Summary Report of the Global-Bio-Pact Project

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

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1 Introduction

Many countries worldwide are increasingly engaging in the promotion of biomass production for industrial uses such as biofuels and bioproducts (chemicals, bioplastics, etc.). Until today, mainly biofuels were supported by European policies, but support for bioproducts is still lagging behind. Thus, also the public sustainability debate concentrated on biofuels, but so far not on bioproducts. Driven by the strong public debate on sustainability aspects, biofuels are confronted with many environmental and socio-economic impacts. For instance, social impacts, which can be both positive and negative, include property rights, labour conditions, social welfare, economic wealth, poverty reduction, etc. In order to address these sustainability aspects of biomass production for industrial uses, different national and international efforts towards certification systems have been evolving, including the European Renewable Energy Directive (RED). However, besides many efforts on environmental aspects, there is a general lack of socio-economic considerations. This gap was addressed by the EU-FP7 Global-Bio-Pact project in a comprehensive approach involving partners from Europe, Latin America, Africa, and Asia. The main aim of the Global-Bio-Pact project was 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 was placed on an assessment of the socio-economic impacts of raw material production and a variety of biomass conversion chains.

2 Project objectives

The main aim of the Global-Bio-Pact project was 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 was 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 were analysed. Furthermore, the Global-Bio-Pact project investigated the impact of biomass production on food security and the interrelationship of global sustainability certification systems with the international trade of biomass and bioproducts as well as with the public perception of biomass production for industrial uses. As a major output, Global-Bio-Pact developed a set of socio-economic impact indicators. Finally, the project elaborated recommendations on how to best integrate socio-economic sustainability criteria in European legislation and policies on biomass and bioproducts.

The Global-Bio-Pact project “**Global Assessment of Biomass and Bioproduct Impacts on Socio-economics and Sustainability**” (Contract No. FP7- 245085) was supported by the European Commission in the Seventh Framework Programme for Research and Technological Development (FP7). Global-Bio-Pact was coordinated by WIP Renewable Energies and ran from February 2010 to January 2013.

3 Main results of the Global-Bio-Pact project

The Global-Bio-Pact work programme was divided into a set of 9 work packages (WP). WP1 was the project management and is not further discussed here. The main work was done in WP2 “Socio-economic impacts of biomass production, WP3 “Socio-economic impacts of biofuel/bioproduct conversion chains”, WP4 “Analysis of food security impacts of biomass production”, WP5 “Link between socio-economic and environmental impacts, WP6 “Current and future trading schemes”, and WP7 “”Public perception of biomass production for industrial use”. A key work package was WP8 “Recommendations on sustainability certification schemes” as the main results of all other WPs was used here to define recommendations and suggestions for further work. Finally, WP9 on “Project dissemination and stakeholder involvement” implemented several activities to integrate stakeholders in project activities and to disseminate the project.

3.1 Socio-economic impacts of biomass production (WP2)

In general, the production of biomass for biofuels/bioproducts may have positive and/or negative socio-economic impacts on local people as well as on local, regional, and national economies. Thus, different feedstock types were investigated regarding their socio-economic impacts on the company, community, and country level. In order to assess the impacts in more depth, they were investigated in Case Studies on socio-economic impacts on both biomass production (WP2) and biofuel/bioproduct conversion chains (WP3). The following Case Studies were investigated in the project:

- Biodiesel from soy in Argentina
- Palm oil and biodiesel in Indonesia
- Jatropha oil and biodiesel in Tanzania
- Jatropha oil and biodiesel in Mali
- Bioethanol from sugarcane in Brazil
- Bioethanol from sugarcane in Costa Rica
- 2nd generation biofuels in Canada

Each case study partner elaborated a case study report that describes several aspects of the bioenergy sector in their countries. The focus was on three different levels; the national level, regional level and local level. Following a joint methodology, the national level focused on a more general description of different sectors in the country such as the agricultural, forestry and energy sectors and the different policies that can influence the bioenergy sector. Furthermore, each partner has chosen 1 regional case study (except Costa Rica since this country is much smaller than the others) and 2 local case studies. The local case study concerned a specific company or project and describes specific problems that are faced or benefits that were created. Indicators and thresholds were identified. The following reports have been elaborated in this WP.

- "Socio-Economic Impacts of Biomass Feedstock Production"
- "Global-Bio-Pact Case Study: Socio-Economic Impacts of the Soy Chain in Argentina"
- "Global-Bio-Pact Case Study: Socio-Economic Impacts of the Palm oil chain in Indonesia"
- "Global-Bio-Pact Case Study: Socio-Economic Impacts of Jatropha Chains in Tanzania"
- "Global-Bio-Pact Case Study: Socio-Economic Impacts of the Jatropha chain in Mali"
- "Global-Bio-Pact Case Study: Socio-Economic Impacts of the sugarcane-to-ethanol production chain in Costa Rica"
- "Global-Bio-Pact Case Study: Socio-Economic Impacts of the Sugarcane chain in Brazil"
- "Socio-economic indicators identified by case studies - Evaluation of measurable socio-economic units and suggestions for future work" (joint report with WP3)

The aim of the report on "**Socio-Economic Impacts of Biomass Feedstock Production**" was to provide a first overview of the most relevant socio-economic impacts of feedstock production, based on available literature. The review focuses on the biomass resources that were selected for the case studies. This information was combined with a screening of the socio-economic criteria and indicators which are principally used in existing and developing certification systems and legislation to safeguard the sustainability of bioenergy.

The first Case Study on "**Global-Bio-Pact Case Study: Socio-Economic Impacts of the Soy Chain in Argentina**" concludes that the soybean production in Argentina is immersed within a complex agricultural production system that cannot be analysed in an isolated approach. A number of political and market factors both nationally and internationally explains its development and growth throughout the globe. The analysis of those factors is essential to understand the biodiesel industry development and constrains. Socio-economic impacts are mainly characterized by its large impact on the economy at national level. The evolution of the agricultural system with soybean production, as perhaps the most important asset over the last few years, is characterized by a continuous technological improvement. This has allowed a substantial development of the whole agricultural system. The main impact of the soybean sector and adjacent biodiesel production is thus on the national level as contribution to the wealth of the national economy.

