehand as many problems as possible which could arise with the development of the field. However, because the number of themes in the policy is large, this is at the expense of the depth of the matter. All the plans set out in the policy are formulated without a blueprint or a strategy. Except for the regional target to use 10% of bio-ethanol and 5% of biodiesel in 2020, no aims are established. There is no scheme for the realization of the policy. Furthermore, one of the largest impediments for agricultural development in Nicaragua, the problem with land property rights, is not touched upon. While land property rights are the responsibility of the Ministry of Agriculture and Forestry (MAGFOR), the problem should at least be acknowledged in the policy. Moreover, because MAGFOR is part of the inter-institutional commission that formulated the policy the problem should be incorporated in the policy.

[87] Nancy Jesurun-Clements, 'Iniciativas del BID para apoyar Programas de Biocombustibles', IDB, 17-10-'07, <http://www.ceda.org.ec/descargas/ForoBio/4%20PANEL/Nancy%20Jesurun%20Clements.pdf>.
[88] 'Política Nacional de Agro Energía y Biocombustibles', 11.

Another aspect of the policy is the protection of the environment. That biofuels should not be developed at the expense of the environment but in harmony with it, is stressed in the policy statement. It is established in PNAB that forests older then five year, natural and artificial, should not be chopped for agro-energetic crops. While the policy does mention the large amount of deforested lands suited for the use for biofuels, it does not state how it will safeguarded that only these lands will be used for the growth of energetic crops. Moreover, the problem that greenhouse gases which are stored in the soil in these areas will be released if the lands are cultivated is not touched upon. These matters will be a requisite to protect the environment, food production and energy balance of biofuel production. Besides, both sugarcane and cassava are considered suitable for the production of ethanol, while both are food crops and the production of ethanol from it will raise the prices of sugar and *yuca*, the edible root of the cassava. The reason for the inclusion of these crops in the policy is that sugar and cassava are not basic foods and it is therefore believed that they will not affect the food security in Nicaragua.[89]

Summarizing, it may be stated that the PNAB has the potential of being an inclusive policy which treats the environmental, social, fiscal, economic and agricultural aspects of the development of biofuels in Nicaragua. However, it does not include explicit goals, strategies and instruments. Moreover, experts in the field do not believe the PNAB will be approved to become a law in the short term. The development of the field of biofuels is no priority because the Ministry of Energy and Mines is focusing on other types of renewable sources of energy, like hydro- and geothermal energy. The MEM expects that the time needed from the moment the bill is introduced in the National Assembly until the actual biofuel can be produced in Nicaragua, will be approximately seven years. So when the bill is brought in at the end of this year, 2008, the first production will be in 2015. But the chances that the bill will be introduced in the National Assembly this year are small because of other priorities of the government.

The priority of the government in agriculture is food safety. The government was host to a regional summit of the Ministers of Agriculture in April 2008 where it was declared that the use of basic grains to produce biofuels interfered with the availability of food for the peoples of Central America. Two weeks later President Ortega was host to a presidential summit about alimentary safety. One of the reasons given for the alimentary crisis was the production of biofuels in developed countries from food crops, and the attendant heads of state declared that the use of agricultural products should be prioritized to the obtaining of food instead of fuel. Governmental funds will be destined to stimulate the production of food, especially basic grains. President Ortega expressed himself critically about the use of basic food products for the production of fuels, which can be explained through his alliance with the Venezuelan President Hugo Chávez. As the region's biggest oil exporter the development of a biofuel industry is against the interest of Venezuela.[90]

This focus of the government of Nicaragua was also clear during the presentation of their agricultural action plan 2008-2009 about the 'safety and sovereignty of food'.[91] In the following two years the amount of production and the productivity of basic grains like beans, maize, sorghum and rice will be increased. Unused lands will be destined to the production of these food crops and a priority of the government is obtaining the financial means necessary to realize these plans. Keeping the abovementioned in mind, the government will more likely devote it financial resources to the expansion of the production of basic grains than to the development of areas for biofuel production.

3.2 The donor community in Nicaragua

In this paragraph a survey will be given of the activities of various donors in Nicaragua in the area of renewable energy sources and more specifically biofuels. This overview is not comprehensive; it is based on visits I made.

[89] Interview sr. Sánchez, Director General de Políticas y Planificación, MEM, 16-05-'08.
[90] 'Biofuels divide Latin American leaders', *The Nica Times*, 16-05-'08, 1, 4.
[91] 'Plan de Acción ciclo agrícola 2008-2009 para la seguridad y soberanía alimentaria', Gobierno de Reconciliación y Unidad Nacional, 15-05-'08.

USAID

The development organization of the United States is focussing on their PROCAFTA program which includes supporting the Nicaraguan government with the implementation of this free trade agreement. This program will finish at the end of 2008 and at the moment USAID is internally developing a plan for the coming five years. USAID does not work with the value chain approach and neither with biofuels. The organization recognises that the energy sector is the biggest obstacle for development of the private sector in Nicaragua and is therefore working with various ministries on studies on the electricity grid. It financed public-private sector conference in Managua about investment in renewable energy sources. The Millennium Challenge Account does support small farmers to improve their position in the value chain.

European Commission

The European Commission does not have a specific biofuel program in Nicaragua. But is does have multiple general climate change and environmental programs, like the Global Climate Change Alliance and the Global Energy Efficiency and Renewable Energy Fund (GEEREF). In Central America the EC has various programs, for example the EUROSOLAR program which will help indigenous communities to access to solar or wind energy. This program is also active in Nicaragua.

