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Development of strategies and sustainability standards for the certification of biomass for international trade

Summarizing Final Report

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NATURE CONSERVATION AND NUCLEAR SAFETY

Project No. (FKZ) 37 07 93 100
Report No. (UBA-FB) 001398/ZUS,E

Development of strategies and sustainability standards for the certification of biomass for international trade

Summarizing Final Report

by

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On behalf of the Federal Environment Agency (Germany)

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15. Supplementary Notes
Besides the final report, a supplement (on CDROM) was prepared containing all project working papers, a documentation of the workshops held, the most relevant presentations, and a selection of relevant literature (articles, reports, studies).

16. Abstract
The increased production of renewable raw materials for bioenergy and bio-materials needed to meet the ambitious targets of Germany, the EU and other countries implies tradeoffs which could oppose sustainability requirements. The project worked out the scientific base of and developed proposals for sustainability requirements for biomass and their implementation on national, European and global levels, in dialogue with relevant actors and provided inputs into respective processes. For that, discussions with experts from more than 20 countries were held, international networks created and extended, and political decision-makers supported. Besides answers to strategic questions, the issues focused on were greenhouse gas balances (calculation of GHG emissions from direct and indirect land use changes), biodiversity (a globally applicable risk minimization strategy was developed and tested in Brazil, China and South Africa for degraded lands), water scarcity and water quality (requirements for biomass cultivation were developed). The majority of project results was successfully implemented in legal and standardization processes (e.g., German Sustainability Ordinances for bioenergy, EU renewable energy directive, European Committee for Standardization, Global Bioenergy Partnership) and both scientific and environmental and development questions were discussed with – not only governmental – actors. The next steps should be the extension of the approaches developed to other biomass (especially for material use) and the critical review of the further implementation.

17. Keywords
algae, biodiversity, biomass, bioenergy, biofuels, certification, degraded land, greenhouse gases, land use change, life-cycle analysis, potentials, renewable raw materials. soil, sustainability, sustainability standards, trade, water

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<tr><td>14. Abbildungen
13 + 220 in Materialband (auf CDROM)</td></tr>
<tr><td colspan="3">15. Zusätzliche Angaben
Neben dem zusammenfassenden Endbericht wurde ein Materialband (auf CDROM) mit allen Arbeitspapieren des Vorhabens sowie einer Dokumentation der durchgeführten Workshops, den wichtigsten Präsentationen und einer Auswahl relevanter Literatur (Artikel, Berichte, Studien) vorgelegt.</td></tr>
<tr><td colspan="3">16. Kurzfassung
Die vermehrte Erzeugung nachwachsender Rohstoffe für Bioenergie und -materialien durch ambitionierte Ziele in Deutschland, der EU und anderen Ländern birgt Zielkonflikte, die Nachhaltigkeitsanforderungen entgegen stehen können. Das Vorhaben erarbeitete wissenschaftliche Grundlagen und Vorschläge zu Anforderungen an nachhaltige Biomasse sowie zu deren Implementierung auf nationaler, europäischer und globaler Ebene im Dialog mit relevanten Akteuren und brachte sie in entsprechende Prozesse ein. Dazu wurde mit Experten aus über 20 Ländern diskutiert, internationale Netzwerke auf- und ausgebaut und politische Entscheider unterstützt. Neben Antworten zu strategischen Fragen standen die Themen Treibhausgas-Bilanzierung (Berechnung von Klimagasemissionen aufgrund direkter und indirekter Landnutzungsänderungen), Biodiversität (eine weltweit anwendbare Risikominimierungsstrategie wurde entwickelt und in Brasilien, China und Südafrika am Beispiel degradierter Flächen erprobt), Wasserknappheit und Wasserqualität (Anforderungskataloge zum Biomasseanbau erarbeitet) im Mittelpunkt. Die Mehrzahl der Projektergebnisse wurden erfolgreich in Gesetzes- und Normungsprozesse eingebracht (z.B. deutsche Nachhaltigkeitsverordnungen für Bioenergie, EU Erneuerbare Energien Richtlinie, Europäisches Komitee für Normung, Global Bioenergy Partnership) und sowohl wissenschaftliche wie auch umwelt- und entwicklungspolitische Fragen mit - nicht nur staatlichen – Akteuren diskutiert. Nun stehen die Ausweitung der gefundenen Ansätze auf weitere Biomasse (vor allem stoffliche Nutzung) an sowie die kritische Begleitung der weiteren Umsetzung.</td></tr>
<tr><td colspan="3">17. Schlagwörter
Algen, Biodiversität, Biomasse, Bioenergie, Biokraftstoffe, Boden, degradierte Flächen, Handel, Klimaschutz, Landnutzungsänderungen, Lebenswegbilanzen, Nachhaltigkeit, Nachhaltigkeitsstandards, nachwachsende Rohstoffe, Potenziale, Rechtsfragen, Treibhausgase, Wasser, Zertifizierung</td></tr>
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We greatly acknowledge the intense discussion and the technical and organizational support of the UBA project managers, Almut Jering (UBA) and Inge Paulini (now WBGU). We would also like to thank Anne Miehe (UBA) and Kathrin Ammermann (Federal Agency for Nature Conservation, BfN) as well as Kilian Delbrück, Meike Kretschmar, Jessica Löhndorf, Karin Freier, Almuth Ostermeier-Schlöder and Thomas Weber (all BMU) for their critical comments.

The project was supported by an advisory board whose valuable remarks and comments were highly appreciated, as well as many people willing to participate in the workshops held as part of the project. Thanks to all of them[1].

We hope that the results of the completed research project will provide orientation and beneficial information en route towards sustainable biomass production and use.

Darmstadt, Heidelberg, June 2010 The Authors

[1] The members of the advisory board of the project and the workshops have been documented on the attached CD-ROM.

1 Objectives and Approach of the "Bio-global" Research Project

The "Development of strategies and sustainability standards for the certification of biomass for international trade" research project (short title: **Bio-global**) was carried out from Summer 2007 until Spring 2010.

The study is based on the fact that the production of renewable resources (biomass) and their application range are increasing at present as a result of ambitious growth objectives adopted in Germany, the EU, the U.S., as well as some of the developing countries. This development results in conflicts between ecological and social objectives which might counteract the political efforts to protect the climate, biodiversity and resources - not only in Europe, but also at the international level. For this reason, viable, internationally negotiable strategies and instruments have to be developed in order to significantly reduce or even avoid potential conflicts in objectives of increasing biomass use.

In detail, the research project pursued **the following goals:**

- Preparation of a scientific foundation and decision-guidance for the political/administrative definition and stipulation of sustainability standards, based on recent studies. Compliance with these standards must be detectable through suitable indicators;
- Preparation of a scientific foundation and decision-guidance for the (further) development of user-oriented certification systems for sustainable biomass for international trade;
- Exemplary implementation of the corresponding certification systems using selected examples for demonstrating their practical application.
- Interactive contribution of the results and experience obtained from the exemplary implementation to the multi-stakeholder dialog.

The entire biomass traded - not only for the purpose of energy production - was to be included in the observations and considerations.

The questions to be answered by the project and the necessary activities targeted different levels:

- National and European requirements and demands made in the context of sustainability certificates for biomass
- International law (WTO and EU legislation) issues in connection with the implementation of sustainability standards/certification for biomass
- Initiation of and participation in activities and consultation processes at the international level

Dealing with the issues outlined above has to focus on the environmental topics of greenhouse gas reduction and preservation of biodiversity and water resources. Biomass use must have a positive climate balance, and must not contribute to new environmental impacts or the aggravation of existing environmental issues. These issues are directly linked to the type of agricultural land use and land use changes for food, feed and bioenergy production.

The research project was not a classical study dealing primarily with the acquisition of scientific knowledge. Rather, its results were to be established **through a dialog with relevant stakeholders** and to be **contributed to international processes**. This was also the purpose of ongoing national policy consulting as well as the participation in and organization of national, European and international conferences and workshops. Therefore, the project was strongly committed to communication.

Due to the broad range of material work and the large number of project-specific activities designed to foster expert debate and actor-based dissemination of results, the project's results were summarized in the form of working papers that were prepared in parallel to the actual project. In addition, suitable input papers were prepared for the workshops and conferences, and the input provided by third parties as well as the discussions during the workshops and their results were published on the Internet in a close time frame.