The "**Global-Bio-Pact Case Study: Socio-Economic Impacts of the Palm Oil Chain in Indonesia**" found evidence of socio-economic impacts of the palm oil chain at all three scales analysed: national, regional and local. At the national scale, the cumulative economic impacts of the sector are significant. It was observed that the contribution of the palm oil sector to Indonesia's exports is significant. An expanding output in the context of high crude palm oil (CPO) prices means that the value of the sector is increasing. The palm oil chain in Indonesia is, however, skewed towards production of CPO. The downstream processing industries are still relatively undeveloped, especially in comparison to neighbouring Malaysia. The biodiesel sector in particular is still in its infancy, and will require sustained political support and changed incentives if its development is to gain traction. The palm oil chain is concentrated in a relatively small number of regions, including North Sumatra, where the cumulative impacts of the sector are most significant at a regional scale. In regions with high levels of palm oil production, and in particular those which have downstream processing facilities, the economic impacts appear to be significant. The impact of the sector on employment, although difficult to quantify, is likely to be significant in higher producing regions. Impacts on food security were also found to be potentially significant at a regional scale in regions with high levels of palm oil production and rapid rates of land conversion. The majority of the socio-economic impacts discussed in this report are most relevant at a local scale. The local impacts for which most evidence was found in this report included those associated with employment creation, working conditions and risks for smallholders. However, the palm oil chain, and its associated impacts, exhibit considerable variations, both spatially and temporally. Impacts in terms of regions with established palm oil plantations (such as North Sumatra) are likely to differ substantially from regions where plantations are currently expanding (for example, in terms of employment intensity and social conflict). The examples analysed in this study also found that the potential for smallholders to benefit from palm oil production varies regionally. Smallholders in North Sumatra experienced greater benefits than those in Jambi. The key conclusion from these findings is that any generalisations about the socio-economic impacts of palm oil, and any examples claiming to be „representative" should be treated with caution. Both positive and negative socio-economic impacts are, for the most part, a function of company practices, in combination with the regulatory and institutional context. In many cases, the legal instruments exist in Indonesia at least to minimise negative impacts (for example on working conditions and labour rights), but poor enforcement and corruption present challenges. Sustainability standards and certification schemes, therefore, both voluntary and mandatory, have an important role to play in improving the socio-economic sustainability of the palm oil sector in the future.

The "**Global-Bio-Pact Case Study: Socio-Economic Impacts of Jatropha Chains in Tanzania**" shows that Jatropha farming is characterized by a wide range of stakeholders with diverse interests. This is combined with the rapid evolution of the sector and needs proper coordination to ensure sustainable jatropha farming. This study has demonstrated that jatropha farming in Tanzania is far from being sustainable and therefore policy making has to take into account a number of dissatisfactions with various players and stakeholders and the uncertainties that surround their current and future roles in the production, processing and marketing of jatropha products. The policy makers must look into the whole process of developing jatropha and minimize negative socio-economic drawbacks and improve factors which will create growth of production, processing and utilization of Jatropha products.

The "**Global-Bio-Pact Case Study: Socio-Economic Impacts of the Jatropha chain in Mali**" shows that jatropha production in Mali offers a great opportunity to create local supply of energy and additional income to rural farmers, contribute to local development, increase women participation in the value chain and increase their income, while contributing to a pathway towards a green economy. Although the models currently being developed have not caused any land conflicts or food security issues, the development of sustainability criteria based on these models is necessary to avoid any future negative impacts that are warranted due to the growing interest of large corporation in the sector. In addition, the expected growing prices of fuels will make the jatropha market more and more attractive and competitive. In the production side, data on yields are sparse and inconsistent partly due to the fact that the plant is not yet fully domesticated

stressing the need for stronger agricultural research. Finally, the government through the Biofuel Agency (ANADEB) must put in place a robust monitoring mechanism and develop sustainability criteria to ensure the sustainable growth of the field from established best practises.

The "**Global-Bio-Pact Case Study: Socio-Economic Impacts of the sugarcane-to-ethanol production chain in Costa Rica**" studied the sugarcane-to-ethanol supply-chain in Costa Rica, in addition to the case study in Brazil. Costa Rica has a long history of sugarcane plantations with sugar as a main product and alcohols produced out of the molasses. However, no sugarcane-to-ethanol production chain has been settled yet in spite of the 2008 biofuel law, promoting the substitution of up to 10% of the gasoline consumed nationally by ethanol. Two companies in the country are growing sugarcane, producing sugar and molasses out of which they process ethanol exported to the EU. The national ethanol consumption is limited to one region and comes from hydrated ethanol imported from Brazil and dehydrated ethanol from Costa Rica. The only favourable region for large-scale sugarcane cultivation for ethanol production is Guanacaste province where a few large farms co-exist with smallholders. In this province with relatively low population density and high poverty rates, sugarcane production has been offering the possibility for the main income generation for the major part of the population since long-time. However it does not seem that the sector can take the province out of poverty. Opportunities offered by sugarcane production are limited due to land prices that are rising with tourism development and higher value-added crops. In the rest of the country, complementarity sugarcane production with other agricultural production is key to the sustainability of the sector. The transformation of sugar to ethanol comes after sugar production. Bagasse is used to provide the process heat. However, the framework for selling electricity to the network is not favourable, due to the prices. Main issues on environmental impacts are related to the upstream burning of sugarcane before harvesting and downstream to the spreading of vinasses given that some soils are saturated with nutrients. Further developments of the sugarcane-to-ethanol supply chain mainly rely on better incentives to optimise production and conversion processes.

In the "**Global-Bio-Pact Case Study: Socio-Economic Impacts of the Sugarcane chain in Brazil**" two specific case studies related with ethanol production from sugarcane, in Brazil, were presented. One case study was developed in Alagoas, in northeast, and a second in São Paulo, in the southeast region. It was not possible to confirm the hypothesis that the working conditions and socio-economic impacts are better in these two cases, as the Pindorama mill (in Alagoas) is a cooperative and as the São Francisco mill (in São Paulo) gives priority to organic production. However, in both cases it was possible to identify that working conditions and socio-economic indicators are similar to the best sugarcane and ethanol producers in Brazil. In both cases, due to the classified nature of some information, it was not possible to go into details in the assessment of socio-economic aspects. Despite the previous actions and positive results, in both cases improvement opportunities for reducing negative impacts were identified. On the other hand, the examples of a cooperative of sugarcane producers, and the production of organic sugarcane, shall be disseminated in Brazil. Finally, an important conclusion is that certification schemes would not have a negative impact on ethanol production in Brazil. On the contrary, the impacts would be positive, inducing improvements and the adoption of best practices.

