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Global Assessment of Biomass and Bioproduct Impacts on Socio-economics and Sustainability

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The Global-Bio-Pact consortium at the Kick-off-Meeting in Munich

Launch of the Global-Bio-Pact Project

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The Global-Bio-Pact project was officially launched at the Kick-off-Meeting in Munich, Germany on 8-9 March 2010. The main aim of Global-Bio-Pact is the improvement and harmonisation of global sustainability certification systems for biomass production, conversion systems and trade in order to prevent negative socio-economic impacts. Thereby, emphasis is placed on a detailed assessment of the socio-economic impacts of raw material production and a variety of biomass conversion chains. The impact of biomass production on global and local food security and the links between environmental and socio-economic impacts are analysed. Furthermore, the Global-Bio-Pact project investigates the impact of biomass production on food security and the interrelationship of global sustainability certification systems with international trade of biomass and bioproducts as well as with public perception of biomass production for industrial uses. Finally, Global-Bio-Pact focuses on socio-economic sustainability criteria and indicators for inclusion into certification schemes, and the project elaborates recommendations on how to best integrate socio-economic sustainability criteria in European legislation and policies on biomass and bioproducts. Global-Bio-Pact "Global Assessment of Biomass and Bioproduct Impacts on Socio-economics and Sustainability" (Contract No. FP7- 245085) is supported by the European Commission in the Seventh Framework Programme (FP7). It is coordinated by WIP Renewable Energies and runs from February 2010 to January 2013.

The Global-Bio-Pact Consortium

WIP Renewable Energies

WIP Renewable Energies, Germany, has been active in the clean energy and environment sectors for over three decades, providing a range of technical expert and non-technical services to both industrial and public sector clients at the international level. In the field of bioenergy WIP is involved in several research, demonstration, and market support projects which have the overall aim to support the development of the European bioenergy sector through the stimulation of new biofuel markets. WIP offers project development, project management, technical supervision and realisation of both large- and small-scale projects, which includes the coordination of international consortia.

Imperial College London

The research focus of Imperial College's Faculty of Life Sciences, Centre for Environmental Policy, UK, is on techno-economic, environmental and policy issues related to biomass energy systems applied to the heat, electricity and transport sectors. The group is composed of an inter-disciplinary team of experienced researchers. Work is carried out for a range of governmental research councils, governmental and international organisations, nongovernmental organisations and industry. Group members have published extensively in the area, and participate in national and international expert committees.

Utrecht University - Copernicus Institute

The Copernicus Institute for Sustainable Development and Innovation, Netherlands, aims to support the search for sustainable development and innovation through the development of knowledge, methods and instruments. The Copernicus Institute houses a wide range of disciplines, with researchers from the natural and social sciences. The institute houses some 100 research staff and has a strong track record in relation to bioenergy research and advice. The department Science, Technology & Society (STS) is one of the four departments that form a part of the Copernicus Institute. STS is a department of the Faculty of Chemistry of the Utrecht University and employs about 45 people. The research activities include, amongst others, the following main fields: Energy System Analysis, Energy Efficiency, Biomass Energy, and Land Use and Biodiversity.

BTG Biomass Technology Group BV

BTG Biomass Technology Group BV, Netherlands, is an independent, private firm which for the past 25 years has specialised in the process of conversion of biomass into biofuels and bio-energy. BTG's two business units, Consultancy and RTD, work in synergy. The business units work on technology and project development, provide strategic advice to customers and carry out availability, feasibility and scenario studies. BTG has proven to be leading as an innovative company in the bio-energy field. The unique combination of Consultancy and RTD is the base for highly innovative and commercially feasible activities.

ifeu – Institut für Energie- und Umweltforschung Heidelberg

Since the 1970's, the ifeu - Institute for Energy and Environmental Research Heidelberg, Germany, works as an independent body for environmental research, covering areas like life cycle assessment, renewable energies and energy planning, environmental impact assessment and environmental management. IFEU is a limited liability company and a non-profit organisation. The regular clients of IFEU are local, regional and federal governments and authorities, the European Commission, national and international foundations and organisations as well as companies and industry associations. IFEU staff participate in national and international advisory panels, e. g. at the Ministry of Agriculture in the German state of Lower-Saxony, advise FAO and IEA and has a key position in the present discussion on biomass for food, feed, fuel, and fibres.

Proforest

ProForest, UK, is an independent company working with natural resource management and specialising in practical approaches to sustainability. Its work ranges from international policy development to the practical implementation of requirements on the ground, with a particular focus on turning policy into practice. At the same time, Proforest brings a wealth of current practical experience to policy development processes and debates. The ProForest team is international and multilingual and has a broad variety of backgrounds, ranging from industry to academia and NGOs. This allows to work comfortably in many types of organisations, as well as

in a range of cultures. Proforest's expertise covers a wide range of aspects in the natural resources sector focussing on forestry and agricultural commodities and including policy development/ implementation, conservation planning, supply chain management, field assessments, training and responsible investment.

Ecole Polytechnique Fédérale de Lausanne Roundtable on Sustainable Biofuels

The Roundtable on Sustainable Biofuels (RSB), Switzerland, is an international multi-stakeholder initiative bringing together companies, NGOs, governments, and experts worldwide to develop a standard for sustainable biofuels production and processing. The primary use of this Standard, which includes social and environmental requirements for biofuel operators, is a certification system, to be run in collaboration with independent certification agencies. The Energy Center at the Swiss Federal Institute of Technology in Lausanne (EPFL) provides a neutral host for the RSB, ensuring that the discussions of biofuels' sustainability remain rooted in scientific understanding.

Univerity of Campinas

Unicamp, Brazil, was founded in 1966. Even within the Brazilian context (the oldest university is 70 years old) Unicamp can be considered a young institution, but has already conquered a strong tradition in education, in research and services to society. Unicamp has three campi – in Campinas, Piracicaba and Limeira – consisting of 22 centers of teaching and research. It also has a vast hospital complex, 23 interdisciplinary centers, two technical high schools, and a series of support units within a universe of about 50 thousand people. The University has approximately 17 thousand students in its undergraduate courses and 16 thousand matriculated in its 135 graduate programs; it is responsible for 12% of the master's and doctoral theses in the country. Currently, all projects developed at Unicamp represent about 15 % of all research done in Brazilian universities. Unicamp is largely involved in research on sustainability and international trade of biofuels.