Thus, most of the materials and results obtained were made available to the expert public already in the course of the project.

The present final report summarizes the results of the research project in different subject-related chapters:

- Which international **strategy** promises to yield **globally** sustainable biomass, and are **sustainability standards** the right answer (chapter 2)?
- What relevance can be attributed to biomass trading now and in the future, and what legal issues have to be raised with a view to sustainable trade (chapter 3)?
- What is the **life cycle assessment** of greenhouse gas (GHG) emissions from bioenergy with respect to possible land use changes (chapter 4)?
- How can negative effects of biomass cultivation on **biodiversity** be successfully reduced (chapter 5)?
- What are the effects of bioenergy on **water** resources (chapter 6)?
- How can sustainable land use for bioenergy be achieved, and which potentials are offered by **unused land** (chapter 7)?
- How can bioenergy **from algae** be assessed (chapter 8)?
- Which sustainability standards for bioenergy can be transferred to the use of biomass as a **(raw) material** (chapter 9)?
- What open questions remain for research after the completion of the research project (chapter 10)?

The **Annex** contains important acronyms and an overview of the working papers from the project provided on the attached **CD-ROM** together with the documentation of the workshops including all presentations and papers.

In addition, a short breakdown of the current state of the discussion concerning **social** standards was included in the Annex.

2 International Strategy for Global Sustainability of Biomass

2.1 Long-term, globally sustainable biomass

The key formula of a long-term strategy beyond the year 2030 for sustainable biomass is that renewable resources are primarily used as **raw materials**, whereas waste and biomass residues mainly serve as **energy sources**.

In the long term, sustainable bioenergy may contribute up to 25% - and thus only a **relatively** small share - to the global energy input[2] because its area-specific energy yield remains substantially below that of solar systems, and because the areas needed for biogenic cultivation systems and the required material inputs (especially water) are limiting factors.

Industrially used biogenic resources are **primarily** cultivated on unused areas, or areas with a limited usability from the point of view of food and feed production, and which are unobjectionable under nature conservation aspects. Preferred plants and cultivation methods (crop rotation etc.) require low input in agro-chemicals and water and have a broad genetic basis.

After the material use of biogenic raw materials, their subsequent **energy** use is a sensible option, i.e. for generating electricity and heat or as fuels. Due to the increased electrification of vehicles, the boundary between the sectors of bioenergy use is gradually vanishing. When processing biogenic raw materials, integrated concepts ("biorefineries") involving multiple product use may be significant.

Of key importance is the modernization of waste management as the “back end” of material use, which has to provide adequate identification of and logistics for biogenic waste and residuals as a precondition of their subsequent energy use.

In addition to classical, terrestrial biomass, **highly productive algae** may play a role as a raw material supplier and may be integrated in aquaculture systems where they utilize excess organic residuals and nitrogen.

Instead of the currently prevailing cultivation of biomass for direct conversion into bioenergy for power, heat and fuels, a **cascaded use** will be practiced in the future which will largely **disconnect** the production of food and feed from that of renewable resources both with respect to the plants and the land used.

Therefore, cultivating food and feed plants for energy or material use is but a **medium-term transitional strategy**.

The conversion of biogenic waste and residuals to 2nd generation biofuels and to biomethane (from synthesis gas or biogas) will complement (co-)combustion in combined heat and power generation plants.

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2 The range of globally sustainable bioenergy potentials amounts to 5-50% of future global primary energy supply, depending on the assumptions concerning the development of yields, food/feed demand and technologies for bioenergy conversion and use - refer to "Better Use of Biomass for Energy"; prepared for IEA RETD and IEA Bioenergy http://www.iea-retd.org/files/IEA_RETD_BIOENERGY_position_paper091215.pdf

In addition, bioenergy trade will be faced with new opportunities because the quantity of biogenic residuals and the final use of the biogenic energy carriers obtained can also be disconnected **spatially** (e.g. through bioethanol and liquefied gas tank ships or supply to natural gas networks).

2.2 Strategic questions concerning sustainability standards

Whereas the other chapters of this paper deal with the drafting of the sustainability standards and the related certification systems, the present chapter asks

- which organizations and stakeholders at the international level could agree on and implement these standards, and
- which incentives can be offered to stakeholders to cooperate in the implementation of biomass-related sustainability standards, or at least do not obstruct it.

Any strategy must be based on the long-term significance of biomass as part of sustainable energy and resource management – and will thus provide a standard for critics (potential threats) and promoters (market potential) and arrange the stakeholders according to their respective interests. In parallel, the analysis of the possible international governance structures is of importance[3].

The result of this work is to strategically concentrate on "globalization" and harmonization of **climate protection requirements** (convention on methods plus greenhouse gas (GHG) reduction goals) and the land-related **protection of biodiversity** with respect to biomass cultivation. The directional certainty of the GHG standards to be designed with respect to areas of ecologically valuable land outside of protected zones – or indirect land use – is of great significance here (cf. chapter 4.2).

Of central importance in this context are the working groups of the Global Bioenergy Partnership (**GBEP**)[4] which also integrated Brazil and China. They provide a forum for presenting the benefits for the developing countries subject to the individual GHG objective and method, and for addressing biodiversity through the issue of land use.

The GBEP currently is the **only** mechanism that enables global negotiations on sustainability standards for GHG as well as biodiversity and social issues (e.g. food security, occupational safety and health, land use rights) on the basis of mutual exchange and coordination.

The "core catalog" on sustainability standards and suitable criteria/indicators, which is currently being developed by GBEP, provides a basis for global implementation.

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3 The research project also provided input on this aspect for the study “World in Transition - Future Bioenergy and Sustainable Land Use”; WBGU; Berlin http://www.wbgu.de/wbgu_jg2008_en.pdf

4 GBEP is a partnership of the G8-plus-5 states (G8 states plus Brazil, China, India, Mexico and South Africa) that was founded at the initiative of Italy at the Gleneagles G8 summit in the year 2005; its Secretariat is hosted by the FAO in Rome. Meanwhile, more international institutions including FAO, UNEP and UNIDO as well as industrialized and developing countries have joined GBEP. For more information, refer to www.globalbioenergy.org

The second strategic approach involves the inclusion of central sustainability issues of biomass in the **existing global conventions**:

The Clean Development Mechanism (CDM) of the Kyoto Protocol for the UN Framework Convention on Climate Change offers incentives for bioenergy use in developing countries by offering not only provisions on GHG balances, but generally also on biodiversity issues – a consistent approach of global conventions must be demanded here.

The discussion about REDD (reduced emissions from deforestation and degradation) is an additional option because degraded areas are capable of absorbing large amounts of carbon, and bioenergy offers sensible co-use opportunities (refer to chapter 7).

Many developing countries are interested in CDM and REDD, including Brazil, China, India and Indonesia, resulting in good chances to integrate bioenergy issues if properly designed, and to illustrate how **especially** developing countries can benefit from global sustainability standards for biomass.

At the ninth meeting of the Conference of the Parties to the UN Convention on Biodiversity (**CBD**) in Bonn, Germany, in May 2008, the first considerations relating to the importance of biomass were discussed and a questionnaire was adopted in order to prepare possible regulations for the next meeting in Japan in October 2010.

Both this process and the related regional forums offer significant opportunities to specifically support the drafting of acceptable global rules for minimizing negative consequences of biomass use on biodiversity.

Based on experience so far, it is decisive to integrate Brazil and Indonesia in this process, and for this reason, it is necessary to win partners there and to clarify the **options for incentives** (e.g. in CDM and REDD).

In the long term, it will be necessary to amend the relevant global conventions by setting clear requirements for all parties involved and their verifiable implementation in order to ensure the effectiveness of all rules relating to sustainable bioenergy markets.

As regards the Climate Framework Convention and the CBD as well as their protocols, this would mean that the potentially negative consequences of **indirect** land use changes on climate protection and biodiversity would be **generally avoided** if the application of CO_2 emission limits also included global land use changes and areas rich in biodiversity were globally protected. For the time being, there seems to be no other approach than the global conventions by which the indirect effects of increasing biomass cultivation can be kept under control (cf. chapter 4.2).

The third strategic approach is to develop binding **project-specific** sustainability standards (biodiversity, soil/water, social issues) for international and bilateral **financing** institutions because they are "below" the WTO threshold and could also deal with local environmental issues (soil, water) and social concerns.