The report on "**Socio-economic indicators identified by case studies - Evaluation of measurable socio-economic units and suggestions for future work**" was a joint report with WP3. It concludes that both, positive and negative socio-economic impacts are, for the most part, a function of company practices, in combination with the regulatory and institutional context. Furthermore, impacts on the local level are often not visible at an aggregated national level, which is the case for example with economic indicators on local level versus macro level. Therefore, it is essential to look at impacts on different levels; national, regional and local. Background indicators provide a quick snapshot image to determine whether the theme, e.g. food security, is an issue at all in the project region. After this determination, more detailed indicators can be applied to give insight in the extent of the potential impact. More methodologies have to be developed to gain better insight in socio-economic impacts. These methodologies should preferably be based on quantitative data. Many indicators are currently based on qualitative data, which is sufficient for themes such as working conditions, health issues and land use conflicts. But other, more complex,

themes such as food security, land competition or economic development of e.g. a region, that link with many different factors, need more comprehensive methodologies such as Input/output analyses or General Equilibrium models. More data collection is required on all levels (national, regional and local). Most economic indicators are based on robust methodologies, but accurate data is lacking and therefore it is hard to use the indicators effectively. Government bodies or international organisations could collect and monitor the data which would provide for example the basic data for the background indicators.

3.2 Socio-economic impacts of biofuel/bioproduct conversion chains (WP3)

Work Package 3 of the Global-Bio-Pact project covered socio-economic impacts of the conversion part in the biofuel/bioproduct chains. The objective of this WP was to assess the sustainability of existing and new biofuel/bioproduct conversion chains with respect to its economic and social impacts. Thereby, emphasis was put on industrial conversion chains in comparison with small-scale use of biomass. Close cooperation with WP2 was maintained in order to assess the economic and social impacts of the whole life cycle of biofuels/bioproducts. The following reports have been prepared.

- “Identification of current and future industrial and small scale conversion chains”
- "Introduction to socio-economic impact analysis”
- “Report on identified biomass conversion chains, their general socio-economic impacts and the translation of criteria into practically applicable indicators and thresholds”
- “Global-Bio-Pact Case Study: Socio-economic impacts of second generation conversion technologies in Canada”

The report on “**Identification of current and future industrial and small scale conversion chains**” provides an overview of current and future biomass conversion technologies, with special focus on the technologies described in the case study i.e. sugar cane, jatropha, palm oil, and soy based biofuels, as well as on the different types of biorefineries. For lignocellulosic biomass several pathways are described, using a systematic approach distinguishing between biochemical, thermochemical and hybrid pathways. Also the status of the different pathways was discussed.

The report on "**Introduction to socio-economic impact analysis**” discusses various impact assessment methods like Socio-economic impact assessment (SEIA), Environmental impact assessment (EIA), Strategic environmental assessment (SEA), Social impact assessment (SIA), Development impact assessment / sustainable development, Fiscal impact analysis, and Traffic impact analysis. As the socio-economic impacts of biofuel/bioproduct conversion chains were the main topic of interest in the project, the socio-economic impact assessment (SEIA) is expected to be the most relevant assessment method. Furthermore a general overview of possible impacts is provided, as well as other lists of impacts that could be used as checklists when preparing a selection of relevant impacts for a particular project.

The “**Report on identified biomass conversion chains, their general socio-economic impacts and the translation of criteria into practically applicable indicators and thresholds**” is including results of the two previous reports and describes identified biomass conversion chains, their general socio-economic impacts and the translation of criteria into practically applicable indicators and thresholds.

In the “**Global-Bio-Pact Case Study: Socio-economic impacts of second generation conversion technologies in Canada**” was allocated to this WP, as the main focus was on the conversion step in the value chain. Two different technologies were selected as cases: lignin and ethanol production with the Lignol process and pyrolysis oil production with the BTG process. Although these technologies are different, their socioeconomic impacts as well as the biomass supply chains are similar: both technologies can use pulp wood, forest residues, saw mill residues, waste wood, etc. Especially when biomass is extracted from forests, socio-economic issues like land ownership and conflicts are relevant. The conversion side has also many similar characteristics: both processes are in the demonstration phase, have the challenge to sale new bio-products with potentially high added value, but with the challenge of selling these products in a

fossil dominated market. Also their factories will have a quite similar general outline and need of technical and operational personal. Working conditions, health and gender issues are expected to be similar to those found in the forestry sector (biomass supply) and the chemical industry (biomass conversion). The processes are expected to have environmental benefits and the products will be marketed as being 'green'. This image of green being equal to good, needs to be supported by proper measures to ensure that proper socio-economic conditions in the field of labour conditions, health and gender equality, etc. are created and sustained.

Finally, a public **workshop** on "**Sustainability of Biofuels in Westafrica**" was held on 28 September 2011 in Bamako, Mali, in the framework of this work package. The workshop was organised by MFC and WIP and supported by the Global-Bio-Pact project as well as by the project "Mainstreaming Sustainability in the Biofuel Sector in Mali". It was co-organised by the National Agency for the Development of Biofuels (ANADEB), NL Agency, and FACT Foundation. Core of the workshop was the National Strategy on Renewable Energy in Mali and the development of a national sustainability certification scheme for biofuels in Mali. Several on-going sustainability certification schemes in Mali and other countries were presented. The need for the set-up of a national certification scheme was highlighted by the workshop participants, including about 100 representatives from politics, industry, farmers, research and NGOs. In a study tour on 29 September 2011, workshop members had the opportunity to visit Mali Biocarburant (www.malibiocarburant.com) in Koulikoro. Mali Biocarburant SA is a private company with smallholders as shareholders that produce biofuels in a way that supplements farmers' incomes, contributes to poverty alleviation and respects the environment.

3.3 Analysis of food security impacts of biomass production (WP4)

The objective of this WP was to deliver a framework and initial application of a model-based assessment of the food security impacts of changes in bioenergy production and relevant policies on food security. The results are included in the report on "**An economy-wide assessment of the food security impacts of changes in bioenergy use**", which is summarised below.