INTA National Bioenergy Program

The National Bioenergy program of INTA, Argentina, works through national & international projects and coordinates actions within INTA and with external actors at a national and international level Its aim is Secure the supply of sustainable bioenergy sources and services, taking care and supporting sustainable development, national energy security, poverty reduction, climate change attenuation & environmental equilibrium in all the national territory INTA is a public decentralized body subordinated to the Ministry of Agriculture & Livestock with operative and financial autarchy. 47 experiment stations, 260 extension units, and 15 research institutes, enable INTA to contribute substantially to production and land management change processes that Argentine agriculture needs to be able to compete in the world's new production and marketing scenario.

CATIE – Centro Agronómico Tropical de Investigación y Enseñanza

CATIE (Tropical Agricultural Research and Higher Education Center) is a regional center headquartered in Turrialba, Costa Rica. Its mission is to increase human well-being and reduce rural poverty through education, research and technical cooperation, promoting sustainable agriculture and natural resource management. Its innovative initiatives are geared to enhance the health of ecosystems, influence policy and build leadership. Faculty, graduate students and technical staff work through an interdisciplinary approach in climate change, agroecological production of food crops, tree crops in agroforestry systems (coffee, cacao, fruit trees), livestock and environmental management, production and conservation in forests, competitiveness and value chains, governance, socioeconomics, watershed management and biodiversity. CATIE has been involved in 100 research and development projects in 17 countries over the past two years.

Tanzania Traditional Energy Development Organisation (TaTEDO)

TaTEDO is a centre for sustainable modern energy development initiatives based in Dar es Salaam, Tanzania, with more than nineteen years experience in facilitating access to sustainable modern energy services. TaTEDO undertakes activities in 10 regions and in more than 120 villages in Tanzania. Its mission is to advance popular access to sustainable modern energy technologies in marginalized communities in Tanzania through energy technological adaptations, community mobilization and advocacy for increased access to sustainable energy services, poverty reduction, environmental conservation and self-reliance. The goals of TaTEDO are: (1) to improve quality of life of Tanzanians by contributing to availability of improved and sustainable modern energy services, employment and income generating opportunities, which are essential for poverty reduction, (2) to reduce environmental degradation resulting from increased use of wood and fossil fuels, (3) to contribute in reducing the country's dependence on imported energy.

Mali-Folkecenter

Mali-Folkecenter Nyetaa (MFC) is a Malian NGO, created in 1999. MFC's mission is to work with the Malian society towards the goal of sustainable development, comprising the environment as well as social and economic development. MFC promotes renewable energy and environmental protection for the improvement of living conditions in rural area. It is strongly involved in capacity building of local people, village leaders and municipality members in order to increase awareness about environmental protection and to increase access to modern energy services in their local development strategies. MFC develops appropriate financial mechanisms for access to modern clean energy services, environmentally friendly technologies, and drinking water supply. In the field of biomass, MFC gained relevant expertise and experience through both project implementation on the ground and policy related work. Thereby, MFC has large expertise in all aspects of Jatropha cultivation and use. For instance, MFC initiated the the Garalo Bagani Yelen Project (Jatropha fuelled rural electrification for 10,000 people in the municipality of Garalo) to provide renewable electricity based on sustainable biofuel.

PT Greenlight Biofuels Indonesia

PT Greenlight Biofuels Indonesia is a wholly-owned subsidiary of Greenlight Energy Resources, a diversified renewable energy business with divisions in four targeted renewable energy sectors: biodiesel, wind, solar and wave. Greenlight Biofuels was formed in early 2007 following successful sale of wind power projects to BP in August 2006 for more than $100 million. Greenlight Biofuels is actively expanding its presence in both biodiesel production and in waste vegetable oil collection and processing. In 2009, PT Greenlight Biofuels Indonesia was established as a wholly owned subsidiary to develop biodiesel production using waste vegetable oil and and Jatropha curcas as feedstock. The principals of Greenlight have been successful participants in the renewable energy industry for more than a decade.

Overview on the Case Study Countries of Global-Bio-Pact

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In order to generate data on the ground, five in-depth Case Studies for socio-economic impacts are investigated in the framework of Global-Bio-Pact which are presented below. In order to work towards sustainable biomass production, concrete on-site examples showing main areas of concern are good measures to practically analyse relevant socio-economic issues of biomass production. The Global-Bio-Pact Case Studies focus on different bioproduct/biofuel life cycles and describe socio-economic impacts, their interlinks with environmental impacts, and trade issues, as well as on implications in terms of sustainability and applications of certification schemes. Positive and negative socio-economic impacts on micro- and macro-level are currently assessed for all Global-Bio-Pact Case Studies.

The Case Studies were selected in order to balance the geographical distribution (Africa, Latin America, Asia, Europe, N-America), feedstock sources (soy, palm oil, jatropha, sugarcane, lignocellulosic feedstock), conversion technologies (e.g. fermentation, pressing, transesterification, hydrolysis, gasification) and products (biodiesel, pure plant oil, ethanol, oil refinery, bioproducts, 2nd generation technologies). Thereby, the assessment focuses on existing conversion technologies since these are the current hotspots of socio-economic concern, but also include impacts of future technologies which are not yet commercially available.

Case Study 1: Soy in Argentina

The first Global-Bio-Pact case study is on biodiesel from soy and its related co-products in Argentina which is a main player in biodiesel production with a present capacity reaching 2.5 million tons (2010) and investments that forecast a total production of 3 million t/a in 2011. According to the Argentine Biofuels Chamber, Argentina produced in 2009 about 10% of world biodiesel and still has a very large market growth. Currently, biofuel production in Argentina is mainly based on the use of soybean oil a by-product of soymeal production. There is an internal biodiesel consumption of 800.000 Tons (5 % mandatory blend) rising to 1.2million tons in August 2010 since mandatory blend has been raised to B7. An equivalent fraction is exported mainly to the EU.

In Argentina, there is an increasing intensification of agricultural production and conversion from cultivated pastures to crop agriculture. There is also an expansion of the agriculture frontier with deforestation. This process is presently regulated by a na-

tional law that enforces a planning of the final use of the land in the different provinces.

Agriculture has always been an important component in Argentina's economy. The characteristics of the country as having an important area with deep soils, temperate climate, favourable levels of precipitation and good accessibility to ports, have given Argentina favourable advantages for agricultural productivity and export possibilities. These natural advantages have been increased with high technology input of farmers that adopted new technologies as no-till, precision agriculture, modern and efficient farm machinery and the use of Genetically Modified Organisms (GMO). Thanks to the highly specialized and professional farming and the natural endowments the country has been able to maintain and increase its agricultural productivity, conserving soils and increasing the water and energy efficiency. Recent studies also found an increase in soil biodiversity after 30 years of no tillage practices.