GTZ

The German Development Corporation in Nicaragua is an expert in value chains. It developed a detailed Value Chain Approach. At the moment it is working in the value chains of solar energy, cacao, forestry, and ecotourism. The last area in which GTZ is going to work has yet to be chosen. GTZ analyses value chains and gives technical help. One of the key areas of the German Cooperation in Nicaragua is renewable resources. In this area it supports the government with the development of legislation, for example in the area of land property rights.

Embassy of Denmark

The Danish Embassy in Managua is working with a bottom-up approach to fight against poverty by means of private sector development. Their Business-to-Business program supports long-term cooperation between Nicaraguan and Danish companies from all kinds of sectors, this could also be biofuels. The company will in the last phase receive financing for environmental and CSR measures. Moreover, Denmark has a regional environmental plan; however the program involves no specific action in the production of renewable energy.

DFID

Although the Department for International Development of the United Kingdom is withdrawing from Nicaragua in 2009, it starts a new 4.5 year private sector program. This program PROPEMCE is developed in cooperation with the Embassy of Finland. In this program five value chains will be supported by way of improving the provision of services to small and medium enterprises and regulative environment. The value chains in which PROPEMCE probably will be working are dairy products, cacao, furniture, fisheries and flowers.

Austrian Development Agency

Austria does not work specifically with value chains, but chooses an area and works with the already existing production structures in that area. Austria has the most experience in biofuels in Nicaragua, due to it's tempate project in the 1990's. However, at this moment it does not have a specific biofuels program in Nicaragua. Together with Finland it is working in a regional program, the Energy and Environment Partnership with Central America (EEP), to promote renewable energy sources. It is supporting various biofuel projects in the region, but not in Nicaragua, because there is no demand from farmers or companies in this field.

Inter-American Development Bank (IDB)

The IDB has a regional program called the Sustainable Energy and Climate Change Initiative (SECCI). One pillar of this program is biofuel development. This is a broad program with researching facilities, financial and technical help. However, SECCI is not active in Nicaragua, because there is no demand. If the government of Nicaragua decides to develop biofuels it can apply for help from the SECCI program for viability studies, the development of a regulatory framework and the financing of infrastructure and installations. The IDB is also supporting the Mesoamerican Biofuels Group with logistical help from which ten Central-American and Caribbean countries are members. The group is formed to exchange information and to facilitate regional biofuel initiatives.

JICA

JICA, the technical development agency of Japan, performed a study together with IICA to investigate the possibilities for the cultivation of African palm in the municipality El Tortuguero in the autonomic region RAAS. But because the government and the local authorities are not prioritizing the development of biofuels from African palm, JICA will not act further in this area. JICA also did some research to the actual situation and the demand for energy in Nicaragua in 2007. But it focuses on other areas like rural development and health.

3.3 Non-governmental organizations and research institutes

SNV

The Netherlands Development Organization is a worldwide active NGO that has experience in value chains, gender integration in value chains and inclusive businesses. This year SNV Nicaragua is starting to work in biofuels through inclusive business. Herein they will try to improve the regulatory framework and policy for the biofuel sector, analyse value chains and strengthen linkages between large enterprises and small producers. At the moment SNV is exploring the options in Nicaragua with regard to biofuels. SNV did already research to biofuels in other countries in the region. It signed an agreement with MEM to cooperate with the development of the policy, laws and an action plan for the coming years. It is also working with Jícaro S.A. to search finance to develop fuel-ethanol production facilities.

IICA

The Interamerican Institute for Cooperation on Agriculture has knowledge and expertise about the possibilities for the development of biofuels in Nicaragua. It performed various studies about areas suitable for the production of crops for biofuels, about the inclusion of small producers in the field of biofuels, etc. In collaboration with Petronic it developed a national program for the cultivation of 250,000 ha of biofuel-crops in Nicaragua which will create 165,000 jobs. Petronic is interested in producing biodiesel. This program will be presented to the President of the Republic in the following months. Until that time the content of this study is not made public.

Universidad Nacional de Ingeniera

The Laboratory Biomass of the UNI was counterpart during the tempate-project in the 1990's. It did scientific research to the possibilities to produce biofuels from various crops, about the economic viability, etc. At the moment it is investigating the production of biodiesel from pig grease in combination with the cultivation of marango. The UNI has the technical knowledge about the production of biofuels. The Centre for Cleaner Production of the UNI is helping companies with the improvement of their production processes, to make them more energy-efficient etc. It is also training experts in the field formulated a national strategy for cleaner production.

3.4 Private sector

Interviews were held with most companies active in biofuels in Nicaragua like Nicaraguan Sugar Estates Limited, the producer of ethanol from sugarcane, Jícaro S.A., the company producing ethanol

from jícaro (although no fuel-ethanol) and the cooperative of farmers producing African palm, COMEPA. In the preceding chapters their plans for (further) development of the production of biofuels are spelt out.

Generally, all the companies agree that biofuels can not yet be commercialized in Nicaragua because of the lack of a regulatory framework. There are companies in Nicaragua that produce biodiesel or ethanol on a small scale and use it in their own company, like Agrifuturo in Chinandega. But the sale of biofuels in Nicaragua is not possible for the lack of a regulatory framework. This is also the obstacle for investment. A lot of companies have shown interest in investing in biofuels in Nicaragua, but are waiting for the development of a regulatory framework. Other companies, like Jícaro S.A., want to invest in biofuel facilities but have no financing possibilities.

The most important employers organization in Nicaragua, the *Consejo Superior de la Empresa Privada* (COSEP), agrees that financial incentives are needed to stimulate the production of biofuels and to create a national market. To encourage investments infrastructure must be improved. In collaboration with SNV COSEP is initiating dialogue with government and National Assembly to stimulate public-private partnerships and the adoption of a regulatory framework.