The relations between first generation biofuels and food security require careful examination, which take into account the idiosyncratic conditions surrounding a planned investment or policy that aims to advance the use of biofuels. From an economic perspective, there are at least four possible impact pathways that connect biofuels to their impact on food security. The pathways relate to land competition, impact on short and long term developments in food prices, impact on farm income and macroeconomic performance. Based on a limited qualitative assessment of these individual pathways, it is concluded that the direction of impacts on food security is not a priori clear. A basic framework is introduced for an encompassing analysis, and applied to a set of targets for biofuel share in fuel use for the purpose of illustrating the mechanisms at play. A preliminary conclusion from the illustrative exercise is that the level of biofuel ambition alone provides insufficient grounds to analyse their impact; the socioeconomic setting (e.g. a policy framework aimed more at global trade integration or self-sufficiency in the region) that forms the backdrop for a biofuel policy is a key determinant of the impact of the biofuel policy on agricultural markets and global food security.

An illustrative analysis using a global modelling framework project shows that a global biofuels policy could contribute to upward pressure on land and food prices in several developing regions. While global price and land use effects appear to preclude a negative evaluation on food security, there are several positive in-country effects that call for further specification and analysis.

The focus countries of the analysis (Brazil, Argentina and Indonesia) and several African regions will expand land use and biofuel production in response to a strong demand on the world market, as simulated by ambitious targets for biofuel use in the largest economies of the world. The land use implications are substantial: competitive Brazil produces six times beyond its local use. Its production expansion is based on an expansion of agricultural land use and on increasing productivity. In Brazil, Argentina and Indonesia the land use expansion is a factor 6, 3 and 2 higher respectively than required for an ambitious national biofuel target. The impact on land use

expansion in Africa is also large as they start producing biomass for biofuels in the countries with a biofuel ambition.

There are several arguments to underpin the consistency of these observations. First, there is an unused global land supply which is assumed to accommodate rising feedstock demand. Second, biofuel policies raise world feedstock prices, which induce intensification and technical change into the agricultural sector. The analysis suggests not only that technological change is a strong determinant of the overall impact of biofuels, but also that raising biofuel ambition may induce an acceleration of agricultural innovation. Third, biofuels potential is evaluated in the analysis against the backdrop of given crude oil prices; depending on the settings – in particular the assumed GDP growth – price incentives and market dynamics come a long way in promoting the development of a biofuel sector without policy intervention.

The combined impact of the price and income effects from a biofuels policy on food security can be assessed with the framework presented on various levels, from global food availability to national self-sufficiency and household-level affordability. The results suggest that an ambitious set of biofuel targets could structurally raise global crop prices by 3% in 2020, on top of an already elevated price level in the 2007 reference year.

A shortcoming was listed in terms of the limited scope to address (excessive) price swings and fluctuations in income, which are main determinants of the risk of falling into a state of hunger and malnutrition. Given the wide scope and multiple dimensions of the food security concept, a comprehensive framework is needed that covers all pathways and a broad set of indicators. Improved insight into nutritional impact – a basic determinant of food utilization – is a first priority for extending the framework towards maximum relevance for decision-making on food security. However, even to incorporate the impact pathways for food availability and food accessibility requires substantial progress the current state of the art. Starting from the existing and already advanced modelling framework, which integrates economics and biophysical perspectives on the food and energy systems, the following elements could be thought of as useful additions:

1. The evaluation of the potential of bioenergy and biofuel to promote rural development. The impact of bioenergy on income generation and therefore food (in)security depends partly on the production technology employed, and the institutional setting. The analytical framework would need to incorporate how the bioenergy supply chain is integrated into agricultural, social and economic systems. Large scale biofuel investments may enhance growth and poverty reduction despite some displacement of food crops by biofuels. Benefits depend on the production system, labour-intensity and the land rent scheme. Technology spill-overs will need to be assessed, as these have been identified as major contributors to positive growth effects, also for making growth inclusive. Further the analysis should incorporate a valuation of by-products to improve the representation of market incentives, and consider non-linear approaches to technological change.

2. Capture nutritional aspects, both for long term and short term implications. The individual and household level food security indicators presented in the paper can be strongly improved by providing more detailed impact assessments for typologies of households. Two other challenges appear at least as prominent. First, there is a need to open up the consumption basket in terms of nutrient content in order to enable the identification of changes to nutrient adequacy of diets. Modelling frameworks should move beyond dietary quantity (calories) towards quality (i.e. nutritional composition in terms of, for example, fat and micronutrient content). A nutrition module can take the form of a matrix incorporating nutritional aspects per unit of food consumption for all food items in the database of the MAGNET model. Second, the assessment framework is of limited value for an evaluation of the coping mechanisms of vulnerable households under biofuel-induced compromises to food access. At best, a diversification of the income base can be derived from the analysis. Complementary assessment frameworks are required to address the stability and risk dimensions of food security in relation to biofuels.

Notwithstanding the obvious merit of a macro-level modelling framework of analysis, a breadth of field survey and micro-level analysis is required to unravel the implications of biofuels for rural economic development and household livelihood.

3.4 Link between socio-economic and environmental impacts (WP5)

The objective of this work package was to identify synergies and conflicts between environmental and socio-economic impacts of biofuels and bioproducts. In this WP five reports were elaborated:

- "General environmental impacts, principles, criteria and indicators of biomass production and conversion"
- "Tools for identifying the suitability of different land types for sustainable biomass production"
- "Report on show cases and linkage of environmental impacts to socio-economic impacts"
- "Report on sustainability impacts of the use of marginal areas and grassy biomass"
- "Strategies for the harmonization of environmental and socio-economic sustainability criteria"

The report on "**General environmental impacts, principles, criteria and indicators of biomass production and conversion**" provides an overview of the environmental impacts that are typically associated with biomass production and conversion for biofuels/bioproducts. Moreover, it reviews existing certification systems in this field, which are meant to mitigate negative impacts on the environment. The report concludes that biofuels/bioproducts are typically associated with a number of environmental impacts often showing a distinct pattern: environmental advantages in terms of energy and greenhouse gas savings (provided that there is no carbon stock change due to land use changes), but ambiguous results or even disadvantages regarding acidification, eutrophication, ozone depletion, summer smog, and human toxicity. Secondly, it concludes that the range of sustainability standards reviewed is quite similar in terms of coverage of issues identified for the review: almost all of them include a cut-off date for land-use change, carbon reduction/conservation in operations is not well covered, carbon emissions related to land use change is explicitly covered in some standards, air is not particularly well covered, and finally biodiversity is addressed in all of the standards reviewed, but the detail of the requirements varies considerably.