The initiative of the Inter-American Development Bank is a first step that must be extended to the World Bank etc., but generally also to private businesses (such as oil companies) and will have to be specifically supported by German stakeholders.

Analogous to the binding sustainability standards for bioenergy markets, Germany (through KfW) and the EU (through the EBRD and EIB) could take a lead in project financing, thus giving incentives for the U.S. and Japan, for example, and making appropriate use of their voting rights in the multilateral financing institutions.

During a start phase of such project-specific sustainability standards, **voluntary** approaches such as the Roundtable on Sustainable Biofuels (RSB) would also be useful in order to collect practical experience with the certification and facilitate the accession of more stakeholders.

However, project-specific activities should be governed by binding rules in the long term and accompanied by **bilateral** agreements (e.g. by BMU for nature conservation), even though such agreements would only have indirect effects on the bioenergy markets.

2.3 Certification as the Silver Bullet?

Since the beginning of the research project in summer 2007, the "landscape" of the previously **voluntary** and manifold sustainability standards for biomass – from cotton and wood to bio food, flowers and coffee and up to "green biopower" – has changed, achieving the **mandatory** certification of biofuels[5]. The German sustainability ordinances for biomass aiming at fuels and power generation from liquid bioenergy carriers, which came into force in 2009, were the first statutory set of rules governing compliance with sustainability requirements that was based on the Renewable Energy Directive 2009/28/EC (RED) adopted in April 2009[6].

In March 2010, the EU Commission presented a report on the extension of the RED to all bioenergy carriers and proposed that the RED criteria could be **voluntarily** adopted by the member states to apply to solid and gaseous bioenergy carriers as well[7].

In the U.S., negotiations concerning federal biofuel standards are under way, whereas an act on biogenic volatile organic compounds has already been implemented in California, and Brazil is working on its own sustainability seal for ethanol.

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[5] In parallel to these statutory provisions, RSPO and RSB drafted voluntary sustainability standards – that even reach beyond the RED – and the European standardization organization CEN as well as the global ISO body are also working on their own drafts.

[6] Basically, EU Directive 2009/28/EC is aimed at a GHG reduction and biodiversity protection, whereas social aspects were excluded due to their likely non-conformity with WTO standards. Previous discussions dealt with the concepts of **voluntary** certification (Cramer Report in the Netherlands) or **reporting** requirements on sustainability aspects (RTFO in UK) and became part of the corresponding **voluntary** initiatives for sustainability standards.

[7] EC (European Commission) 2010: Report from the Commission to the Council and the European Parliament on sustainability requirements for the use of solid and gaseous biomass sources in electricity, heating and cooling; SEC(2010) 65/SEC(2010) 66; Brussels http://ec.europa.eu/energy/renewables/transparency_platform/doc/2010_report/com_2010_0011_3_report.pdf

This quick development must be called positive and needs to be further supported, especially with respect to the developing countries and the outstanding "globalization" (cf. above 2.2)[8].

However, it must not be overlooked that so far, there are **no efficient rules** concerning indirect effects (refer to chapter 4.2) and concerning the consequences of an increase in bioenergy production for food safety (cf. Annex 3).

Certification systems – especially obligatory ones – have **not** been able to provide sufficient guidance concerning the broader environmental and social effects because this would result in trade law problems.

Here, **project-specific** sustainability standards are an important complement which may extend the "reach" of the legal provisions in the medium term by demonstrating best practices.

What has been achieved in the field of bioenergy not only has to be developed in further detail, it also has to be transferred to the other biomass segments – but this development has only just started (cf. chapter 9).

8 This quick sequence of events – despite the complexity of the issues at stake –was mainly due to massive criticism of the potential environmental and social consequences of the political objectives relating to biofuel shares in almost all countries the implementation of which would require fairly high subsidies.

3 International Biomass Trade and Legal Questions concerning Sustainable Biomass

3.1 International biomass trade

During the past few years, the increasing production and use of bioenergy has created a growing international biomass market that more and more often also includes developing countries and transition countries. The following table provides a quantitative impression of the significance of biomass as a whole and the individual bioenergy carriers, showing both the quantities produced and the quantities traded across borders.

Table 3-1 Global biomass production and trade in the year 2006

Product	World production	Internationally traded	Unit	International trade/world production
Industrial wood, forestry products	**3009**	**424**	**Million t**	**14%**
Industrial logs[a]	1684	120	Million m^3	7%
Wood chips and chippings[b]	232	37	Million m^3	19%
Saw logs[c]	427	120	Million m^3	31%
Cellulose pulp	190	42	Million t	22%
Cardboard and paper	354	100	Million t	31%
Agricultural products	**2214**	**290**	**Million t**	**13%**
Corn	695	83	Million t	12%
Wheat	606	118	Million t	19%
Oats, barley, rye	175	27	Million t	15%
Rice	635	28	Million t	4%
Palm oil	37	23	Million t	62%
Rapeseed, rapeseed oil	66	11	Million t	17%
Bioenergy	**1284**	**15**	**Million t**	**1%**
		300	**PJ**	
Ethanol	51	4,3 (120 PJ)	Million m^3	8%
Bio diesel	5	< 0,5 (15 PJ)	Million t	8%
Palm oil	1,4	1,1 (40 PJ)	Million t	79%
Firewood	1827	4 (40 PJ)	Million m^3	0%
Charcoal	43	1,4 (20 PJ)	Million t	3%
Pellets	8	3,6 (60 PJ)	Million t	45%
Indirectly traded bioenergy carriers		**630**	**PJ**	
Industrial logs[a]		480	PJ	
Wood chips and chippings[b]		150	PJ	
Total bioenergy traded		**930**	**PJ**	

Source: own calculations according to Heinimö, J./Junginger, M.: Production and trading of biomass for energy – An overview of the global status; in: Biomass & Bioenergy 33 no. 9, p. 1310-1320

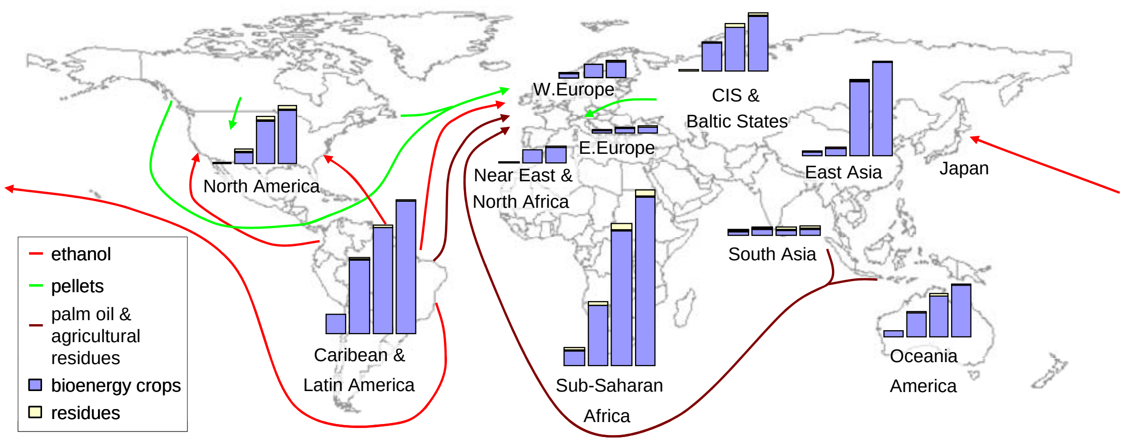
This overview shows that trade with wood products is predominant in terms of quantity, while wheat and corn are the principal cereals traded on the world market. With 62% (or 79% for energy), palm oil accounts for the biggest **proportionate share** in trade, followed by wooden pellets, saw logs and paper/cardboard.

With a global energy demand of approx 450 EJ, **traded** bioenergy carriers have so far accounted for less than 1 % (despite a contribution of approx. 11%).

However, this cannot hide the possibility of a highly dynamic market development in the **future**: increasing oil prices will also increase the attractiveness of cultivating bioenergy plants, or of valorizing biogenic waste and residuals. The IEA Bioenergy Task 40 has studied (sustainable) international bioenergy trading activities for some years, and has forecast a massive increase both of the quantities traded globally and the absolute quantities in the medium to long term[9].