The Argentine oilseed crushing complex is sophisticated, has modern infrastructure that allows for the profitable conversion of vegetable oils into biodiesel. It has a total crushing capacity in excess of 160,000 tons per day and is comprised of global and national enterprises. More than 80% of the crushing capacity is located in Santa Fe province and soybean production is mainly done in a radius of 300 hundred kilometers from this cluster.

By composition of the soybean, the oil content ranges around 18 % and it's a final co-product obtained from the big scale feed and food flour production. Historically there have been market problems to introduce large amounts of oil produced by the enormous scale of production. Biodiesel has mainly been developed as a market strategy to broaden the sale possibility of the product in different markets.

The general approaches of bioenergy studies look for a farmer or producer of the product and all the social, economic and environmental impacts are developed around this concept. In the case of soybean productions there are no dedicated biodiesel soybean farms or farmers since this crop is not planted specifically for biofuel production since it is a byproduct in the whole soy value chain. Seeds are sold and commercialized and the farmer has neither intervention nor information regarding the final end use of the product.

More than 80 % of soybean production is produced in areas located in Las Pampas containing parts of Buenos Aires, Cordoba, Santa Fe and Entre Ríos. In recent years, however, agriculture has extended to less fertile and more remote areas in the northeast and west of Argentina. The recent land use changes are mainly caused by economic better international prices of agricultural commodities. This impact is partially diminished by the government high export taxes over this commodity. Livestock production is rapidly changing from traditionally low productivity grazing into intensive feedlots this enables to significantly increase agricultural production maintaining the total number of heads in the principal agricultural area. Agriculture is using more intensive technologies with effects on crop rotation.

Another important topic in relation to soy production in Argentina is the use of genetically modified (GMO). GMO soy currently accounts for 99% of the soy production in Argentina. The country has a very strict evaluation and approval system that works in conjunction (mirror) with EU approvals till now. The social, economic and environmental impacts of GMO crops are permanent under study and survey. When genetically modified herbicide-tolerant soy was introduced in Argentina in 1998, it was rapidly adopted by Argentine farmers. The resistance of GMO soy to the herbicide glyphosate facilitated weed control and no-till farming significantly increasing soil conservation and water efficiency and, reducing carbon emissions.

There is a continuous improvement in application technology on herbicides although there has been accidents due to the extension of the production however, they seem to be marginal and under correction. There is a risk of intensification of soy monoculture at a large scale. This is now under study in order to set up differentiated export taxes in order to promote other crops.

Soy bean (Argentina)

Although required labour input for large-scale and mechanized agricultural soybean production in Argentina, generates around one labour place for every 200 hectares. Rural jobs are rapidly being replaced by new jobs in the agro industry which are related to the production of the different products, The total soybean production chain has a very strong impact in job generation of better quality for the new generations.

Land prices as in the rest of the world increased strongly in the last few years in Argentina. Average increases of 10% in agricultural land rents in

2006/2007 compared to the previous year are mentioned and similar increases (10–15%) are mentioned for 2007/2008. This is caused by various factors. Land rents are pushed by high outputs and price levels for annual crops as soybean or maize. This creates good income perspectives for farmers, especially with the expectation of further increasing yields. Consequently, there is a high demand for renting suitable land for annual crop production and a supply that does not catch up. Also, the agricultural sector is seen as a secure financial investment. The increase in land rents as well as other costs and investment costs forces producers to select a crop with sufficient income.

Land use rights are officially laid down and described in Argentina. Land property is largely regulated through private ownership or tenure of land. In case the land is rented there are basically two forms of contracts. The first form is a contract in which the owner charges a fixed amount per year or per harvest. The second form is that the owner receives a certain percentage of the production obtained by the tenant.

The working conditions for employees in the soy value chain in Argentina are influenced by the Tripartite Declaration of Principles. The Argentinean government itself has subscribed the OECD guidelines for multinational enterprises. The Ministry of Labour has established the ‘‘Network for Corporate Social Responsibility and Decent Work’’ to promote Corporate Social Responsibility. This network of companies signed a Commitment to Corporate Social Responsibility and Decent Work in 2007.

Rural work conditions in Argentina are regulated by specific resolutions. The ‘Rural Worker License law’ aims at regulating different aspects of the hiring process of permanent, temporary and harvest workers in the agricultural sector. The National Record Office of Rural Employers and Workers is established in 2001 to combat informal employment and to increase protection of workers. Literature sources show variable estimations about the amount of informal workers (with no to limited access to insurance) and formal workers in agriculture in Argentina. Accurate statistical data are difficult to obtain. Unofficial estimations range from 17.5% to 50% of the workers in the agricultural sector engaged in formal employment.

Violations against human rights related to the working conditions of employees and child labour are not mentioned as an issue in Argentina.

Case Study 2: Oil palm in Indonesia

Malaysia and Indonesia are the world’s largest producers of palm oil, producing 86% of total global palm oil output in 2006. Other producing countries are Thailand, Nigeria, Colombia, Ecuador, Papua New Guinea, Ivory Coast, Costa Rica and Honduras. The primary mode of production is the large-scale monoculture production system. In addition, the sector counts more than a million of small scale producers with plots ranging from 1 to 50 hectares.

As palm oil is one of the major natural resources for bioproduct and biofuel production in Indonesia and as large impacts are expected, it was selected as Global-Bio-Pact Case Study.

Oil palm fruits

Palm oil, which is extracted from the fruits of the oil palm, has many uses, for example in food products, cosmetics, animal feed, biofuels, and chemicals. Partly because the oil palm has the highest per-hectare yield of all edible oils and due to the steady increase of Indonesia’s palm oil export, palm oil is foreseen to become one of the most important vegetable oils in the world. Thus, growers in Indonesia are increasing the production of palm oil to meet the global demand. The Indonesian Government promotes palm oil production to become the world's top producer. At the same time it is regarded as a major tool of rural socio-economic development.

Although palm oil generates a considerable amount of foreign currency for Indonesia, its production may have significant negative environmental (e.g. deforestation) and socio-economic impacts resulting from large scale palm oil production. Examples are expropriation of community forest land, which deprives local communities of their livelihood resources. Large scale oil palm cultivation may also undermine local employment.