The report on "**Tools for identifying the suitability of different land types for sustainable biomass production**" presents an assessment of selected methodologies, frameworks and tools for assessing land use for bioenergy production. These tools are necessary to define areas which do not conflict with other uses (e.g. food and feed production) and values (e.g. High Conservation Value Areas, biodiversity, carbon storage). Depending on the methodology of the tools (e.g. mapping, zoning, modelling), their suitability for developing countries is different. The investigated case studies clearly demonstrated that a combination of different tools is necessary in order to assess the land use. Furthermore, the information also contributes and responds to policy making process in different parts of the world.

The "**Report on show cases and linkage of environmental impacts to socio-economic impacts**", presents the results of an analysis of strengths, weaknesses, opportunities and threats for each Global-Bio-Pact case study. Through the SWOT analyses on the Global-Bio-Pact case studies, all types of linkages be-tween socio-economic and environmental impacts could be identified: positive correlations, trade-offs as well as negative correlations. These insights were interpreted in the light of the ecosystem services approach, according to which environmental impacts lead to changes in ecosystem services which in turn negatively affect the so-called constituents of human well-being. This holds especially for 'provisioning' and 'regulating' ecosystem services which affect some but not all constituents of well-being. 'Security', 'basic material for good life' and 'health' are affected, whereas there is only a weak linkage between the ecosystem services mentioned above and 'good social relations' and 'freedom of choice and action'. Thus, the authors conclude that (1) trade-offs and negative correlations between environmental and socio-economic impacts are a sign of deteriorations of environmental services which negatively affect the constituents of human well-being 'security', 'basic material for good life' and 'health'. These impacts are often related to inappropriate management practices during feedstock production and conversion which either reflect the absence of respective regulations or at least a weak law enforcement by the country's institutions. Certification could help here, at least by raising awareness. Furthermore, it is concluded that (2) the second cause for trade-offs and

negative correlations is land use conflicts and land-use change. For direct land-use change (dLUC), the same applies as for inappropriate management practices (see above). However, certification does not help resolving the issue of indirect land-use change (iLUC). Another conclusion is that (3) the impacts associated with the production of a feedstock are fairly independent of its use, i.e. whether the feedstock is used for biofuels / bioproducts or for other purposes. Therefore, most of the conclusions drawn are applicable for the general cultivation of the respective feedstock. They do not necessarily reflect the specific impact of the biofuel production as such. Therefore it is important to apply the same rules for all agricultural products irrespective of their use for food, feed, fibre or fuel. Finally, it is found that (4) most of the linkages between environmental and socio-economic impacts can be detected at local level, whereas some linkages can only be detected at country level (or even higher), e.g. impacts on food security. Furthermore, some of the linkages regarding food security will need additional studies and a different methodology to be able to fully demonstrate that biofuel production may cause food insecurity and in how far biofuel mandates in developed countries and / or globally rising energy prices contribute to that.

The "**Report on sustainability impacts of the use of marginal areas and grassy biomass**" aims to challenge two frequent hypotheses, according to which land-use competition and its negative side-effects can be reduced or mitigated: i) through the use of marginal (or degraded) land and/or ii) through the use of grassy biomass. It is concluded that it is rather unlikely that the use of marginal (or degraded) land and/or the use of grassy biomass can significantly contribute to alleviate land-use competition and its negative side-effects. The authors of this report think that these frequently heard hypotheses are refuted.

The report "**Strategies for the harmonization of environmental and socio-economic sustainability criteria**" summarizes all findings of the work package. It is found that the ecosystem services approach proves to be very suitable for establishing the linkage between environmental and socio-economic impacts, but is still new in the business and project arena and requires further development. The number of companies that use approaches and standards such as the Corporate Ecosystem Services Review (ESR) or the Equator Principles is still very limited, particularly in the bioenergy sector. In terms of harmonisation of environmental and socio-economic sustainability criteria any strategy should especially focus on the mandates with sustainability requirements such as the EU Renewable Energy Directive (2009/28/EC, RED), since these are to a large extent setting the scene. At European level, it is recommended to include additional mandatory environmental sustainability criteria regarding soil, water and air protection, i.e. criteria that have a strong link to ecosystem services (e.g. /UNEP et al. 2011/). This way, some social impacts affecting 'security', 'basic material for good life' and 'health' can be covered indirectly. Moreover, it is recommended to include mandatory socio-economic criteria regarding working conditions and rights, land use conflicts and land tenure, health and safety as well as gender. Last but not least the authors suggest to deepen the existing reporting obligations by establishing a monitoring system.

3.5 Current and future trading schemes (WP6)

The objective of this work package was to identify future trends of global biomass/biofuels/bioproducts trade and its impacts. International trade of biomass and its products is increasing steadily. However, future trade of biomass/biofuels/bioproducts depends on legislation, trade barriers, as well as on demand and supply of different countries. In general export may increase from developing countries to emerging economies and industrialised countries. These future trends may have positive and negative, social and environmental impacts. Three reports have been elaborated in this work package:

- "Overview of Current Trading Regimes for biomass/biofuels/bioproducts"
- "Impacts of biofuels/bioproducts trade and certification schemes on economies in Africa, LA and Asia"

- "Report on impacts of biofuels/bioproducts trade and new legislation on economies in Europe"

The report on "**Overview of current and future trading regimes for biomass/biofuels/bioproducts**" provides an overview on current trading regimes for biofuels and bioproducts. Emphasis has been given to ethanol, biodiesel, pellets and forest products. The production of nonconventional bioproducts, such chemicals, is still very small and detailed information is not available for the time being. The main conclusions of this report are that trade of ethanol, biodiesel and wood pellets are growing, but the volumes traded are still low regarding other energy and agriculture commodities. International trade of liquid biofuels has been strongly influenced by trade regimes imposed by US and EU, which are by far the main markets for ethanol and biodiesel, respectively. In the case of pellets, the main consumer market has been the EU and the main exporters have been the US and Canada. Trade regimes have been much less restricted for pellets regarding liquid biofuels. Sustainability requirements and certification schemes will have a strong influence on trade regimes both for liquid biofuels and pellets. In case of liquid biofuels, sustainability requirements have already been imposed by EU and US. In the case of pellets the consumer market that has been imposing sustainability requirements.