3.5 Possibilities for cooperation

This chapter made clear that the regulatory framework, donor cooperation and development help from NGO's concerning biofuel production are in an initial phase. The Ortega government has indicated in its multi-annual plan that it is interested in developing the production of biofuels. Also a policy is formulated and there are plans to draft a law. However, most experts in the field do not believe the law will be approved in the short term. Although MEM is focusing on renewable energy sources, biofuels are no priority. And because of the focus on food security it is not likely that the government in the short term will put its efforts in biofuels. This implies on the one hand an opportunity for the Dutch Embassy to support the development of a proper regulatory framework which focuses on social and environmental sustainability. On the other hand it implies that projects will probably be less successful as long as no laws exists which regulate the production of biofuels. Besides, the protection of environment and food security can not be safeguarded as long as the law is not approved.

Although Nicaragua has some experience with biofuels, at this moment only a few organizations are investigating the possibilities for development, namely the IICA, SNV and the UNI. SNV has shown interest in cooperating with the Embassy in biofuels. Because SNV will support MEM with the formulation of the law and a strategy, the Embassy could join this effort. Besides, SNV is looking for partners to finance (future) biofuel projects.

None of the donor countries in Nicaragua is working specifically with biofuels. Many of them have renewable energy projects, or regional programs that include biofuels. A number of projects, like the EEP from Austria and Finland and SECCI from the IDB, work with biofuels in other countries in the region, but not in Nicaragua. The involvement of biofuel projects in Nicaragua is possible in the future. If the Embassy wants to support the government with the development of a regulatory framework collaboration with the IDB can be sought which already has a regional program in this area. Other countries are working with various value chains, like Finland, GTZ, and DFID. Although biofuels is not one of their value chains, in a number of cases one or two additional value chains yet have to be chosen. If the Embassy approaches these countries there might be possibilities to work in biofuels. To what extend these opportunities fit within the policy of the Embassy will be considered in the next chapter.

Chapter 4 – Biofuel policy of the Netherlands

4.1 The policy of the Dutch government

The Dutch government is very concerned about the worldwide problem of extreme poverty. A majority of the poorest people in the world live in rural areas and the rising prices of food affect these groups the most. Therefore the development policy of the Netherlands is focusing on rural development, the issue of food security and trade to achieve the first Millennium Development Goal (eradication of extreme poverty and hunger). The core of the growth- and distribution issue is the promotion of inclusive or pro-poor economic growth and the increase of economic participation of the poor.

There are multiple causes of the recent rising food prices. One of them is the growing market for energy crops, due to subsidies of the United States and the blending obligation of the European Union. The European Council has decided that the blending obligation will only hold if the biomass is produced sustainably and cost-effectively. Dutch development policy is focusing on sustainability by means of certification of biomass for energy means.

In the policy document 'Agriculture, rural activity and food safety'[92] of the Dutch Ministry of Foreign Affairs five policy areas for development cooperation in third world countries are formulated: improvement of productivity; enabling environment (the government should develop a conducive regulatory framework); sustainable development of value chains; improvement of market access; and food safety. The most important policy area for this study is the sustainable development of biofuel value chains.

The policy states that the energy security of the Netherlands may not lead to a transfer of the costs to the environment of other countries. Because of this responsibility the government balances the benefits and costs of *People, Planet and Profit* (the 'Triple P'), which means the economic distribution of welfare, ecological sustainability and economic growth. The social and environmental sustainability of the production of biomass is mentioned explicitly and the policy focuses on 'competing claims': the competition between food, fuels, feed for cattle, environment and biodiversity.

Biofuels give developing countries an opportunity to diversify agriculture, export and contribute to the provision of energy. It is important that value is added to the product locally so that not merely primary products will be exported. But because of the possible negative effects of biofuels, assuring the sustainability of the production through certification is the core of the Dutch policy concerning biofuels.

Also the intra-ministerial policy of the Netherlands concerning biomass for energy purposes[93] does focus on sustainability and certification of biomass. In this respect the government signed the 'Agreement of Schokland' in 2007 to commit itself to the sustainability of biomass for energy use. The most important aspect of this agreement is the development of a certification system and a 'clearing house' for sustainable biomass. These will be made operational in 2008/2009. A framework to check the sustainability of biomass production is already developed. The framework distinguishes six relevant themes, linked to the 'Triple P' of sustainable development:[94]

- The emission of greenhouse gasses must be significantly less with the use of biofuels compared to the use of fossil fuels;
- There must be no competition between the production of biomass and food;
- The production of biomass may not affect negatively protected or vulnerable biodiversity;
- The production may not have negative environmental effects, for example through the use of pesticides and chemical fertilizers;
- The production of biomass must contribute to the local welfare;

[92] 'Landbouw, rurale bedrijvigheid en voedselzekerheid', 08-05-'08, notitie Directie DDE, Dutch Ministry of Foreign Affairs.
[93] 'Biomassa voor energiedoeleinden. Plan van Aanpak Biomassa Mondiaal', Ministries of EZ, LNV, VROM, BZ/OS, 10-03-'08.
[94] 'Toetsingskader voor duurzame biomassa. Eindrapport van de projectgroep "Duurzame productie van biomassa"', 23-04-'07.

- It must have positive effects on the living conditions of local population and employees.

In developing countries the Netherlands will help with the formulation of a framework for the sustainable production of biomass, policy development, capacity building, monitoring macro-effects and certification of production. Besides Schokland, other certification initiatives like the Roundtables on Sustainable Biofuels and the Forest Stewardship Council are supported.[95] In the European Union- and the multilateral context the Netherlands are pushing for a global monitoring system for the production of biofuels.