Land right conflicts are persistent in the oil palm plantation sector. Indonesia’s forestlands provide livelihoods to some 100 million people, of which 40 million are indigenous people. Because these communities rarely have formal rights, licensed palm oil companies have taken over large tracts, which communities perceive as theirs by customary law. Oil palm smallholders in Indonesia and Malaysia are usually fully dependent on neighbouring plantation companies for inputs (e.g. seeds, fertil-

izer) and marketing. As oil palm fruits have to be processed within 24 hours, smallholders have no choice but to supply their fruits to the crude palm oil mill of the plantation company. This may lead to exploiting their bargaining power and offering very low prices to smallholders, especially when there are no strong collective bodies defending their interests.

Case Study 3: Jatropha in Tanzania/Mali

Mali and Tanzania are among the key countries in Jatropha research, development and promotion and the expansion of Jatropha cultivation is currently discussed at several levels.

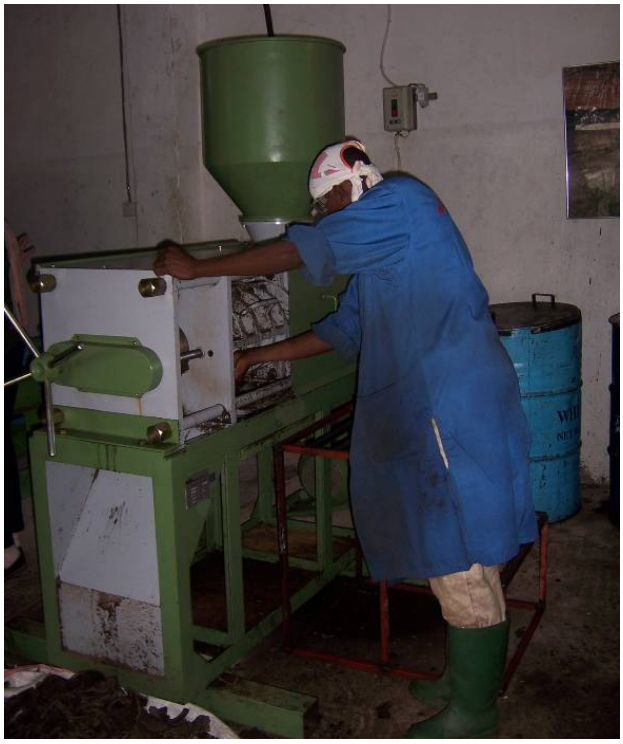
Two-thirds of the population in the developing world, where poverty is at its peak, derive their incomes from agriculture. Thus, the cultivation of Jatropha as feedstock for biofuels and bioproducts is considered as large opportunity to improve their economic situation. Traditionally, farmers cultivate the *Jatropha curcas* scrub to produce oil for lighting lamps and manufacturing medicinal soaps. Furthermore, Jatropha serves as insecticide, for medicinal applications, and as firewood.

Jatropha is also increasingly cultivated for biofuel production. At the community level farmers who produce dedicated energy crops can increase their incomes and grow their own supply of affordable and reliable energy for their internal needs. At the national level, cultivating biofuel crops may generate new industries, technologies, jobs and new markets. At the same time, producing more biofuels will reduce energy expenditures and allow developing countries to put more of their resources into health, education and other services for their neediest citizens.

Jatropha (Tanzania)

On the other hand, the cultivation of large Jatropha monocultures for industrial use is envisaged by international large scale companies and investors. This may cause negative socio-economic impacts, especially on land tenure issues and national revenues. Many large-scale economic models discourage pro-development practices. In order to prevent negative social, economic, and environmental impacts, a sustainability scheme is needed.

Jatropha production has been seen as a tool for local empowerment and poverty alleviation. The benefits of a centralized model for communities are guaranteed markets for seeds and crop management support, which is expected to enhance rural development through job creation, income generation and capability support. However, in comparison a decentralized model is expected to increase the local availability of biodiesel and by-products.



Pressing of Jatropha (Tanzania)

Marginal lands are regarded as a potential production area for bioenergy production. Marginal lands are considered to provide little economic or ecological benefits although these lands represent an integral part of the livelihood of the rural poor, to which they supply essential commodities as food, fuel or fodder. Marginal lands are particularly important for women. On marginal lands, women have traditionally grown crops for household consumption, medical uses, etc. The conversion of these lands to plantations might therefore cause the partial or total displacement of women's agricultural activities. Though it is possible for Jatropha to grow on low-productivity land, larger yields on high-productivity lands may cause converting land currently under food production to Jatropha production fields.

The low level of agronomic information currently available for Jatropha means that it is difficult to gauge whether a plantation will be high yielding. Failure of a plantation to live up to expected yields

may have a significant effect, as local communities may have been promised improved living conditions or farmers may have invested their livelihoods.

Because of the variable timing of the ripening, Jatropha seeds are currently harvested by hand. This translates into high labour costs and substantial job creation. However, first attempts to mechanically harvest Jatropha are underway.

Land conflicts are common phenomena in Africa, especially when a large parcel of land is being earmarked for large scale commercial projects such as commercial plantations of Jatropha. This is because boundaries of many properties are not clearly demarcated and land title ownership is generally not well documented. It often only exists as common historical knowledge among elders of the community. It is therefore likely that one of the key constraints that large scale commercial plantations may face is land ownership conflicts.

Case Study 4: Sugarcane in Costa Rica/Brazil

Due to the importance of ethanol production from sugarcane in Latin America and the large associated positive and negative socio-economic impacts, Brazil and Costa Rica were selected as Global-Bio-Pact Case Study.

Brazil is the world's largest exporter and second largest producer of ethanol. Also Costa Rica has a growing sugarcane industry progressively oriented towards ethanol production from sugarcane. Currently, ethanol is mainly used for biofuel production, but also increasingly for chemical applications such as for ethane/polyethylene production.

The agricultures of Brazil and Costa Rica are characteristically dynamic. Land has a skewed ownership distribution, and agricultural production is essential for smallholders of rural poor regions. Due to increasing demand of ethanol worldwide, Brazil is expected to expand its sugarcane based ethanol production. In Costa Rica, sugarcane areas could increase by 45% and dehydrating and rectifying facilities that process Brazilian ethanol before exportation, could improve their efficiency. Socio-economic impacts of sugarcane based ethanol production in Brazil and Costa Rica are mainly related to income distribution and land tenure, working conditions, worker rights, especially that of migrant workers in Costa Rica and child labor in Brazil.