The following figure shows the future major trade routes of traded bioenergy carriers as well as the regional bioenergy potentials by different scenarios.

Figure 3-1 Theoretical bioenergy potentials and main trade routes



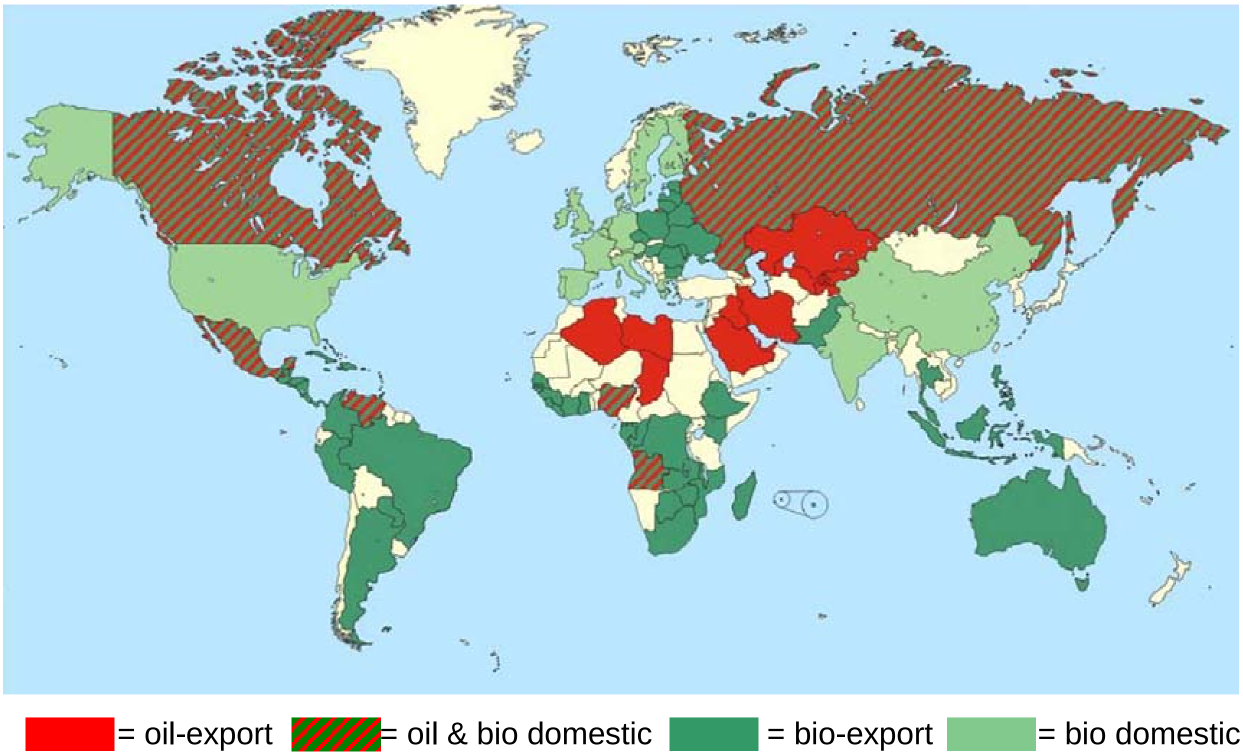
Source: according to IEA (2007)

Accordingly, Latin America and South East Asia, and to some extent also Canada and Eastern Europe/CIS, will be important exporting regions, whereas Africa (Sub-Sahara) will not yet play a major role in trade as a result of poor infrastructure.

However, IEA has also published a world map showing the regions with future relevance which has been provided below.

9 for more information, refer to www.bioenergytrade.org

Figure 3-2 Global perspective of bioenergy trade



Source: own representation, according to IEA

What is clearly visible is the equatorial "belt" of potential bioenergy exporting countries which even include Australia, depending on the availability of water.

The regions depicted in light green color – mainly the U.S., China, India, as well as Western and Northern Europe – will predominantly use bioenergy domestically, and will be interested in imports.

The central and east European countries (CEE) are potential exporters, and the western part of Russia could be part of them.

Compared to the previous focus in the discussion surrounding international trade, therefore, **Southern Africa**[10] and the CEE region will have to be considered in the future, in addition to Brazil and Indonesia. Developments in these regions will massively determine the future route of international bioenergy trading.

10 In addition to South Africa, this region mainly includes Congo, Mozambique and Kenya/Tanzania. In South Africa and Mozambique, good conditions are already offered today by ports and (some) transport infrastructure, whereas this is practically not the case mainly in Congo.

3.2 Selected legal issues surrounding sustainable bioenergy

The trade law implications of regulating biomass markets were especially investigated in the course of the research project. Important results include the following:

Based on its primary law-making powers, the EU may adopt import bans on biogenic industrial resources that were not sustainably produced. Under EU law, member states may also adopt import bans based on non-sustainable production. An import ban interferes with the protected sphere of free trade of goods, but may be justified for compelling reasons of public well-being – if it serves to protect global community assets (climate, biological diversity).

An import or application ban may be justified under Art. XX GATT 1994. Whether or not it can be justified by Art. XX lit. b GATT 1994 (protection of human, animal or plant life or health) depends on which extraterritorial measures are covered by the scope of Art. XX lit. b GATT 1994. This question refers to, e.g., the protection of workers at work or the groundwater and biodiversity in the territory of the exporting nation. The question as to whether or not WTO members may adopt an import ban in order to protect extraterritorial protected assets has not yet been finally resolved by the WTO dispute-solving bodies. When following the opinion that Art. XX lit. b GATT 1994 also covers the protection of extraterritorial protected assets, an import ban may be justified by all sustainability criteria investigated. The following must be noted when adopting an import or application ban:

- the importing state must not require compliance with the sustainability criteria that define the import ban in absolute terms, but should rather stipulate target norms – in order to leave the exporting state a certain freedom of choice of means in order to comply with the sustainability criteria;
- no diverging introductory periods should be specified for the import ban with respect to exporting states in which comparable conditions prevail;
- Germany or the EU have at least tried to enter into negotiations with the exporting states concerning rules for the sustainable production of biogenic industrial resources.

And finally, the import ban must be necessary, i.e. there must not be any other means that equally contribute to the protection of the legally protected interests without impairing trade as strongly as an import ban.

While environmental rules contained in Art. XX GATT 1994 are expressly recognized as limiting world trade, it is controversial whether social and other human-rights-related protected interests are capable of justifying an import or application ban.

Bilateral agreements on environmental matters between Germany/EU and Indonesia, Brazil, South Africa, Ukraine and Belarus were investigated as a medium-term strategy for the introduction of sustainability standards for biogenic industrial resources. Bilateral agreements may be a starting point for establishing sustainability standards, however, the associated negative effects on the remaining trade community must remain low in accordance with GATT.

4 Biomass and Climate Protection

4.1 Life cycle assessments and direct land use changes

From the environmental policy point of view, using biomass considerably contributes to climate protection. For this reason, giving proof that it contributes towards minimizing greenhouse gas (GHG) emissions throughout its entire life cycle is a crucial criterion.

If it is to be used as binding evidence for the evaluation of bioenergy carrier sustainability, the life cycle assessment for greenhouse gas must be calculated according to a predefined method. An open method would not guarantee the comparability of the results or identical competitive conditions for the market participants liable to submit this evidence.

The principles of calculating the GHG life cycle had already been defined prior to the present research project by the project participants involved: first, by the German partners using the initial draft biomass sustainability ordinance (BioNachV) presented in 2007, then through the European **RED** which closely follows the German methodological concept. The basic rules laid down in Annex V to the RED can be summarized as follows:

- Inclusion of the entire life cycle components which include **direct land use changes** (change in stocks of carbon by establishing biomass cultivation and during the cultivation cycle)
- The division of the **carbon stock changes** over 20 years.
- Accounting for co-products and by-products by the **energy allocation method** (lower calorific value).
- The **minimum emission savings** of 35% (after 2017: 50%) compared to the life cycle of the fossil fuel saved.
- Conservative **default values** are calculated in advance for the most important paths in order to spare the actors concerned the effort of performing individual calculations for the actual case.