4.2 The policy of the Embassy

The goal of the Embassy in Nicaragua is 'to contribute to poverty reduction through support to sustainable development in an inclusive and equitable society'. In the Multi Annual Strategic Plan (MASP) 2008-2011[96] the Embassy decided to work in a number of key areas. One of these is 'value chains for sustainable economic growth'. It is the Embassy's view that poverty reduction in Nicaragua has to be based on income generation through the creation of jobs and production for the export market. The objective is inclusive economic growth involving a majority of small scale producers and their associations aiming at equitable growth in the rural areas. Special attention will be paid to the participation of women and environmental sustainability. The sector 'value chains' aligns with the Nicaraguan government's policy on export and development of the agricultural sector. If the Embassy decides to work in biofuels, consumption and production for the national market is important. In the MASP a few focal points are given for the selection of value chains: the participation of stakeholders in the chain, the involvement of small and medium enterprises, of female producers, sustainability and certification. Better alignment and donor harmonization is a very important goal of the Embassy.

Once the value chains are selected, the Embassy has multiple methods of supporting the development of the chain. On the one hand an important part of the budget of the Embassy conributes to institutional assistance to governmental organizations. Nowadays these funds can be used for general expenditures, but in the future the funds will be tied to certain value chains. Switzerland, Austria and possibly the European Commission also use this system. The second method is the financing of Business Development Services, linked to selected value chains. In this way the Embassy supports enterprises in a certain value chain through private sector organizations. Besides, it will focus on public-private partnerships with Dutch enterprises and will push for a multi-donor program and common fund in support of selected strategic value chains. In this area Finland and DFID founded a common fund in their new program PROPEMCE. The Embassy is investigating the possibilities for support to private enterprises like banks. An option is the development of a guarantee fund to (partly) cover the risks of the bank which issues loans to enterprises in a value chain.

[95] See chapter 2 and annex 5 for an overview of certification initiatives.
[96] MASP 2008-2011 Nicaragua MNG, Royal Dutch Embassy in Managua, Nicaragua.

Chapter 5 - Criteria, conclusions and recommendations

5.1 Formulation of criteria

The numbers of theoretical approaches to select a value chain within the framework of the Value Chain Approaches are abundant.[97] However, the formulation of criteria for the Embassy to select a value chain will be based on the points of particular interest which appeared in this study. The criteria will have to reflect the policy of the Netherlands and the priorities of the Nicaraguan government. Because the goal of the Embassy is the reduction of poverty, the criteria have to be pro-poor. Besides, because of the focus on income generation, a criterion should be whether there is national and international demand for the product. Moreover, the value the Dutch biofuel policy attaches to certification and sustainable production methods should be reflected in the criteria. The guiding principles will be the abovementioned themes of the Agreement of Schokland. Since the biofuel industry in Nicaragua is still in its infancy the government is needed for the development of rules and regulations. Finally, the criteria should reflect the importance of donor alignment, harmonization and cooperation with NGO's. These themes are reflected in the following criteria:

(1) The possibilities for creation of employment and involvement of small and medium producers;
(2) The possibilities to export the product or to produce for the national market;
(3) The environmental sustainability of the production and the value chain;
(4) The willingness of the government to develop biofuels in Nicaragua;
(5) The actions of other stakeholders in the field.

In view of these criteria conclusions will be drawn about the development of a biofuel industry in Nicaragua in the following paragraphs. Hereafter recommendations will be made whether the goals of the Embassy are reflected in this field and what the Embassy could contribute to its development.

5.2 Conclusions

Social and economic aspects

The production of ethanol from sugarcane requires economies of scale to be cost-effective because factories to produce fuel ethanol are very costly. Because of the need to insure input and output, the only ethanol producer in Nicaragua, NSEL, integrated the entire value chain from production to the sale of the ethanol. Therefore there is no involvement of small producers in this value chain. As a consequence the chances to involve small producers through external interference by way of the Value Chain Approach are limited. The generation of jobs is substantial with 5,000 employees and because 100% of the ethanol produced is exported, this industry generates income for the country.

The production of biodiesel from African palm is to the present day impeded through the lack of a regulatory framework and the high prices of palm oil in export markets. Therefore the appeal to produce biodiesel, either for export or for the national market, is low. However, the rising prices of fossil oil increase the financial incentives to produce biodiesel. Furthermore, biodiesel from African palm has no great demand in Europe, the most important export market for biodiesel, because of product requirements. Because African palm has the tendency to be cultivated in large plantations, while there are possibilities for small farmers, there is a great potential for a social inclusive development of the sector through value chain development.

The production of biodiesel from tempate has most direct potential for poverty reduction through the inclusion of small producers. Small-scale cultivation and production of biodiesel is possible, and due to the various by-products and the biodiesel itself, can improve access to energy and electricity for the poor in remote, off-grid areas. However, the sale to the national and international

[97] For various examples of the Value Chain Approach, see annex 5.

market is more problematic. Infrastructure has to be built, the farmers have to be trained, and research to production costs of the biodiesel is needed. Moreover, there is no commerical production of tempate at the moment in Nicaragua, which means that the field has to be built up from the start.

Environmental sustainability

Nicaragua has a great agro-ecological potential to produce biofuels in an environmentally friendly way. Due to an enormous amount of deforested and unused lands, which are suitable for the cultivation of tempate, African palm, jícaro, cassava, etc., Nicaragua could be become a producer of biofuels without endangering food production. However, greenhouse gases stored in the soil can be released if deforested lands are ploughed, which would bring into discussion the energy balance of the biofuel produced from these lands. Further research is needed. Moreover, a sustainable development of biofuel production can only be promoted if a robust regulatory framework is implemented and enforced. Considering the difficult accessibility of major parts of the country, the enforcement will be a difficult task.