Considering increasing large-scale production, impacts on net employment effects may be very significant. For instance, mechanised sugarcane harvesting may have severe impacts on overall employment, but is currently being introduced in the State of São Paulo in order to erase manual cutting of sugarcane which is hard and harmful to health and furthermore pollutes the environment due to pre-harvest burning. It is estimated that by 2020 the manual cutting of sugar cane in São Paulo will be practically non-existent. It is also anticipated that between 2006 and 2020, the number of employees in the sugar cane industry in that state will be reduced from 260 thousand to 146 thousand workers, even with an increase of 20 thousand employees in manufacturing. Furthermore, the seasonality of jobs in the sector has been decreasing as a consequence of extending harvests and higher levels of mechanization.

Sugar cane (Brazil)

With the evolution of the technologies employed, less growth can be observed in labour demand, along with higher required qualifications and an increase in quality of the work performed. Current trends towards increased efficiency and the replacement of labourers suggest that the employment benefits of sugarcane production for landless rural workers will disappear. A sugar cane harvester (a machine), for instance, can replace up to eighty cutters (people). In Costa Rica, mechanization possibilities are not generalized because of land relief. Sugarcane production might remain quite labor intensive with harsher conditions due to the progressive prohibition of pre-harvest field burning.

Another example and area of concern is the income concentration of large scale sugarcane production. Sugarcane and bioethanol production shows significant economies of scale. Thus, there is a gradual transition towards larger capacity units. This trend is aggravated by the low attractiveness of a large number of farming activities and the economic deprivations of some regions where sugarcane production becomes one of the more viable alternatives, compared with traditional crops. In order to preserve small-scale agriculture and its agricultural production model, it has been suggested that biofuel production shall be stimulated in a decentralized manner which allows the market entry of small-scale farmers as biofuel producers. It happens in Costa Rica where a few distilleries are developed by small producer cooperatives for local demand.

The increasing demand for ethanol production is encouraging the sugar/alcohol industry to expand to other regions. Part of the land use competition is compensated by the intensification of cattle breeding which requires generally less land. However, an effect of the increase on land use competition is price increases, exacerbated in Costa Rica by the demand for land from urbanization and tourism.

Sugarcane bioethanol plant (Brazil)

Case Study 5: Lignocellulosic biomass in Europe and North-America

Lignocellulose is a feedstock which can be used for various processes, including different biofuels and bioproducts. However, the current use of lignocellulose is still limited since the conversion processes requires large financial and technical efforts and improvements. Due to the large advantages of lignocellulosic feedstock, namely low prices, availability, and high productivity, its use for 2nd generation conversion chains of biofuels and bioproducts, is promoted. These conversion chains include Biomass-to-Liquid (BtL) and 2nd generation bioethanol conversion in the biofuel sector as well as the conversion of lignocellulose into bioproducts and bioplastics (biorefinery).

Eucalyptus (Argentina)

Due to the currently limited use of lignocellulose for the above mentioned technologies, socio-economic and environmental impacts are low at the moment, but are expected to significantly increase in future. Since 2nd generation conversion routes are currently mainly developed in industrialized countries (e.g. USA, Sweden, Germany, Austria), the Global-Bio-Pact Case Study assesses the current and future impacts of lignocellulose for 2nd generation biofuels and biorefineries in Europe and North-America. These impacts include mainly effects on employment and on macro- and microeconomics of agricultural markets.

As the timing and scale of market of lignocellulosic conversion routes are difficult to foresee in developed countries, it is still not clear if and when 2nd generation conversion routes will be introduced in developing countries and under which framework conditions. One of the main obstacles will be the high investments for setting up conversion facilities. In addition poor infrastructure, lack of capacity and instable economic conditions present main challenges in developing countries.

Lignocellulosic bioethanol plant (Spain)

Once expanded to developing countries, bioenergy and bio-products from lignocellulosic feedstock may have large impacts especially for local people, economies, and farmers due to competition between 1st and 2nd generation conversion technologies, between large-scale (industrial) and small-scale conversion concepts, as well as between centralised versus decentralised approaches.

An important issue which determines the overall sustainability of lignocellulosic conversion routes is the choice of the feedstock origin. Thus, the impacts will be largely influenced by whether the feedstock is specifically cultivated (e.g. short rotation woody crops) or if it is waste material, such as from forestry or from other conversion processes (e.g. bagasse from sugarcane).

Excerpt from "Global Socio-Economic Impact Assessment of Biofuels and Bioproduct Chains" by Rutz et al. (2010) in the Proceedings of the 18th European Biomass Conference in Lyon, France. The full paper is available at the Global-Bio-Pact website.

Overview on Socio-Economic Impacts

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Socio-economic issues are covered by many local, national, and international legislation and agreements. On international level, the most important declarations include the Declaration of Human Rights adopted by the General Assembly of the United Nations in 1948 and the United Nations Millennium Development Goals adopted in 2000. Furthermore, the international labour standards of the International Labour Organisation (ILO) are an important agreement focussing on worker rights. These agreements include various aspects which are also relevant to the value chain of bioproducts and biofuels, especially if internationally traded.

Gender aspects

Gender aspects in the bioenergy field in *developed countries* are important, but usually more related to the general gender situation in a country and not specifically related to bioenergy.

In *developing and emerging countries* the general situation of women in rural areas are often weak. For instance, in many developing countries, most of the land is owned by men and not by women, and health conditions are also disadvantageous for women. The general situation depends upon the cultural framework, social status, and the rights of women in a specific country. In the bioenergy/bioproducts field, gender issues are much more important for developing and emerging countries than for developed countries due to several reasons which are explained below.

Traditional use of bioenergy (firewood) is still one of the most important energy sources for households in developing countries. Women are primarily responsible for activities such as preparing food, gathering firewood, collecting water, and growing crops. The use of firewood for cooking is harmful to the women's health due to in-house air pollution.

Modern bioenergy may create several advantages for women and improve the overall situation of women in developing countries. Thus, on the one hand, the substitution of traditional fuel, such as firewood by modern bioenergy carriers (e.g. ethanol) reduces in-house respiratory intoxication, avoids the destruction of valuable trees and shrubs, and decreases the time spent for collecting firewood. On the other hand, the initial investment and operation costs for modern bioenergy stoves may be higher. However, there is also the risk of harming women, especially if bioenergy/bioproducts are not produced for local use, but on industrial scale for external markets. This is especially relevant if bioenergy production competes, either directly or indirectly, with water and firewood supplies. The establishment of energy crop plantations on "marginal" lands might negatively affect women's ability to meet household obligations, including traditional food provision and food security. The establishment of such plantations might also lead to a loss of wild edible plant species, which women are usually responsible for collecting and preparing and which play a key role in the food security of rural households. At the same time, biofuels production might also affect men's contribution to household food security, due to its potential negative impact on ruminant production (cattle, sheep and goats), which men are often responsible for. The combination of these processes would have a negative impact on the food security of rural households.