In the course of the present research project, the technical discussion regarding the methodology, values, and data was continued, because the principles outlined above, including those provided in Annex V of the RED, left many open questions and raised a number of new ones as regards their practical implementation. In detail, the following activities were performed with respect to the GHG life cycle assessment of bioenergy carriers:

- Addition of the paths "pure soybean oil" and "pure palm oil" missing in Annex V of the RED to the default values, which are nevertheless relevant for the German biofuels market.
- Recommendations concerning the calculation method for **stationary bioenergy use (electricity/heat)**

- Calculation of and suggestions for default values for biogas paths and various solid biofuels
- Calculation of regionalized GHG emission values for the raw materials relevant in Germany (wheat, corn, sugar beet, rapeseed) for the purpose of complying with the requirements of RED Article 19(2).
- Active cooperation in the standardization bodies of CEN TC383 (*sustainably produced biomass for energy application*), in particular, the GHG working group and its corresponding body within DIN; furthermore, active guidance at the level of the ongoing international discussion (workshops of the EU Commission, GBEP Task Force GHG)

Amendment of the default values

As part of the present research project, default values were developed for the implementation of the EEG (Renewable Energies Act) and the related *Biomass-electricity-sustainability ordinance (BioSt-NachV)*. For this purpose, the methodological requirements of RED Annex V and the available data bases of the Joint Research Centre of the EU Commission (JRC, Ispra) concerning the default values were accounted for.

The resulting default values refer to the **liquid bioenergy carriers**:

- pure **soybean oil**
- pure **palm oil** (processed using methane capture at the oil mill)

Table 4-1 GHG emission values for soybean and palm oil

Data in g CO_2 equ./MJ	**Soybean oil**	**Palm oil with methane capture**
DEFAULT VALUES		
Cultivation **"e_{ec}"**	20.9	15.5
Processing **"e_p - e_{ee}"** *(typical value)*	*(8.5)*	*(3.5)*
Typical value x 1.4 [a)]	11.9	4.9
Transport **"e_{td}"**	13.0	5.0
TOTAL	**45.8**	**25.4**

The total number of processing steps (typical value) was multiplied by 1.4 here in accordance with JRC 1.

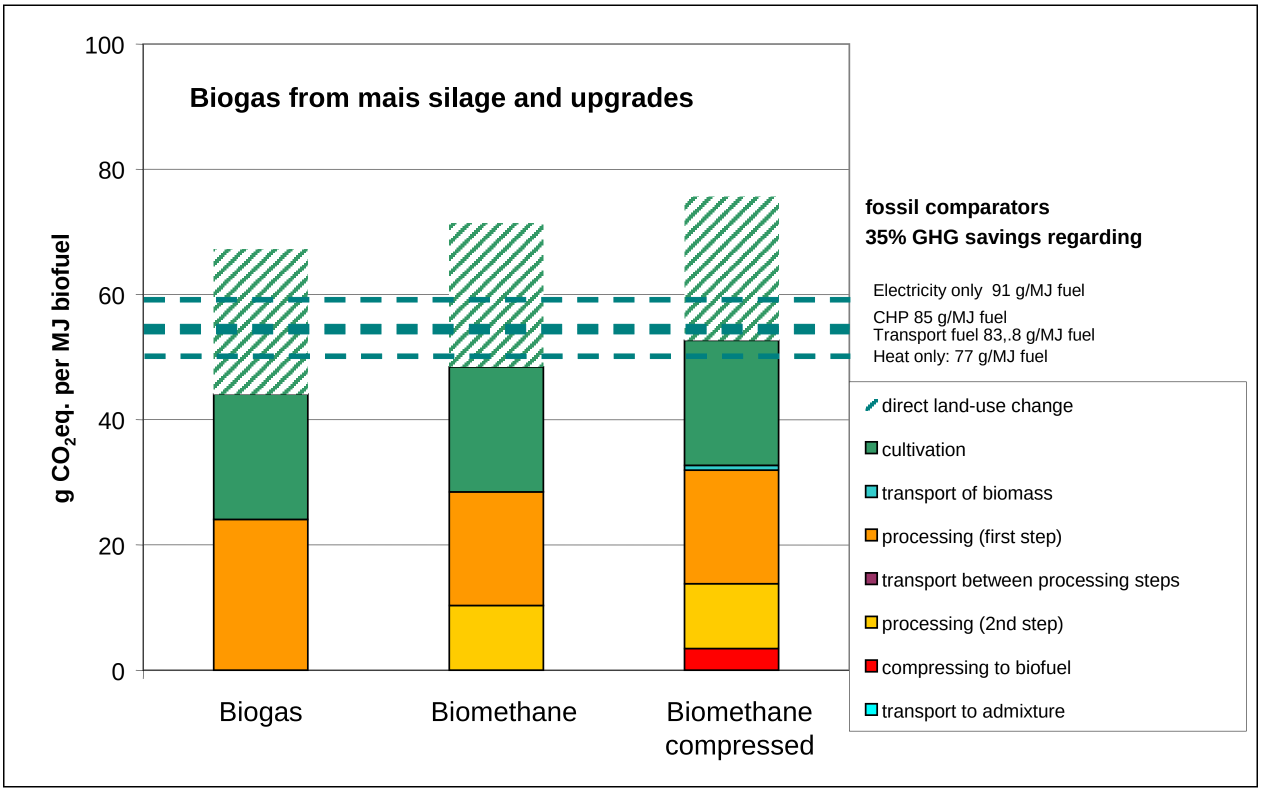
Source: own calculations

Pure **palm oil** (process fuel not indicated, no methane capture measures at the oil mill) also requires default values. However, the deductions made by the project for pure palm oil based on the data bases available from JRC revealed excessively high data uncertainties.

The calculation of these values according to the EU methodology cannot be reconstructed unless the underlying data has been made transparent by JRC.

In addition, default values were developed and proposed for **biogas** and **solid fuels**. The following figure shows the three possible stages of biogas (electricity/heat), biomethane (feed into gas network for possible use in electricity/heat generation) and compressed biomethane (transport fuel) by the example of corn silage. It turned out that the criterion of 35% savings is satisfied in all cases, although with very low margins in some cases, and always **without** including emissions resulting from direct land use change (LUC; e.g. from ploughing up grassland).

Figure 4-1 GHG life cycle assessment of biogas and biomethane



Source: own calculations

Recommendations concerning the calculation method for stationary bioenergy use

In addition, the details of the methodology and the default values for the segment of **stationary bioenergy use (electricity/heat)** as well as the technical foundations for a sustainability directive amending the EEG were worked out. The treatment of this topic by the EU-RED is rather fragmentary.

The following specific questions have not yet been sufficiently clarified by the biofuel-focused RED:

1. Is the **efficiency of use** (electricity/heat) to be accounted for?
   This is currently not envisaged by RED. Under the existing rules, pure power generation is eventually even preferred to cogeneration (CHP). The research institutions find it absolutely necessary to account for the efficiency of use, proposing to make reference to the methods of the Cogeneration Directive.

2. What **reference systems** should be used for stationary bioenergy use? Basically, the reference systems enumerated in Annex V No. 19 of the RED can be maintained with respect to electricity and usable heat. In order to include the efficiency of use, they would have to be adjusted by the standard efficiency values listed in Annex IIIf to the Cogeneration Directive with respect to pure electricity generation (0.44) or pure heat generation (0.9).
3. How can **CHP** be accounted for if the efficient use is a criterion?
   If item 2 was implemented, the electricity produced and the heat generated could be added to the total efficiency-adjusted savings rates for electricity and heat (produced separately) for CHP use.

(*In January 2010 – **after** the end of the research project – the EU Commission presented a draft report*[11] *addressing the three items listed above and making highly commendable proposals).*

4. How can a distinction be made between co-products and waste?
   The "**residuals**" complex is a very important aspect that is currently being used in the RED without a clear definition. The research institutions are still part of the ongoing process of CEN standardization where they recommend a definition that not only accounts for the legal definitions of the EU Framework Directive on Waste, but is also guided by the market conditions (price relations, marketing relations).
5. How should a **land use change** be handled for **forestry**?
   It is deemed necessary to account for changes in the carbon stock. However, the data currently presented in the IPCC reports is not sufficient for recommending default values. For this purpose, it will be required to reprocess all research results, if any, existing in this area, or to conduct further research concerning the impact of forest management activities on the carbon content on forests.
6. How should **emissions that have been avoided** be handled?
   The importance of this aspect is demonstrated by the example of fermented wet manure and the possibility to avoid methane emissions by using non-fermented wet manure –
   When disregarding the fact that methane emissions have been avoided, a GHG life cycle assessment concerning fermented wet manure will not yield the required 35% savings, although avoiding methane emission will save more GHG emissions than caused by fermentation of wet manure.
   There is more need for methodological clarification, because the calculation of the default values in Annex V of the RED has not been entirely transparent so far, and does not match the values calculated by the project.