In this respect worrisome are the accusations made against the ethanol-from-sugarcane producer NSEL which include child labour, the use of illegal pesticides, the contamination and depletion of groundwater.[98] If these accusations are true, the production of ethanol from sugarcane does not comply with at least three of the six Schokland-sustainability themes. Besides, every drop of ethanol that is produced is a grain of sugar less. This means that the price of sugar will rise if the production of ethanol is extended dramatically. To avoid this legislation will have to be implemented.

The accusations against the palm plantations in the region Río San Juan of having negative environmental effects (including the chopping down of forests for the construction of plantations, child labour and the use of illegal pesticides)[99] reflect the risks of developing the production of energetic crops without a regulatory framework. While small-scale production of African palm can be rentable, experiences in other developing countries show that African palm is inclined to convert large areas in monocultures which have negative effects on biodiversity and make the area vulnerable to plagues. Because of these risks associated with the large-scale production of biofuels from African palm and sugarcane, more promising crops for environmentally sustainable production are tempate and jícaro. These plants need no fertilizers, irrigation systems, and can grow on very poor soils. Besides, the cultivation can be combined with other crops or cattle breeding and will therefore not compete with food production. Because of the suitability for small-scale production, it will not affect biodiversity drastically and there will be no risk of the conversion of large areas of land into monocultures. In this way it is able to comply with the Schokland standards. So the biofuel industry in Nicaragua, and especially the small-scale production of biofuels, does have the potential to be developed sustainably. However, at the moment it can not be guaranteed due to the lack of legislation.

Willingness of the government and possibilities for collaboration

The Nicaraguan government has indicated its intentions to develop a legislative framework for the development of a biofuel-industry. A policy has been formulated. But because of other political priorities and the negative atmosphere surrounding biofuels in connection with food safety, it is not expected that this will be realized in the short term. However, the mounting prices for fossil fuels in combination with the complete dependency of the transport sector in Nicaragua on petroleum may force the government to stimulate the use of biofuels. The fifth criterion, the willingness of the government, is therefore partly realized.

Like the government, other organizations in Nicaragua interested in working in biofuels are in an initial phase. Various NGO's performed studies and are willing to work in the field, but real projects have not yet been planned. Other countries are involved in the value chain approach, but are not working in biofuels. Although some are working with a regional program which does include biofuels in neighbouring countries, none of them treats biofuels in Nicaragua. Collaboration is possible with donors in Nicaragua, but the Embassy will have to act as a pioneer in the field of biofuels. So the sixth criterion of the Embassy, collaboration in biofuels with other donors, would have to be initiated by the Embassy.

[98] 'People of León and Chinandega's complaint regarding the operations of NSEL'; see chapter 2.
[99] See chapter 2.

	Sugarcane	African palm	Tempate
Creation employment	+	+	+
Involvement SME's	-	- / +	+
Export opportunities	+	-	-
National market	- / +	- / +	- / +
Environmental sustainability	- / +	- / +	+
Willingness government	- / +	- / +	- / +
Actions other donors	-	-	-

Figure 8. Summary of potential of various criteria for ethanol from sugarcane and biodiesel from African palm and tempate. Source: own design.

5.2 Recommendations

The field of biofuels is different from other, more traditional agrarian products like coffee or cacao. The difference is the fact that the value chains still have to be developed in Nicaragua, except for ethanol from sugarcane. And last mentioned is not interesting for the Embassy to work with in terms of the Value Chain Approach, because this chain is to a large extent integrated through two big enterprises. Bottlenecks in the chain will be solved by these companies; support from third parties is not needed. Small companies are not included and will not likely be involved in the future because of high barriers to entry.

In terms of biodiesel production the chains have to be developed. In the case of African palm, only the last part of the chain (that is the production of biodiesel), in case of tempate, the complete chain. Experiences from past projects show that this will only be successful in the long term if this development comes from the market players itself, since the producers and companies involved in the market have most information about international and national demand and supply. Past projects showed the functioning of the market is important for the success of the project. Additionally, because the Embassy is not interested in working on individual projects the direct creation of value chains in the sector through projects will not be an option. However, the Embassy can support private sector organizations with the development of projects, for example to solve constraints in the value chain.

Despite the fact that the biofuel industry in Nicaragua is in an initial phase it is important for the Embassy to get involved because of the enormous potential biofuels can have, with both positive and negative effects. The reasons are the following. First, considering the intentions of the government to develop the industry and the regional goal to which the government commited itself (reduce in 2020 the consumption of derivatives of petroleum in public and private transport with 15% by means of the incorporation of 10% bio-ethanol and 5% biodiesel), this will mean that Nicaragua has to produce the ethanol and biodiesel itself, or will have to import it. To avoid continuing dependence on foreign energy sources in the transport sector, the biofuel industry has to be developed.

The second reason concerns the importance the Netherlands attaches to the sustainability of biofuel production. The opportunity for a sustainable development of the biofuel industry in Nicaragua exists, but should be safeguarded. Because the development of the regulatory framework is still in an initial phase, the Embassy could support the ministries to incorporate social and environmental sustainability criteria from the beginning. Moreover, it could support the development of a

certification system. Another possibility is to support the government to solve the problems of land property rights, which are obstacles for development in large parts of the country.