The report on "**Impacts of biofuels/bioproducts trade and certification schemes on economies in Africa, LA and Asia**" concludes that the trade of ethanol, biodiesel and wood pellets is growing, but the volumes traded are still low. The international bioenergy trade is both supply and demand driven, despite the fact that the demand has been induced by national policies, as mandates. Up to now, import duties have largely influenced trade volumes, and tariff preferences are the main driver of trade routes. According to one the studies quoted in this report, in 2020 almost 50% of the biofuels demand would be used in the EU and North America (mostly US) and almost 30% in Latin America (mostly Brazil). The remaining demand would be in China and other Asian countries. In this sense, biofuels trade will become increasingly important and can help trigger investments and mobilise biomass potentials in certain regions. As long as the technologies of second generation biofuels develop, the production of liquid biofuels would be more concentrate in countries that dominate such technologies and/or the consumption is higher. Raw biomass could be supplied by the regions with higher potential for the production and, in principle, certain biofuel trade routes could only exist for a limited period. Regarding trade of pellets, the markets of non-industrial pellets are largely self-sufficient, markets of industrial pellets depend on the import from outside the EU. Industrial pellet markets are relatively mature, compared to non-industrial ones, because of their advanced storage facilities and long-term price-setting, but depend on the establishment of public support schemes. The market for pellets is growing rapidly mainly in Europe and in a smaller extent in North America and in Asia. The European market will require a significant share of imports, mainly of industrial pellets; so far the main suppliers are Canada and US, but there are good opportunities for new players. A clear tendency seems to be the production of advanced bio-products (and also advanced biofuels) in the developed countries, in the so-called hub-harbours, using feedstock imported from developing countries. Considering the six countries specifically addressed in the Global Bio-Pact project, those with large potential for the production of biofuels (and in some sense also with potential for bioproducts production) are Argentina and Brazil. This statement is due to land availability, the existing infra-structure, the tradition on the production of agricultural goods, and the production stage regarding sustainability. Indonesia has also reasonable potential, but at this moment sustainability has been a constraint for a reasonable share of the production (e.g., of palm oil). Costa Rica and Tanzania have constrains due to small land availability and the lack of infra-structure, respectively. And, finally, Mali, is the country with lower possibilities of becoming an exporter of biofuels/bio-products. Considering the time horizon of 8-10 years, sustainability requirements and certification schemes will not be a severe barrier for exporting biofuels/bio-products, at least for the countries with potential of producing reasonable volumes in such period. This is the case of Argentina and Brazil, but Indonesia can face difficulties. A country like Tanzania has a limited potential of being an exporter of biofuels/biomass and it will be a challenge starting the production fulfilling the requirements imposed by Europe and in US.

The "**Report on impacts of biofuels/bioproducts trade and new legislation on economies in Europe**" states that trade of biofuels and biomass has increased significantly over the past 10 years and this trend is expected to continue in the future. The EU currently is the most lucrative market for solid and liquid biofuels. This is mainly due to EU policies and the emphasis on sustainability. The report concludes that the main market of liquid biofuels in Europe is still biodiesel, but some Member States could give priority to ethanol in the future. Import to Europe will play an increasing important role. Furthermore, the authors conclude: Certified production of liquid biofuels is a reality. The explicit consideration of socio-economic impacts could be added. The production of new bio-products is an opportunity, but the market barely will be large in short to mid-term. The production of new bio-products will most likely happen within Europe from imported raw materials. This is shown by on-going investments in important ports in Europe. In the future, the production of new bioproducts must be certified (regarding sustainability) as well. The sustainability initiatives for biofuels shall be a guideline.

Finally, within this work package an international **workshop** on "**Sustainability of Global Trade of Biofuels & Bioproducts**" was organised by Greenlight Biofuels Indonesia and supported by WIP Renewable Energies, Germany, on Wednesday 16 March 2011in Medan, Indonesia. The workshop engaged various stakeholders working on sustainability issues related to the biofuel and bioproduct value chains and trade, and enabled discussion and exchange of ideas between international members of the Global-Bio-Pact consortium and Indonesian stakeholders. As the workshop was held in Indonesia, much of the discussion, and all the presentations from Indonesian participants focused on issues in the palm oil sector, as palm oil is the country's primary potential feedstock for biofuel production. Over 40 participants attended the workshop. Participants represented academia, national research institutes and NGOs. Recurring themes throughout the workshop included the challenges faced by smallholders in obtaining certification, the role of sustainability certification schemes in improving sustainability standards and the conflicts between social and environmental sustainability and economic development. The workshop was followed on 17 March by a study tour for the Global-Bio-Pact consortium members. The objectives of the study tour were to enable the Global-Bio-Pact participants to see the actual palm oil production chain and discuss production practices with mill operators. The tour included visits to an independent palm oil mill (T Karya Pertama Niaga Jaya CPO Mill, KPNJ) in Batubara District, and to a group of independent oil palm smallholders in Perbaungan District, both in North Sumatra Province, south of Medan.

3.6 Public perception of biomass production for industrial use (WP7)

Public perception is a prerequisite for future development of the biofuel/bioproduct sector in Europe and worldwide since it determines the public acceptance, and thus the demand of biofuels/bioproducts. Public perception largely depends on cultural aspects, history and economy of the producing countries, objectives of importing countries, environmental and social targets, as well as on the positive or negative impacts on individuals and communities. Different public perspectives in Africa, Latin America, Asia, Europe, and North America were assessed and compared to each other.