[11] refer to footnote 7

Calculating GHG emissions for cultivation at the NUTS 2 level

In accordance with Article 19(1) of the RED, GHG emission savings by 35 % can be proven by using the default values provided in Annex V. However, these default values may only be used with respect to the raw materials cultivated in the EU if a member state has reported to the EU Commission on or before March 31, 2010 that the cultivation of the relevant raw materials in the region concerned[12] is not associated with higher GHG emissions than the "disaggregated default value for cultivation" in accordance with Annex V Part D of the RED. For this purpose, the GHG emission values were calculated by the research project for the cultivation of the relevant raw materials in the regions under review. The results have shown that even in the least favorable regions of Germany in terms of soil and climate conditions, the value for the cultivation of bioenergy resources remains **below** the relevant part default value specified in the RED. Thus, the criterion set forth in Article 19(2) of the RED is fulfilled, i.e. that the default values must be applicable in all regions of Germany.

Active cooperation in various bodies

Upon conclusion of the research project, several details remain to be clarified as regards the precise calculation of the GHG emission values in accordance with the RED.

Communication and expert discussion on this issue must continue. The same applies to the standardization efforts (CEN TC 383, ISO), and to GBEP.

4.2 Greenhouse gas effects through indirect land use changes

Indirect land use changes (iLUC) occur if a different use (such as food or feed cultivation) previously prevailing on areas designed for biomass cultivation is **crowded out**.

Since there still is need for the food or feed formerly produced on this surface, their production is now relocated to **different** areas at least to some extent[13]. These different areas may have a high carbon stock (e.g. forests, moors) which is reduced if used for the "crowded-out" cultivation of food or feed.

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[12] Resolved according to level 2 regions of the "Nomenclature of Units for Territorial Statistics" (NUTS, or *"Nomenclature d'unités territoriales statistiques"*), corresponding to the "Regierungsbezirk" level comprising several districts in Germany.

[13] The area balance is not simply calculated as 1 ha of biomass cultivation = 1 ha of crowded-out previous use, because effects such as yield increases, price-induced changes in demand (e.g. higher prices for feed or meat), and substitution (e.g. forage for concentrated feed) as well as co-products that may result from bioenergy production (e.g. press cake) may reduce the net area balance of "crowding out" to a value that is **significantly lower than** 1.

The resulting potential CO_2 emissions are **indirectly** caused by biomass cultivation and must be allocated to it. The amount of possible CO_2 emissions may be considerable, depending on the land use "crowded out".

How should indirect CO_2 emissions be assessed?

In parallel to the development of the GHG life cycle assessments for biomass, a methodological approach was developed by the project which may be used for a simplified estimate of the iLUC emissions.

The CO_2 assessment of displaced former land uses basically corresponds exactly to that of direct LUC (dLUC), however, the question arises as to **how many** and **which** surfaces are concerned. The following table shows regional types of land use changes and their potential C emissions from direct LUC.

Table 4-2 Assumptions for C from direct LUC

Region, culture vs. land type	t C/ha, above-ground	C soil +below-ground	Total C [t/ha]	t CO_2/ha
EU, rapeseed/wheat vs. grassland	6,3	63	69	254
US, corn vs. grassland	6,3	63	69	254
BR, sugar cane vs. savanna	66	68	134	491
ID, palm oil vs. rainforest	165	100	265	972

Source: own calculations according to IPCC, BR = Brazil, ID = Indonesia

Since displacement effects may also take place **outside** a region or country due to global trade (reduced exports), they can only be allocated to biomass cultivation on certain areas through a **model exercise**.

Many studies, conferences and workshops have dealt with this issue since early 2008, which were discussed and critically analyzed by the research project. In the process, the so-called **"iLUC factor"** was developed as a contribution to the discussion surrounding the inclusion of iLUC in the GHG life cycle assessment under the RED. It is based on the assumption that from a global point of view, only those countries are affected by iLUC that act as exporters in world trade – they are the only ones that enjoy incentives for additional production and can trigger indirect LUC for this reason only. The potential CO_2 emissions from iLUC can be simplified and determined as the mean value of surface areas required for agricultural exports by world regions and the relevant C release by the LUC there.

Alternatively, the evaluation of satellite data concerning the historic development of LUC as a result of the global extension of agricultural surfaces since 1980 may lead to a mean calculated C release reflecting the proportionate importance of converting grassland, savanna, forests etc.[14].

[14] Gibbs, Holly et al. 2010: Pathways of Agricultural Expansion Across the Tropics: Implications for Forest Resources; in: Proceedings of the National Academy of Science (forthcoming)

The **theoretical** GHG emission calculated amounts to 270-600 t CO_2/ha of indirect land use change, depending on the model chosen. When dividing this amount over a period of 20 years according to IPCC, the result is 13.5-30 t CO_2/ha*a.
However, this factor will **not materialize fully in reality** because **not all** of the biomass produced will result in iLUC:

- Some of the feedstocks are produced on set-aside land and through intensification or yield increases where **no** indirect effects are observed.
- In the future, 2nd generation biofuels (lignocellulosic ethanol, BtL) will use biogenic **residuals** (straw, logging residues) for economic reasons for which no iLUC will have to be considered.
- Substitution by co-products from bioenergy production may also strongly reduce displaced land in some areas.

For this reason, the iLUC factor will have to be adjusted with time because the shares of individual countries and agricultural products in world trade and the relevant yields are subject to change.

On the other hand, the iLUC factor will have to be accounted for more or less strongly, depending on the estimated dynamics of bioenergy produced and the land required by it, because the potential availability of biogenic residuals and set-aside land is limited, and farmland and grassland will be used to an increasing extent to satisfy an increasing demand for biofuel. Therefore, a certain **risk range** has to be assumed.

The simplified model calculations for the iLUC factor performed in the Bio-global project have shown[15] that

- from 2005 to 2010 and up to 2020, the area-specific, **theoretical** value will increase from 13.5 to 14.5 t CO_2/ha*a, and
- in 2030, depending on the assumptions on world trade and the LUC effects triggered by it, it will be in between 11 (optimistic) and 17 (pessimistic) t CO_2/ha*a, with a reference value of 14.5 t CO_2/ha*a in 2030.

It is proposed to use the 25% level of the relevant **theoretical** iLUC factor as the lower limit and 50% as its upper limit for the calculations relating to the time until 2030.

The **25% level** of the iLUC factor amounts to 3.4 t CO_2/ha*a for 2005 to 2010 and to 3.6 t CO_2/ha*a for 2020-2030 (reference value for the latter time period, with variation being 2.8 to 4.3 t CO_2/ha*a).