Women working on plantations for industrial bioenergy generally tend to be disadvantaged, compared to men in terms of employment benefits and exposure to occupational safety and health risks. A significant number of agricultural workers in developing countries are employed on a seasonal and often on a casual or temporary basis with limited, if any, social security, including medical assistance. An increasing share of these workers is women. Reliable data on the share of women waged agricultural workers are difficult to obtain, given the prevalence of informal labour arrangements. There is evidence, however, that this share has been rising worldwide and women now account for 20-30% of total waged agricultural workers. There is also evidence that women tend to receive on average less training and instruction than men, they often do repetitive work that can result in health problems, and face reproductive hazards as a result of exposure to agrochemicals. In Malaysia, for instance, women, who represent about half the workforce on plantations, are often recruited as sprayers of chemical pesticides and herbicides, without proper training and safety equipment. This may have seri-

ous implications for the long-term health of these women workers.

Employment opportunities and risks

The growing global demand for bioenergy and bioproducts is regarded as a way to create new employment opportunities in rural areas, thus leading to increased income generation and rural development. Employment increase is generally related to all steps of the value chain, from agricultural feedstock production, to the conversion process, and to the end use. For instance, in comparison to fossil fuels, the employment rate of biofuel production is much higher. However, the positive or negative impacts on employment largely depend on the scale of the production systems. With the increasing mechanization of agricultural production in many countries, and the substitution of traditional agricultural systems, the number of agricultural jobs associated with the production of liquid biofuels is likely to decrease over time.

Working conditions

Generally, working conditions are regulated by national and international legislation (e.g. ILO). However, it is argued that in some cases, legislation is not enforced. A large share of the agricultural jobs in the biofuel industry would be of poor quality and targeted mainly to low-skilled seasonal agricultural workers (often migrants), who tend to be particularly vulnerable. Nevertheless, this is not a problem specifically addressed to the production of bioenergy/bioproducts but rather to the general legislative enforcement in a country. Thus, working conditions shall be ensured, independently if in the fields of bioenergy, bioproducts, other agricultural commodities, or even in the crude oil sector. In any case, specific studies and data on the working conditions on dedicated energy crop plantations are still scarce and have to be investigated in more depth.

Food security

Currently, the world food production is large enough to produce food to feed all people worldwide. Generally, the reasons for *food insecurity* are of national/local nature and manifold. The principal problem is that many people in the world do not have sufficient income to purchase enough food. Poverty is the principal cause of hunger. Furthermore, availability of suitable land to grow food at dedicated sites, instable economic systems, conflicts, agricultural commodity speculation and climate change are principle causes of food insecurity.

Bioenergy and bioproducts are currently not contributing to global *food scarcity*. However, this may change in the long-term as fossil resources become scarcer and land competition increases among the different sectors. Furthermore, several studies have shown that bioenergy and bioproducts are currently contributing only marginally to the increase of food prices and thus to reduced availability for the poor.

Increasing *food prices* may have large impacts on poor people in developing countries who spend a high portion of their income on food. On the other hand, increased commodity prices could contribute to rural development and poverty reduction since small-scale farmers gain more money from their products.

A number of developing countries that produce, or have the potential to produce, biofuels (or simply biofuel feedstock) are also food insecure. For this reason, it is important to assess the potential impacts of biofuels production on the food security of people living in these countries. The establishment of energy crop plantations and the impacts of the increasing demand for liquid biofuels on food prices might affect at least two key dimensions of food security – availability and access. A strategic objective would be to develop integrated agricultural systems for the simultaneous sustainable production of food, fuel and bioproducts.

Land use change

One of the most controversial subjects in developing countries is the issue of land occupation. Especially in Africa, land ownership systems are associated with uncertainties, since land property is often not officially secured, and cadastral registries are often non-existent. Land is often leased from the state or held communally and is not based on private property. Therefore, land rights are often in dispute. This uncertainty is crucial, since it does not allow for a calculation of how much land is actually available, how it is distributed across the country and how it is prevalently used. Against this background, potential development of the bioenergy sector could lead to increased demand for land and competition among actors, thus possibly exacerbating the aforementioned problems. This applies to both first- and second-generation bioenergy production from dedicated energy crops.

Previous to any land use change activity for bioenergy and bioproducts, it is important to investigate whether there is enough arable land available for food and feedstock production at the dedicated site. Furthermore, it needs to be investigated if land cultivation is possible in terms of soil conservation and efficient water use. Expansion of current bioenergy/bioproduct production is criticized especially in countries where food security is precarious since it is believed that bioenergy production aggravates competition about limited land resources.

In some areas (e.g. in Argentina, Brazil) the livestock sector may be affected by the production of

liquid biofuels. This is due to the conversion of grazing lands to energy crop plantations, and to increased livestock feed prices caused by the growing demand for agricultural commodities for the production of biofuels. This rising demand might also give rise to a potential competition for land between food and feedstock production.

Due to economies of scale, generally the production of energy crops is more cost efficient on large scale. This may lead to an agricultural transition from small to large-scale agriculture with extensive monocultures. Insight is needed on the effects of this transition, especially on social impacts.

Large-scale production of current generation feedstock is often criticized for depriving small farmers of their properties. Unclear land rights and poorly regulated land acquisition – conditions which often prevail in developing countries – lead to displacement of local farmers to non-arable regions or urban centers. These concerns are basically the same if dedicated energy crops are grown for first or second-generation bioenergy production.

According to the early adapters in the biofuel market will be the larger farmers in areas with well-functioning markets. These farmers can afford the start-up costs of converting land to another crop, expanding land under production, or changing the technological or labour inputs. Large-scale plantations for the production of liquid biofuels require intensive use of resources and inputs to which smallholder farmers (particularly female farmers) traditionally have limited access. These resources include land, water and especially modern agricultural inputs (fertilizer, pesticide, seeds). If smallholders use these inputs, they may become highly dependent and risk severe problems due to potential market shocks such as rapid increases in the prices of agricultural inputs.