This type of aid, direct institutional assistance to the ministries or indirect through private sector organizations to support the development of a sustainable framework, fits within the policy of the Embassy. Because the biofuel industry in Nicaragua is still in its infancy, the first number of years the emphasis will be on institutional support to the government to develop the enabling environment. If these are established, support can be given to organizations in the sector to develop a certification system or to help producers to join international initiatives. Other possibilities are the facilitation of public-private partnerships and the assistance to organizations in the field with the creation of pilot projects, for example to develop inclusive forms of production with the involvement of small producers or the solvation of constraints in the value chain. In conclusion, while there are no possibilities for support to the already existing chain of ethanol from sugarcane with the aim of including small producers, the assistance to sustainability criteria and certification can contribute to safeguard the positive influence the production process has a on its surroundings. And while the Embassy does not have the option to directly develop the value chains of biodiesel from tempate or African palm to include small-scale production, it can contribute to capacity building of governmental institutions and sector organizations to make sure the future development will happen in a environmentally and social sustainable manner.

Annexes

Annex 1

Producción estimada de biocombustibles por TM y Ha.

Cultivo	Producción TM/Ha*	Producción Biocombustibles Litros/TM		Producción Biocombustibles Litros/Ha	
		Etanol	Biodiesel	Etanol	Biodiesel
Caña de azúcar	80-100[1]	60	-	4,800-6,000	-
Yuca*	30-35[2]	200	-	6,000-7,000	-
Maíz**	1.5-2.0 t	400	-	600-1,000	-
Palma Africana	25.0[2]	-		-	5,550
Tempate	10.0[4]	-	385	-	3,850
Higuerilla	2.0 t	-	1.0 aceite	-	1,320
Maní	3.68 t	-		-	990
Soya	1.95 t	-	0.54 aceite	-	613

* Rendimientos estimados para Nicaragua.
Los cultivos más prometedores para Nicaragua son:
- Producción de Etanol: Caña de Azúcar y Yuca
- Producción de Biodiesel: Palma Africana y Tempate (*Jatropha curcas*)

[1] Fuente MAGFOR. Nicaragua
[2] INTA y UNA. Nicaragua
[3] EMBRAPA. Brasil
[4] Dr Frederique Rosa e Abreu. Experiencia de Brasil en el desarrollo y difusión de especies con fines energéticos. 2006

Cultivos energéticos		Costos US$ /Hectárea	Producción US$/Ha.	Área Hectáreas	Inversiones Agric. + Indust. MM US $
Palma africana (1)	a)	3,051.00	1,350.00	10.000	30.3
	b)	10,790.00	32,100.00	200.000	606.2
En 25 años		13,841.00	33,450.00		
Tempate (2)	a)	1,949.70	3,219.50		
	b)	3,975.00	25,000.00	20.000	
En 25 años		5,924.70	28,219.50		
Soya (3)		431.20	536.56		No recomendado
Yuca (4)	a)	533.00	933.00		
	b)			60.000	
Caña de Azúcar (5)	a)			15.000	110.0
	b)			30.000	220.0

a) Acumulado primeros 5 años – Módulo económico eficiente. - Valor de inversión para M E E.
b) Costos del 6to al 25 Año - Área total propuesta - Valor de inversión para área total propuesta.
(1) Corporación DINANT
(2) Dr. D. Joerderis-Roettger. GTZ, Perú. UNI y MAGFOR, 1997. = un costo de US $ 526/año/Ha
(3) MAGFOR, Nicaragua. 2005
(4) MAGFOR, Nicaragua. 2005 . Con rendimiento de 11.48 TM/Ha (consumo humano) para variedades industriales los resultados de investigación oscilan 30-45 TM/Ha.
(5) Ingenio San Antonio, Nicaragua.

Table 'Estimated biofuel production per metric ton and hectare' and table 'Production costs'. Source: 'Programa Nacional de Biocombustibles', IICA, 2008.

Annex 2

History of the cultivation of African palm in Nicaragua[100]

- The cultivation of African palm in Nicaragua started in 1945. In 1945 by the Kukra Development Company in the Atlantic Coast region grew approximately 500 hectares of African palm in Río Siquía and El Rama.
- In 1973 and 1976 TAHAL and FAO published studies which indicated the economic viability for the cultivation of African palm in Nicaragua.
- The first project of considerable magnitude was realized in 1982 by the Ministry of Agriculture and Agrarian Reform (MIDINRA) in the municipality of El Castillo. The project involved 1,200 hectares and the producers where organized in cooperatives. The project failed because of organizational problems with the producers and low international prices for vegetable oils.
- In 1988 MIDINRA founded eight cooperatives to produce African palm for an industrial fabric which was owned by the state enterprise ENDEPARA.
- This fabric was bought in 1994 by E. Chamorro Industrial, who produced for six years. This project was not successful either for the same reasons expressed above.
- In 1996 the eight cooperatives formed the *Unión de Cooperativas Palmeras* (UCOPA). They started a project in 1999 to cultivate 180 ha of African palm.

[100] 'Política Nacional de Agro Energía y Biocombustibles', Ministerio de Energía y Minas, 19-12-'07.

Annex 3

The Austrian tempate project in the 1990's in cooperation with UNI and Petronic[101]

The goals of the project:

1. The goal of the researching phase was to find an alternative source of energy for Nicaragua, to decrease the dependence of petroleum;
2. The investigation the area of energetic crops;
3. Reducing the pollution of the environment by the agrarian industry;
4. Demonstrating the agricultural and industrial viability of the production of biodiesel from tempate;
5. The development of the production of secondary products from tempate. The seedcake, which was believed to be able to be detoxicated and used as alimentation for animals would help to reduce the external dependence from Nicaragua for protein-rich animal food. The crude oil would be used for the production of edible oil. The fruit pulp would be used as an organic fertilizer. The peel of the seed would be used in the industrial plant as an energy source;
6. The creation of employment;
7. Contribution to the conservation of the environment trough reforestation.