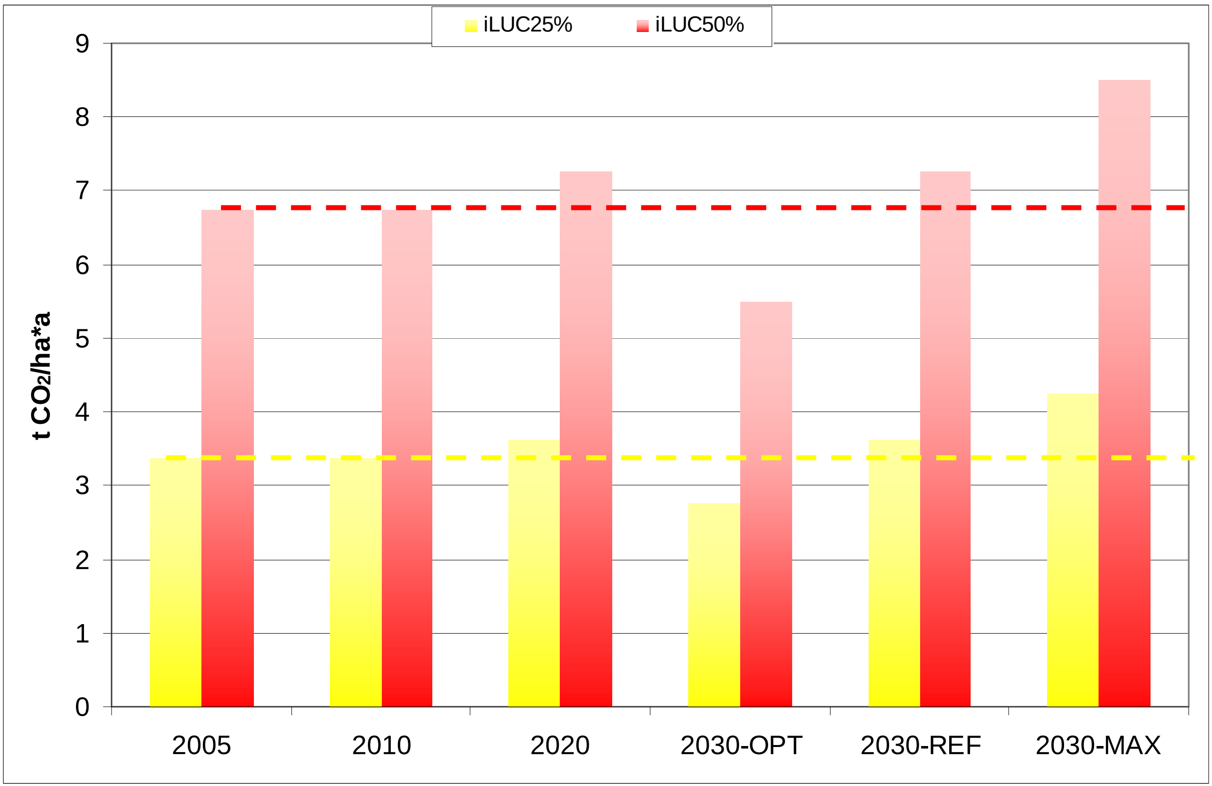
Accordingly, the **50% level** of the iLUC factor amounts to 6.8 t CO_2/ha*a for 2005 to 2010 and to 7.3 t CO_2/ha*a for 2020-2030 (reference value for the latter time period, with variation being 5.5 to 8.5 t CO_2/ha*a).

The **lower limit** should be calculated as **3.5 t/CO_2/ha*a**.

[15] cf. Fritsche, U./Hennenberg, K./Hünecke, K. 2010: The iLUC Factor as a Means to Hedge Risks of GHG Emissions from Indirect Land Use Change Associated with Bioenergy Feedstock Production; working paper as part of the Bio-global project; Öko-Institut; Darmstadt (cf. PDF version provided on enclosed CDROM).

The following chart shows an overview of the iLUC values (25% and 50% level) calculated by the project for 2005 to 2030 (including variation of the latter).

Figure 4-2 Present and future values of CO_2 emissions resulting from iLUC



Source: own calculations

The effects of the range of the iLUC factor (25-20% level) calculated in the project on the life-cycle-related GHG emissions of selected biofuels from different regions are shown in the following table.

Table 4-3 Effects of the iLUC factor on the GHG life cycle emissions of biodiesel in the year 2010 (including direct and indirect LUC effects)

	GHG emission [g CO_2eq/MJ]				**Reduction vs. fossil diesel**			
Region, culture, former use	**LCA only**	**with dLUC**	**with 25% iLUC**	**with 50% iLUC**	**LCA only**	**with dLUC**	**with 25% iLUC**	**with 50% iLUC**
EU RME, farmland	40	40	73	107	-54%	-54%	-15%	24%
EU RME, grassland	40	67	100	134	-54%	-23%	16%	55%
EU SRF, farmland	14	-2	36	75	-84%	-103%	-58%	-14%
EU SRF, grassland	14	29	67	106	-84%	-67%	-22%	22%
AR SME, grassland	20	51	92	118	-76%	-41%	7%	37%
AR SME, savanna	20	188	188	188	-76%	118%	118%	118%
ID PME, grassland	43	12	30	48	-50%	-86%	-65%	-44%
ID PME, degraded	43	-55	-55	-55	-50%	-163%	-163%	-163%
ID PME, trop. forest	43	213	213	213	-50%	147%	147%	147%

Source: own calculations using GEMIS 4.6, allocation and fossil reference values to RED; LCA = life cycle emissions without LUC; RME= methyl ester of rapeseed; SRF = short-rotation forestry for biomass-to-liquid (Fischer-Tropsch) diesel in the year 2030; AR= Argentina; SME = methyl ester of soybean oil; ID = Indonesia; PME= methyl ester of palm oil

Table 4-4 Effects of the iLUC factor on the GHG life cycle emissions of bioethanol in the year 2010 (including direct and indirect LUC effects)

	GHG emission [g CO_2eq/MJ]				Reduction vs. fossil petrol			
Region, culture, former use	**LCA only**	**with dLUC**	**with 25% iLUC**	**with 50% iLUC**	**LCA only**	**with dLUC**	**with 25% iLUC**	**with 50% iLUC**
EU wheat, farmland	45	45	79	112	-46%	-46%	-7%	**32%**
EU wheat, grassland	45	72	106	139	-46%	-15%	**24%**	**63%**
BR SC, farmland	26	26	47	68	-69%	-70%	-45%	-20%
BR SC, grassland	26	43	64	85	-69%	-50%	-25%	**0%**
BR SC, degraded	26	-1	-1	-1	-69%	-101%	-101%	-101%
BR SC, savanna	26	120	120	120	-69%	**41%**	**41%**	**41%**

Source: own calculations using GEMIS 4.6, allocation and fossil reference values to RED; LCA = life cycle emissions without LUC; BR = Brazil; SC= sugar cane

It is quite obvious that biofuels from annual cultures (rapeseed, soy bean, wheat) on farmland would yield slight reductions, but **not** the 35% required under the RED when including the 25% iLUC factor, whereas cultivating these biofuels on grassland would **not** result in any GHG savings due to the additional direct LUC emissions.

In contrast, biofuels from palm oil and sugar cane[16] as well as 2nd generation fuels in Europe (BtL from SRF) would yield **higher** GHG savings than 35% if the 25% iLUC factor was applied and their raw materials were cultivated on farmland. When cultivating the raw materials on grassland, only palm oil is capable of achieving the required savings, whereas BtL from SRF (-22%) and sugar cane EtOH (-25%) would miss this goal.

However, if palm oil and sugar cane were cultivated on **low-carbon, degraded** land, the resulting biofuels would **not have any indirect** LUC effects or **negative** dLUC emissions (because they store carbon in the soil), and would even reach more than 100% GHG savings – they would even constitute a CO_2 **sink** and would not only cause no net addition of CO_2 in the atmosphere, but even reduce the global CO_2 concentration.

Therefore, even the 25% level of the iLUC factor for 2010 would have **considerable impact on the competitiveness** of biofuels, especially from Europe (and analogously for EtOH from corn in the U.S. or wheat in Australia) and would increase pressure not only on the quick introduction of 2nd generation biofuels, but also on the exclusion of

16 Biofuels based on palm oil and sugar cane cultivated on surfaces resulting from the conversion of high-carbon forests or savannas do not reach the minimum GHG reduction required under the RED as a result of **direct** LUC emission (cf. chapter 4.1) although **no** iLUC is applicable in this case.

imports from, e.g., Brazil and Indonesia capable of causing high GHG effects there through **direct** LUC (cf. chapter 4.1).

In parallel, incentives would be given to use raw materials for biofuel production that are not associated with a major iLUC risk, i.e. biogenic waste and residuals as well as biomass cultivated on unused or degraded land (cf. chapters 5.2 and 7).

Beyond the iLUC factor: Minimizing iLUC-induced risks

In the US, the Environmental Protection Agency (EPA) presented statutory GHG life cycle requirements on biofuels containing a quantitative iLUC factor. In parallel, an act on low-GHG fuels was enacted in the state of California which also applies an explicit iLUC factor to biofuels – with both values being in the range of the 2010 iLUC factor proposed above.

In the EU, an iLUC factor was proposed for the GHG life cycle assessment under the RED by various parties, without being generally accepted. In late 2010, a report of the EU Commission will deal with the further treatment of iLUC, and formal consultations are scheduled for 2011.