Furthermore, the early adapters are likely to do very well in the market. Later adapters, most likely the small farmers who take a longer period to e.g. accumulate start up costs, will enter a more crowded field of producers, leading to lower profits (or even losses). The expansion of production of biofuel feedstock will accelerate the transformation of the rural economic landscape through favouring large scale producers.

With careful planning, this displacement of small producers might be avoided through mandates or encouragement of arrangements that integrate small farmers with processing plants.

Change in traditional use and knowledge

The resilience of rural livelihoods might be reduced by the decline of traditional local knowledge linked to the loss of agro-biodiversity. The replacement of local crops with energy crop plantations would threaten especially the extensive knowledge and the traditional set of skills of smallholder farmers in the management of local crops. It would also threaten the knowledge related to the selection and storage of seeds and crops, all activities traditionally performed mainly by women.

The potential reduction in the number and the variety of animals (particularly ruminants) raised by smallholder farmers, due to biofuels production, would contribute to the decline of traditional local knowledge. This process would threaten, in particular, the knowledge related to the use of different animals and animal-derived products.

This article is an excerpt from the Paper "Global Socio-Economic Impact Assessment of Biofuels and Bioproduct Chains" by Rutz et al. (2010) published in the Proceedings of the 18th European Biomass Conference in Lyon, France, as well as of the draft Global-Bio-pact report on socio-economic impacts of biofuels and bioproducts by Van Dam et al. The full paper and the report are available at the Global-Bio-Pact website.

Selected Events on Bioenergy and Bioproducts

Upcoming: 1st Global-Bio-Pact Progress Meeting

The next internal Global-Bio-Pact meeting will be organised on 7-8 September 2010 in Turrialba, Costa Rica. The meeting will be hosted by CATIE - Tropical Agricultural Research and Higher Education Center.

Upcoming: Global-Bio-Pact Workshop on "Public Perception of Biofuels & Bioproducts"

An international workshop on "Public Perception of Biofuels & Bioproducts" will be organised by CATIE - Tropical Agricultural Research and Higher Education Center in Turrialba, Costa Rica, on 9 September 2010.

International Conference 'Bioenergy for Sustainable Development in Africa – Lessons Learnt from COMPETE'

This COMPETE conference was organised by WIP Renewable Energies, Germany, and Imperial College London, United Kingdom, on 24-25 November 2009, in Brussels, Belgium. The main objective of this conference was to contribute to the exploitation of bioenergy resources for sustainable development in African countries in order to: (1) exploit the benefits of innovative bioenergy solutions with respect to sustainable rural development and improved livelihoods, increased energy access and income generation, alternative markets for agricultural products, security of energy supply, and diversification of energy sources and (2) avoid the dangers of negative social and environmental implications, with regards to biodiversity, water availability, land competition, land ownership, insufficient value creation for local farmers, and the 'fuel versus food' debate. A Recommendation Paper was elaborated in 2 round tables with bioenergy experts from Ghana, Mozambique, Senegal, South Africa, and Zambia.

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The conference proceedings, recommendations and presentations held are available at the COMPETE website under:

http://www.compete-bioafrica.net/events/events2/competeevents.html#brussels.

International BioTop conference Biofuels cooperation: Latin America and Europe

The BioTop project provides a broad overview of the existing biofuels sector in Latin American countries. Key focus of the project was the identification and assessment of improved 1st and 2nd generation biofuel conversion technologies. Sustainability, standardization and trade aspects of future large-scale biofuel production are investigated, and scenarios, roadmaps and recommendations were developed. Exchanges between stakeholders active in RTD of biofuel conversion technologies were promoted. Outcome of the BioTop project is increased awareness about EU-LA opportunities for collaboration in the area of biofuels and the identification of suitable areas for biofuels RTD cooperation. The International Conference on "Biofuels cooperation: Latin America and Europe" was organized as final event in the framework of the BioTop project. Around 100 participants from industry and research attended the conference on 13-14 July 2010 in Brussels, Belgium.

All presentations of the conference can be downloaded at www.top-biofuel.org.

Further information: Dominik Rutz, WIP Renewable Energies (dominik.rutz@wip-munich.de).

FAO Technical Consultation on Integrated Food Energy Systems (IFES)

In July 2010, partners of the Global-Bio-Pact project (Abigail Fallot, CATIE, Costa Rica; Rocio Diaz-Chavez, Imperial College, UK; Rainer Janssen, WIP, Germany) joined the technical consultation on "How to make integrated food-energy systems work for both small-scale farmers and rural communities in a climate-friendly way" organized by the Food and Agriculture Organization of the United Nations at the FAO Headquarters in Rome.

Integrated Food Energy Systems (IFES) are designed to integrate, intensify, and thus increase the simultaneous production of food and energy. This is achieved by diversifying land use and production, and by the use of agricultural and forest residues, leading to high resource efficiency and waste reduction. Since biomass is the primary energy source for many developing countries, in some cases delivering up to 90% of their rural energy consumption, it is crucial to address the production and use of both food and energy in a sustainable way. At the same time, the use of biomass to produce biofuels for transport is on top of many national agendas, causing controversy regarding their potential risk to food security for the rural poor in developing countries as well as concerning their potentially negative impact on greenhouse gas emission reductions and other environmental aspects.

The concept of Integrated Food Energy Systems (IFES) is fully in line with the aims and objectives of the Global-Bio-Pact project to develop and promote solutions for biomass production in developing countries which have positive socio-economic impacts for the rural population. Therefore, the Global-Bio-Pact project will seek synergies and cooperation with the FAO initiative on Integrated Food Energy Systems.

Further information: Ms. Anne Bogdanski, Associate Natural Resources Management Officer (Bioenergy), FAO, NRC (Anne.Bogdanski@fao.org).

International Expert Meeting on Biofuels for Development

On 5-6 November 2009 an International Expert Meeting on "Biofuels for Development – Lessons learnt and current trends in Sub-Saharan Africa" was jointly organized by DIE (German Development Institute), GTZ (German Technical Cooperation) and InWEnt (Capacity Building International) in Bonn, Germany. The International Expert Meeting aimed to present and discuss lessons learnt from

existing biofuel projects as well as to identify current trends and highlight new development prospects.

Presently, global biofuel markets undergo important changes to address potential negative environmental and social impacts of biofuel production and use. Industrialised countries introduce environmental and social standards to safeguard the international trade of sustainable biofuels. Furthermore, in developing countries a more balanced view on biofuels is spreading, focussing on a thorough assessment of pros and cons of different ways of producing and using biofuels in different situations, including a higher appreciation for local solutions and for a careful regulatory framework particularly of large biofuel projects. The financial crisis has further reduced liquidity of investors and delayed or stopped investments planned for the development of the biofuels sector.