A document on "**Methodology and Guidelines for Assessing Public Perception on Biofuels and Bioproducts**" was elaborated outlining the methodology and the guidelines to be used by the project partners responsible for conducting the public consultation in Africa, Latin America, Asia, Europe, and North America. As a result of the surveys, the following reports were elaborated:

- **"Public perception of biofuels. The Argentine case"**
- **"Public Perception Assessment on Biofuels. Brazilian Case"**
- **"The public perception of biofuels/bioproducts in Costa Rica"**
- **"Assessment of Public Perception on Biofuels in Germany"**
- **"Assessment of Public Perception on Biofuels and Bioproducts in Indonesia"**
- **"Report on public perception on biofuels in Mali"**
- **"Assessment of Public Perceptions on Biofuels and Bio-Products in Tanzania"**

The results of these reports were analysed and compared to each other in a summary report on "**The public perception on biofuels from different country perspectives**". This report concludes that the knowledge on biofuels is generally low and focused on specific biomass and products. The positive or negative appraisal usually focuses on one aspect of biofuels where expectations are the highest. This aspect is specific to each case study: rural growth in Argentina, biofuel prices from a consumer perspective in Brazil, environmental benefits in Costa Rica, fossil fuel substitution in Germany, economic development in Indonesia, access to energy in Mali, and poverty alleviation in Tanzania. It is important to have more communication to increase the low level of knowledge on biofuels, but it is important to specifically focus on the priority issues and concerns in the country. The main results illustrates that the dynamics of public perception depend on the type of biofuel considered. It is definitely difficult to assess public perception without contextualizing and specifying the type of biofuels, although the public often does not know the differences between the biofuels. An important recommendation of this report is to set priorities and be realistic on the objectives of biomass policies and regulations. Like this, exaggerated expectations and misunderstandings in the public on the outcomes of regulations could be avoided. In addition, the communication on biofuel policies and their preceding consultations has to be transparent, coherent and comprehensible. This also means that decisions and strategies should be based on a sound scientific basis and communicated as such. Public perception can also be accounted for through improved public consultation processes, which should be based on the above recommendations as well. Policy makers need to be open to the results of public consultations and seriously consider the adaptation of the outcomes. Finally, these consultations have to be inclusive and a broad range of stakeholders should be able to comment on regulations. On the long term, it is important to better monitor the dynamics of public perception and the reasons for these fluctuations.

Finally, an "**Inter-cultural workshop on public perception on the use of biomass for biofuels/bioproducts**" was organised on 9 Sept. 2010 in Turrialba, Costa Rica. More than 55 attendees participated in order to discuss about the public perception of bioenergy and more specifically biofuels.

3.7 Recommendations on sustainability certification schemes (WP8)

The main objective of WP8 is to use and further analyse the results of the previous work packages in order to create a "Global-Bio-Pact set of selected socio-economic sustainability impact indicators" for biomass production and conversion which will be audit-field-tested. Furthermore, recommendations on policies and harmonization will be elaborated.

- "Assessment of existing socioeconomic principles, criteria and indicators for biomass production and conversion"
- "Global-Bio-Pact set of selected socio-economic sustainability criteria and indicators"
- "Test auditing of the Global-Bio-Pact socio-economic sustainability criteria and indicators"
- "Recommendations on using audit procedures and tools for achieving sustainability within biomass certification schemes"
- "Recommendations on the integration of socio-economic sustainability criteria in European legislation and policies"
- "Recommendations on how to harmonise sustainability certification for biofuels and bioproducts"

The review of existing sustainability standards in the report on "**Assessment of existing socioeconomic principles, criteria and indicators for biomass production and conversion**" demonstrated that there is still a need to include other socio-economic indicators that can contribute to avoid some negative impacts of biofuel production.

Thus, the objective of the "**Global-Bio-Pact set of selected socio-economic sustainability criteria and indicators**" is to provide a tool that allows to indicate the state of the impact and to monitor it over time. It is expected that these indicators can be useful for different users from project developers, government and standards. The set of indicators proposed by the Global-Bio-

Pact project is balanced and includes the main topics of impacts selected by a clear process with the aid of expert partners of the project. Furthermore, the topics reflect the main identified socio-economic and environmental areas which can be measured in order to monitor and if possible to eliminate negative impacts and to promote the benefits if a sustainable production is in place. The use of these indicators shall help the different users in promoting the sustainable production of biofuel production. The Global-Bio-Pact set of indicators does not aim towards a harmonisation of principles, criteria or indicators, but to work as complementary information source for socio-economic issues of current standards.

In order to test the applicability of the indicators, two field tests in Argentina and Brazil were implemented. The results are included in the report on "**Test auditing of the Global-Bio-Pact socio-economic sustainability criteria and indicators**". The assessment of the indicators showed that most of the indicators were clear and easily understandable for the interviewed company representatives. Some of the indicators could, however, be further refined to make it clear what information is being requested. This was particularly the case for the indicators where parameters had not been clearly defined (e.g. wind-prone region).

The report on "**Recommendations on using audit procedures and tools for achieving sustainability within biomass certification schemes**" shows that collecting impact information data audit process presents a valuable opportunity for sustainability schemes to build on existing procedures. It is likely that existing schemes will need to introduce changes gradually, starting with changes to the audit process requirements and possibly later introducing changes to the standard itself. These changes could range from relatively minor adaptations such as clarifications or specifications, to larger-scale such as introducing new impact indicators to be reported on. Adaptations in this area could also bring other general benefits to the scheme, including greater clarity for both the operation and the auditor on what information is required and how it should be reported. There are also opportunities for the scheme to achieve a higher level of consistency in information that is being reported to them, and that then can be more efficiently used by the scheme. This report presented also practical tools that can be used to identify, measure, and mitigate potential socio-economic impacts: impact assessment tools (screening exercise, guidelines and special online tools); manuals on good practices; monitoring and management plans; and capacity building and trainings. Each of these tools has advantages and disadvantages, but can be complementarity.

As a key result of the Global-Bio-Pact project, the report on "**Recommendations on the integration of socio-economic sustainability criteria in European legislation and policies**" uses the overall findings of the project to propose some direct recommendations to the European Union, and more specifically to the Renewable Energy Directive (RED). It is obvious that the RED should not promote biomass and bioenergy that has negative impacts, either environmental or social. Therefore, measures are needed to guarantee that biomass and bioenergy have mainly positive or at least neutral impacts. In reality there will always exist trade-offs and not all negative impacts can be avoided. Therefore, some guidelines on the prioritisation of impacts may help. It must be considered that also conventional fuels are associated with negative impacts, both environmentally and socially. For fossil fuels, no sustainability scheme exists. Considering the comparison with fossil fuels, it must be ensured that European legislation, such as the RED, is not too complex and does not block-out the development of biomass and bioenergy. However, the application of certain (limited) sustainability criteria to biomass and bioenergy may open a gateway for the certification of other (bio-)products in a bio-based economy. Thereby, certification could act as a tool to improve the overall agricultural sector, not only for bioenergy, but also for bio-products and even for food, feed and fibre. Thus, legislation should be designed to avoid the worst negative impacts, but at the same time to allow for enough freedom for the development of the market. The project identified and assessed socio-economic impacts through the development of a set of indicators that were tested in the field. The studies and results about different types of feedstocks, societies, and agricultural systems clearly demonstrated that it is difficult to develop general approaches for different feedstocks. There is a clear need to differentiate between the types of feedstock (e.g. perennial and annual crops, as well as dedicated energy crops and residues or co-products). The final recommendations from the Global-Bio-Pact project are as follows:

- The set of indicators of the Global-Bio-Pact project is able to indicate and to monitor the impacts of bioenergy production. It is expected that these indicators will be useful for different users from project developers, government and standards.
- The EU should consider the implementation of a Monitoring and Evaluation System at the regional (national) scale within the EU. The data collected at EU level could be used by voluntary standards to feed into their own M&E systems. In return, voluntary standards could also share the data collected in the context of their M&E System with a differentiation between impact indicators and compliance indicators.
- A mandatory Monitoring and Evaluation obligation should be introduced for some selected socio-economic impacts for biomass and bioenergy companies that sell their products on the European market under the RED. These criteria could be the ones considered in current available voluntary standards along with some of the criteria selected in the Global-Bio-Pact project. Furthermore, biomass and bioenergy companies shall be obliged to publish the results of this monitoring as part of their Corporate Social Responsibility Programmes or as part of the compliance with voluntary standards. After a certain period, results could be used in a second step to include selected socio-economic criteria in the legislation.
- The introduction of socio-economic requirements in the RED (or any other legislation), could be seen as “necessary to protect human life or health”, provided that such measures are applied equally to any country in the world without any kind of discriminatory prejudice.
- It should be assessed if the ratification and implementation of the mentioned ILO Conventions could be a precondition for the use of biomass and bioenergy in the EU. The use of biomass and bioenergy from countries that have not ratified or implemented the mentioned ILO Conventions may be blocked out by the legislation. This has to be assessed especially with regards to international trade agreements.
- An amendment of the RED should specify in more detail the socio-economic requirements, including more details on the reporting obligation of the EC to the EP.
- There is an urgent need to inform the European citizens and the general public not only about the negative impacts, but also on the positive impacts of the biomass production– both on environmental and socio-economic issues.
- The difficulty to provide “evidence… that biofuel production has a significant impact on food prices” has been explained. The impacts of increasing demand for biomass and bioenergy on food prices is still controversially discussed. In general it is acknowledged, that increasing demand for biomass and bioenergy is only one factor that leads to increasing food prices although in some cases they could lead to increasing food-feed availability in certain markets. Other factors need to be considered such as speculation, national agricultural policies, weather changes, land disputes, potential indirect impact as displacements and impacts on crops. Furthermore, the term “significant impact” needs to be specified. It is not clear why the RED only mentions impacts on food prices and not on other potential impacts. Thus, other impacts may be included as well.

In addition to these recommendations “**Recommendations on how to harmonise sustainability certification for biofuels and bioproducts**” were elaborated in a separate report. Whilst the development of standards and certification cannot ensure the provision of sustainable supplies of biofuels, they will play a major role in developing the framework for sustainable agriculture and forestry and extend it to a more sustainable biofuel production. Therefore, the way forward is to use these tools to help reconcile the inherent trade-offs between the different demands for photosynthetic products and to increase the efficiencies of production and supply. Harmonisation of the different available standards and schemes (recognised and non-recognised by the EU) for biofuels will be a difficult task to conduct at a European and global level. Furthermore, there is no strict need to do so, even with a meta-standard. In the case of Europe the political and regulatory frameworks are in some way providing the bases for the criteria and indicators considered necessary to assure a sustainable biofuel production. One of the main concerns with the standards is whether they generate barriers for trade and result in discrimination. The World Trade Organisation (WTO) is still unclear in terms of the possible barriers to trade. Indirect land use

change impacts (iLUC) and sustainable verification systems should be applied to other commodities as well specially in countries where this debate is on-going.

Finally, an **international conference** on "**Socio-economic Impacts of Biofuels and Bio-products**" was organized as final event of the Global-Bio-Pact project to present and discuss the project results with stakeholders involved in sustainability aspects of biofuels and bio-products including certification. The conference included presentations from high ranking international bioenergy experts, as well as panel discussions and round tables. The conference took place on 29-30 January 2013 in Brussels, Belgium.

3.8 Project dissemination and stakeholder involvement (WP9)

The objective of this work package was to disseminate project activities and results among stakeholders. This work package actively promoted exchanges between RTD experts, stakeholders and key actors. This work package also supported consultation and integration of stakeholders in project activities by the set-up of an Advisory Board and offered technical tours, an RTD exchange program, workshops, and the final conference to interested stakeholders. A project website was developed (www.globalbiopact.eu) on which all final project reports, publications, workshop presentations, and dissemination material was uploaded. Regular newsletters informed the interested stakeholders about on-going project activities.

4 Conclusion

In response to the call on Topic KBBE-2009-3-4-01 of the Seventh Framework Programme (FP7) for Research and Technological Development of the European Union, the Global-Bio-Pact, the expected impact was: "*The development of sustainability criteria for biomass production, conversion systems and trade could assist in preventing negative socioeconomic impacts. The European and international added value lies in the development of appropriate international certification systems for biomass production and use will contribute to reaching socioeconomic goals and facilitate world trade. The project could assist to reaching the Millennium Development Goals.*"

The expected impact of Global-Bio-Pact was to provide experiences and information on an area that has so-far not provided enough data, information and public participation: socio-economic impacts from biofuels/bioproduct value chains of 1st and 2nd generation technologies. Additionally, the project provided practical case study information on the socio-economic impacts of the implementation of sustainability and certification in sustainable biomass/bioproduct production and enhanced cooperation between key researchers and industries from different regions including the EU, Latin America, Africa and Asia.

To achieve these goals Global-Bio-Pact critically examined the current information on socio-economic impacts, current sustainability and certifications schemes, different conversion technologies and supply chains and public perception. The project used a holistic, multidisciplinary approach to understand the issues of socio-economic implications and the development of effective sustainability certification schemes for biomass and bioproducts.

As a key output, the project formulated recommendations on the integration of socio-economic sustainability criteria in European legislation and policies in order to provide input and advise to the Renewable Energy Directive (RED).

5 Contact and further information

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Further information as well as all Global-Bio-Pact reports and deliverables are available on the Global-Bio-Pact website: www.globalbiopact.eu