Problems during the project:

- The farmers did not completely receive the financing from the Union of Cooperatives who acted as intermediary of the credit. Because this problem continued some farmers decided to separate from the Union of Cooperatives. Now there were three types of producers: the cooperative union of Telica, the cooperative union of León, and the farmers who worked directly for Petronic.
- The harvest was not well organized and the yield of the lands was too low. The yield decreased every year. After a couple of years, and a number of strikes, almost half the farmers decided to quit with the cultivation of tempate. From the estimated 3.000 tons of fruit in the first four years which would be processed in the fabric, only 35 tons reached it. The farmers said the yield was low because of various plagues and because the farmers did not receive technical training. The version of the leaders of the project, the Austrian Nicolás Foidl and director of the department of Biomass from the UNI Leonardo Mayorga is different. They argued the farmers did not use the chemicals and fertilizers to control the plagues. The farmers let the fruit of the tempate fall on the ground and used it as a fertilizer to other crops.[102]
- The production of biodiesel was not rentable because of the low oil prices in the 1990's.[103] There was no clarity about the price of the biodiesel during the project. The price was estimated from $US 0.95 to $US 1.44 / gallon. While the production of biodiesel was not rentable, the industrial plant was economically viable because of the selling of the by-products. According to Mr. Zamora, a scientist who works in the Biomass Laboratory from the UNI, the technical part of the project was well investigated and economically viable. The project failed because the yield from the land was too low.[104]
- Disagreement about the price of the fruit during the project. In the final years, it was believed that the price of the fresh fruit would have to rise to stimulate the production of tempate. Petronic believed a rise in price from $US 1.00 to $US 2.50 / quintal was needed. This would imply that the production costs of the biodiesel would rise with 150%, which would affect the profitability of the biodiesel.

Reasons for failure of the project:

- The research activities in the project were dispersed and isolated. About 20 institutions, national and international, were involved. There was no adequate communication infrastructure and no

[101] This annex is based on the following document, unless otherwise indicated: 'Evaluación 1999 del Proyecto Tempate. Sintesis', Project Nr. 930 ÖEZA, KEK CDC Consultants, 05-'99.
[102] Amalia Morales, 'Malograda cosecha de diesel', *Magazine La Prensa* 34, 24-05-'05, 17.
[103] The price of oil declined steadily following the end of the Gulf War until their lowest level since 1973 in 1994. The average oil price was about $US 25/barrel.
[104] Interview sr. Zamora, Laboratorio Biomasa UNI, 23-04-'08

inter institutional and interdisciplinary strategy. Because of a lack of finance, the board of the project Biomass from the UNI had problems with the management of the investigations which required scientific collaboration. As a consequence, there were frictions with property rights, publications and copyrights because Nicaragua did not have laws to regulate copy- and property rights.

- A lack of cooperation between the national partner Petronic and the Austrian counterpart Biomass led to a bad division of responsibilities. There was disagreement about who was responsible for the fabric and if the project was to be defined as an experimental or economically viable enterprise. There was no knowledge about actual costs of the company and there were no periodic evaluations. This led to contradictions between the producers and the cooperative unions.
- The UNI considered the lack of regulation of property rights in Nicaragua the most important problem of the project. While this problem was beyond the reach of the project, national regulation would improve the possibilities to search new production areas, contract small, medium and large producers, and legally establish the cooperatives.
- The selection of producers was not adequate. The producers did not have sufficient knowledge to be able to maintain the plantations. The producers never grew tempate before and therefore had no experience with tempate. Besides, the culture of the producers focussed on the short term gains and did not have a long term vision. In the evaluation of the project it was stressed that producers must be chosen on productive culture, the criteria should not be just political or social position.
- The government, as manager through Petronic, did not give the project the attention and priority it deserved.[105]
- According to Austria the biggest failure was that there was no collaboration strategy with the farmers. Their attitude to the project was crucial, but their knowledge of the lands was ignored. The cultivation of tempate had to be fitted in a tradition of monoculture. To divide the risk and secure the earnings of the farmers it is important to diversify the types of crops they grow. Because the fruits of the tempate can not be harvested the first few years the producers should have another income. Ideally these would be crops which also can be processed and commercialised in the existing plant like soya, or crops which secure the food production.
- Various actors hold the small producers and cooperatives responsible for the failure of the agricultural production of tempate. The Austrian evaluation therefore says small producers should not be involved in such a project. The Austrians concluded that if the small producers can not be involved, the social component was gone. Because the ultimate goal of the Austrian was the reduction of poverty in Nicaragua, the evaluation of the project questions the industrial production of biodiesel from tempate as the right instrument to reduce poverty in Nicaragua, because the ecological and commercial goals had the upper hand in this project.

[105] Morales, 'Malograda cosecha de diesel', 18.

Annex 4

Value Chains for Development

The theories of Value Chains for Development (VCD) focus on pro-poor growth. It tries to enhance the economic rent of poorer households, by way of upgrading the position of the poor in the value chain. Therefore the focal points in this approach are small and medium producers.[106]

Overview

Within VCD a lot of different approaches exist.[107] A couple will be treated here. The VCD from the Royal Tropical Institute in the Netherlands focuses on the non-economic dimensions of poverty, thereby criticizing other pro-poor development concepts that focus solely on income growth. What is important here is an increase in both control and capacities of the poor in the value chain. These two aspects are captured with the term 'economic rent', which is the ability of producers to safeguard themselves against competitive pressures and their areas of value accretion. There are two key dimensions to asses the position of the producer in the value chain, through the type of activities that farmers undertake in the chain and the involvement of farmers in the management of the chain. The way to enhance the position of the farmer in the chain is to increase the number of activities they perform and to increase their management skills.[108]