Under these new conditions, assessing the prospects for the upcoming years regarding the use of biofuels for mobility and other energy purposes is a challenging task, due to the uncertainties regarding the economic development in industrial but also in developing countries. For Sub-Saharan Africa (SSA) the exploitation of its potentially large biomass potential is challenged by several problems, as SSA countries are most affected by food insecurity, exhibit weak investment climate, are vulnerable to external policy decisions and lack capacities to analyse, steer and regulate biofuel impacts and policies.

Further information: Dr. Michael Bruentrup, German Development Institute (Michael.Bruentrup@die-gdi.de)

Selected Publications

Implications of biofuel sustainability standards for Brazil

The outcomes of this study undertaken by Winrock International show that biofuels can be produced sustainably in Brazil, as long as the necessary precautions are taken. In Brazil, growth of the bioethanol sector has been as part of a conscious effort to address national energy security issues since several decades. Owing to infrastructure availability and good geophysical conditions, the Center-South region of Brazil is expected to be the main area of expansion for sugarcane, where expansion can take place in compliance with existing sustainability standards. The positive socio-economic impacts of biofuels in Brazil include the provision of around 4.1 million jobs and increases of local GDP without negative impacts on food production in areas of sugarcane expansion in the Center-South. Small scale technology or integration of cattle farming with large-scale sugarcane could deliver improved socio-economic outcomes. On the other hand, biodiesel today still plays a minor role in the biofuel industry in Brazil compared to ethanol and is focused on developing smaller-scale production to meet socio-economic goals. Given the substantial legislative framework and number of voluntary codes and initiatives in Brazil, it is unlikely that compliance with international sustainability standards will be the primary obstacle in achieving a sustainable biofuel industry. Of greater significance than the existence of international sustainability standards, is the integration of national legislation and programs with emerging international sustainability initiatives. Existing programs, codes and legislation such as the voluntary sugarcane protocol in Sao Paulo and its compliance mechanisms could be benchmarked against requirements in external markets to ensure maximum use is made of existing initiatives.

Further information: David Walden (dwalden@winrock.org).

Reference: Winrock International, 2009. Implications of biofuel sustainability standards for Brazil – Case Study #2, December 2009

http://www.sweeteralternative.com/formedia/resources

Implications of biofuel sustainability standards for Indonesia

As a net fossil fuel importer and with substantial population growth and employment challenges, Indonesia's main drivers for biofuels are to address national security through both energy security and poverty alleviation. At present, Indonesia's biofuel industry is intended primarily for domestic use and biofuels are unlikely to be traded in any volume. Market-driven approaches to incentivize „sustainable practices" will likely be unsuccessful unless there are benefits to implementation of the standard, i.e. a domestic price support or premium. However, at present, biofuel production in Indonesia is uneconomic compared to subsidized fossil fuels. A biofuels subsidy is proposed to boost the biofuel industry. This subsidy is not linked to any social or

environmental criteria for biofuels. Regional biofuel production and use has local and national benefits that, given the distribution challenges and costs associated with a diverse archipelago, have a greater social relevance than environmental focus. However, economic challenges of biofuel production limit growth of the industry as a whole and compromise both energy security (owing to distribution issues) and poverty alleviation goals. While oil palm production has provided a substantial number of jobs and improved incomes for smallholders, a decentralized framework for biofuels based on regionally appropriate feedstocks has not developed and larger scale biodiesel operations are the outcomes of economic challenges. Reconciling energy security, environmental issues and socio-economic goals is possible but several key issues remain: the lack of institutional capacity and legal framework to address land rights and the absence of a coordinated bioenergy research agenda to assist in developing regionally appropriate bioenergy models.

Further information: Jessica Chalmers (jchalmers@winrock.org)

Jatropha Reality Check

The study 'Jatropha Reality Check - A field assessment of the agronomic and economic viability of Jatropha and other oilseed crops in Kenya' concludes that Jatropha remains an undomesticated plant that requires significant agronomic advances to live up to the hype that has been generated over the past several years throughout the world. It is recommended that Jatropha should not be promoted among smallholder farmers as a monoculture or intercropped plantation crop. Based on experiences of hundreds of farmers growing Jatropha in Kenya, public and private sector actors are urged to stop promoting the crop among smallholder farmers for any plantation other than as a fence. Jatropha fences can be a sound investment for smallholder farmers, and they are a widespread, existing use of Jatropha that farmers are aware of and would likely be willing to adopt quite easily without reducing food production. The fence also has the additional benefit of protecting valuable plantation crops from trespassing wildlife and people. Jatropha could become a complementary component of a diverse livelihood strategy that contributes to overall increased agricultural productivity. However, the lack of scientific knowledge on agronomy, such as high-yielding seeds, best management practices, and optimum soil fertility, inhibits the delivery of effective farmer extension services. Another obstacle is that most growers are geographically dispersed and have yet to produce large enough quantities of seeds to achieve the economies of scale necessary for efficient biofuels processing. A final problem involves whether smallholder farmers with little access to capital can afford to wait the years it will take to recoup their investment and start making a profit. Finally, it was stressed that all actors promoting biofuels should not pick biofuel crop winners and losers without sufficient hard data, but rather should focus on supporting research and development to determine which crops prove to be the most attractive investments for farmers and other investors.

Study conducted by Endelevu Energy in collaboration with World Agroforestry Centre and Kenya Forestry Research Institute (2009)

http://regionalenergy-net.com/images/Publications/Reports/GTZ%20Oil%20Study%20Kenya2_2009.pdf

A Roadmap for Biofuels in Kenya

This study provides a comprehensive overview of the national potential and challenges facing biofuels in Kenya. The goal is to elucidate benefits and analyze viability, while also assessing possible challenges, such as economic feasibility, fiscal and regulatory limitations, and environmental and social impacts, including competition with food. The study highlights the potential of establishing a biofuels industry and analyzes the political and legal environment that will be required to promote the sustainable development of biofuels in Kenya. The study also provides a history and current status of biofuels in Kenya and a critical appraisal of the policy framework within which this sector must develop.

Study commissioned by the Ministry of Agriculture, Government of Kenya and the German Technical Cooperation (GTZ), May 2008.

The full study is available at http://regionalenergy-net.com/images/Publication/Biofuels%20Study%20%2B%20appendices-72dpi%20for%20web.pdf

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