The FIAS (Foreign Investment Advisory Service), a joint facility of the World Bank, the International Financial Cooperation (IFC) and the Multilateral Investment Guarantee Agency, developed a Value Chain Approach which focuses on the public policy environment. The policy and regulatory environment in which private firms operate within a value chain often significantly affect the firm-level competitiveness and the performance of the chain. The approach helps to clarify the continuing constraints to growth and competitiveness. After an extensive analysis of the market, the value chain, the problems within the value chain and the regulatory environment, policy recommendations are made.[109]

The value chain approach of the German Gesellschaft für Technische Zusammenarbeit (GTZ) focuses primarily on market failures within the value chain. It is an action-oriented approach, in which it is assumed that because of the dropping of prices through intense competition, small producers are squeezed out of the value chain. Therefore innovation is important to identify new problems and new market opportunities. Herein the choice of the value chain is a very important step. When the problems in the value chain are specified a strategy is developed to address the problems, for example through cooperation in public private partnerships (PPP's) or the setting of social-, product- and ecological standards.[110]

Finally, the value chains approach of the Development Organization of the United States, USAID, focuses on micro and small enterprises (MSE) into local, regional and global value chains. The approach tries to improve the competitiveness in a value chain with a large number of participants. What is most important is a competitiveness strategy focussed on the end market. This implies the development of an upgrading strategy to address systemic constraints in the value chain. This approach contributes to economic growth, the creation of jobs and a higher income for SME's.[111]

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[106] 'Value chains for development. An introduction', Royal Tropical Institute, KIT Development Policy and Practice department, <http://www.kit.nl/smartsite.shtml?ch=FAB&id=12554>, 13-05-'08.

[107] See for an overview: 'International Conference: Value Chains for Broad-based Development', German Federal Ministry for Economic Cooperation and Development, Berlin 30-05-'07, <http://www.value-links.de/downloads/vc_conference_documentation.pdf>, 13-05-'08.

[108] 'Value chains for development', <http://www.kit.nl/smartsite.shtml?ch=FAB&id=12554>.

[109] 'Moving towards competitiveness. A value-chain approach', FIAS and the Multi-donor Investment Climate Advisory Service of the World Bank, Washington DC, 08-'07.

[110] Andreas Springer-Heinze, GTZ, International Conference: Value Chains for Broad-based Development, 30-05-'07, Berlin, <http://value-links.de/downloads/Session2_Springer-Heinze.ppt>, 13-05-'08.

[111] Jeanne Downing, USAID, International Conference: Value Chains for Broad-based Development, 30-05-'07, Berlin, <http://value-links.de/downloads/Session2_Downing.ppt>, 13-05-'08; 'Introduction to value chain development', Microlinks, <http://www.microlinks.org/ev_en.php?ID=9652_201&ID2=DO_TOPIC>, 13-05-'08.

Criteria to select a value chain:

The different Value Chain Approaches all use different criteria to select a value chain. For example, in one approach the potential for expansion of the market is the primary factor. Does actual or potential demand for the product exist? This is important because the development or increase of products in a value chain will not be successful if there are no buyers for it. Because public resources are limited, the markets must be chosen which have the major potential to affect development positively, based on criteria which endorse growth in favour of the poor.[112]

Other Value Chain Approaches base their selection on, for example, the following considerations: it must be assessed whether the sector choices fits within the overall country strategy, what the contribution is of the sector to the national GDP and what their growth potential is, how much the sector contributes to the country's exports, and which potential it has to attract private investments. Moreover, the potential of the sector to reduce poverty in the country must be analysed, through the creation of employment and the involvement of less-developed regions in the country. In addition, it is important to assess the potential of the sector to establish or change policy with a positive impact on other sectors in the country, about the readiness and demonstrated support within the sector and the government for change, and about the availability of international benchmarks.[113]

[112] 'Seleccionar una cadena de valor para su fomento', ValueLinks Módulo 1, Manual ValueLinks – Metodología para el Fomento de la Cadena de Valor, GTZ, 2007.
[113] 'Moving towards competitiveness', 12.

Annex 5

Certification of biofuels

International organizations and institutes involved in certification of sustainable biomass:

- Roundtable on Sustainable Biofuels (RSB), http://cgse.epfl.ch/page65660.html
- International Organisation for Standardization (ISO), www.iso.org
- Task 39 IEA Bioenergy Agreement (2007 – 2009), www.task39.org
- Task 40 IEA Bioenergy Agreement, www.bioenergytrade.org
- European Biofuels Technology Platform, www.biofuelstp.eu
- FAO/Global Bioenergy Partnership (GBEP), www.globalbioenrgy.org
- UN International Bioenergy Initiative (IBI), www.unfoundation.org/bioenergy

Private initiatives in certification of sustainable biomass:

- Round Table for Responsible Soy (RTRS), www.responsiblesoy.org
- Round Table on Sustainable Palm Oil (RSPO), www.rspo.org
- Better Sugarcane Initiative, www.bettersugarcane.org
- International Social and Environmental Accreditation& Labelling (ISEAL) Alliance, www.isealalliance.org
- Eugene Standard, www.eugenestandard.org
- Carbon Disclosure Project (CDP), www.cdproject.net
- Basel Criteria for Responsible Soy Production, www.panda.org/about_wwf/what_we_do/forests/publications/factsheets_/index.cfm?uNewsID=73900
- Global Reporting Initiative (GRI), www.globalreporting.org

Research institutes:

- International Centre for Trade and Sustainable Development (ICTSD), www.ictsd.org
- Ecofys, www.ecofys.nl.

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