Both in scientific and political discussions, the calculation of a numerical value for iLUC-induced GHG emissions is highly controversial[17]. For this reason, the present research project tried to include not only the iLUC factor, but also **other methodological** approaches towards a reduction of iLUC-related risks and to present them for discussion which

- are based on a **prioritization** of raw materials that are associated with no or low iLUC risks (this could be supported by, e.g., creating financial incentives), or a medium-term reduction in the share of "permitted" fuels in the EU quota
- could explicitly identify those areas in which biomass cultivation will **not** result in **crowding-out** (e.g. unused, abandoned, or degraded areas) and which are not in conflict with biodiversity protection (cf. chapter 7).
- provide for a **compensation** of iLUC risks through **above-average** yield increases in food and feed cultivation, however, the cultivation of bioenergy must in this case be restricted to those surfaces which are "released" by the increased yield, and it would have to be proven that the yield increases take place without any negative impacts on, e.g., biodiversity and N_2O emissions.

In addition, it was pointed out that a given iLUC risk associated with biomass cultivation would have very different impacts on the benefits offered by biomass, depending on the efficiency of biomass conversion, and on the GHG impacts of the reference use.

[17] This applies to both simplified deterministic assessments and the results of more complex life cycle assessment models for simulating worldwide agricultural trade. For a concise overview of the discussion, refer to iLUC working paper (cf. footnote 15) on the attached CDROM.

For example, the impact of the same raw material related iLUC factor is reduced if combined heat and power are generated from biomass rather than using it for the production of biofuel[18].

It is **strategically** important that **no** GHG emissions would occur from indirect LUC effects of biomass cultivation if the UN Climate Convention was further developed and included CO_2 from LUC in all countries as well as the corresponding emission limits or reduction obligations.

In addition, the draft financial instrument REDD (Reduced Emissions from Deforestation and Degradation) was met with a positive response by the 15th Conference of the Parties to the UN Framework Convention on Climate Change in Copenhagen in December 2009 (COP15), and many governments have expressed a financial commitment. Using a well-financed REDD instrument, especially high-carbon forests which are experiencing increasing pressure of conversion – also – due to growing biomass cultivation, could at least be better protected in order to **reduce the effects of iLUC**.

In addition to intergovernmental agreements on the recognition of LUC in climate reports or on limit values, or the agreements on REDD, there is more scope for action in order to reduce iLUC risks of biomass cultivation:

If voluntary initiatives relating to **carbon footprints** of products and services were extended to all (major) biomass products by including the emissions from LUC[19], ignoring GHG emissions in life cycle analyses by displacement effects would no longer be possible.

This kind of system could be organized between major producers of food and feed, wood products and bioenergy, and could generally also be initiated without the approval of governments.

The practical implementation of REDD and the future inclusion of all emissions resulting from land use changes in a global regime or a corresponding, cross-sectoral certification system will most likely be possible to achieve in the medium to long term only, therefore, approaches such as the iLUC factor and the other methods described above should be pursued further.

In the year 2010, iLUC will be the subject of further intense debates in Europe, the U.S. and the GBEP, so that the approaches and suggestions proposed by the project will continue finding a broad forum.

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[18] This was addressed by WBGU (German Advisory Council on Global Change) in its bioenergy report, see footnote 3.

[19] For the GHG life cycle assessment of biomass for product carbon footprints refer to the PCF Memorandum of BMU, UBA and Öko-Institut www.bmu.bund.de/files/pdfs/allgemein/application/pdf/memorandum_pcf_lang_bf.pdf

5 Bioenergy and Biodiversity

The effects of biomass cultivation on biodiversity were addressed by the present research project by working out the foundations for (political) control measures which were tested in the "Potentials of unused areas" sub-project (refer to chapter 7), and the input of the results to political processes. For this purpose, the project developed a **risk minimization strategy** to protect biodiversity in the course of biomass use which addresses three core issues.

5.1 Conservation of land with a significant biodiversity value

The loss of valuable habitats continues to be the key factor for the hazards to and decline in biodiversity. In order not to additionally increase this trend by cultivating biomass, it is necessary to protect high-biodiversity areas. These include the existing protective zones, however, there are many other areas that deserve the same protection status.

Existing identification approaches such as *Key Biodiversity Areas*, *Important Bird Areas* and *High Conservation Value Areas* could be used for this purpose.

The approach for a regional identification of these areas developed in the project together with partners[20] is based on geo-referenced data from remote sensing (GIS) and was tested in country case studies on degraded areas (cf. chapter 7). In the course of our cooperation with FAO, the method was also successfully tested in a desktop study using the example of Tanzania.

The basic elements of this approach were adopted by the RED provisions on biodiversity and their translation into German law[21].

However, more work is necessary to complete the globally available GIS data concerning high-biodiversity areas.[22] And finally, quality assurance (validation), monitoring and updates of GIS data with a sufficiently high resolution are not yet available for all regions and countries.

5.2 Minimizing negative effects from iLUC

In the scientific debate, both negative effects of direct land use change and of indirect effects play a key role. They occur as soon as the production of biomass "crowds out" prior land uses. For example, cultivating rapeseed for biodiesel production may have

20 Including Conservation International (CI), IUCN, UNEP-WCMC and WWF

21 Guidelines on sustainable biomass production; Federal Agency for Agriculture and Food (in German) http://www.ble.de/cln_090/SharedDocs/Downloads/02__Kontrolle__Zulassung/05__NachhaltigeBiomasseerzeugung/LeitfadenNachhaltigeBiomasseherstellung.html for the implementation of the BioSt-NachV http://www.bgbl.de/Xaver/start.xav?startbk=Bundesanzeiger_BGBl&start=//*[@attr_id=%27bgbl109s2174.pdf%27]

22 For example, the current network of protected areas has significant gaps, according to IUCN and CBD, in ensuring sufficient biodiversity protection. With respect to *Key Biodiversity Areas*, so far, approx. 40% of the worldwide land area is accounted for in studies.

the effect that soybeans are cultivated on high-biodiversity tropical areas instead of the forage corn crowded out because the demand for animal feed is undiminished.

In order to minimize these kinds of negative effects, biomass production must be focused on options posing low risks of indirect land use change.

These include, in particular, waste and residuals as well as cultivation on areas **formerly** used for agriculture (*unused degraded land*, *abandoned farmland*), unless such cultivation again poses risks to biodiversity and other goods in need of protection.

5.3 Agricultural practice with low negative effects on biodiversity

It has been internationally recognized that protecting biodiversity in the protected zones alone is not sufficient, and that cultivated areas also have to be included. For biomass cultivation – and for other products – few **economically viable** agricultural practices have been developed that have low negative impacts on biodiversity.

Such practices are based on the following principles: Use of domestic species and local varieties, avoiding monocultures, preferring perennial crops, use of methods causing low erosion and machinery use, low fertilizer and pesticide use and avoiding active irrigation.

In addition, buffer zones must be set up to protect sensitive areas, and corridors and stepping stone biotopes must be preserved on the cultivated land in order to improve the exchange of species between the regions.

So far, however, the requirements on agricultural practice have hardly been put into words in view of the low negative effects on (agro) biodiversity.

The approach developed by the project was discussed at two international workshops where it was also scientifically endorsed or deepened:

- *Joint International Workshop on High Nature Value Criteria and Potential for Sustainable Use of Degraded Lands*. Paris, June 30-July 1, 2008[23]
- *2nd Joint International Workshop on Bioenergy, Biodiversity Mapping and Degraded Lands*. Paris, July 7-8, 2009[24]

The basic elements of this approach were used for the country studies in order to identify any areas that are suitable for biomass cultivation (refer to chapter 6).

23 http://www.bioenergywiki.net/index.php/Joint_International_Workshop_on_High_Nature_Value_Criteria_and_Potential_for_Sustainable_Use_of_Degraded_Lands#Workshop_Outcome

24 http://www.bioenergywiki.net/index.php/2nd_Joint_International_Workshop_Mapping

6 Bioenergy and Water

6.1 Possible conflicts between water as a subject of protection and bioenergy

Cultivating biomass with high productivity and the conversion facilities required to produce bioenergy carriers both need water. As a result, water as a subject of protection may be affected by bioenergy through three mechanisms of activity:

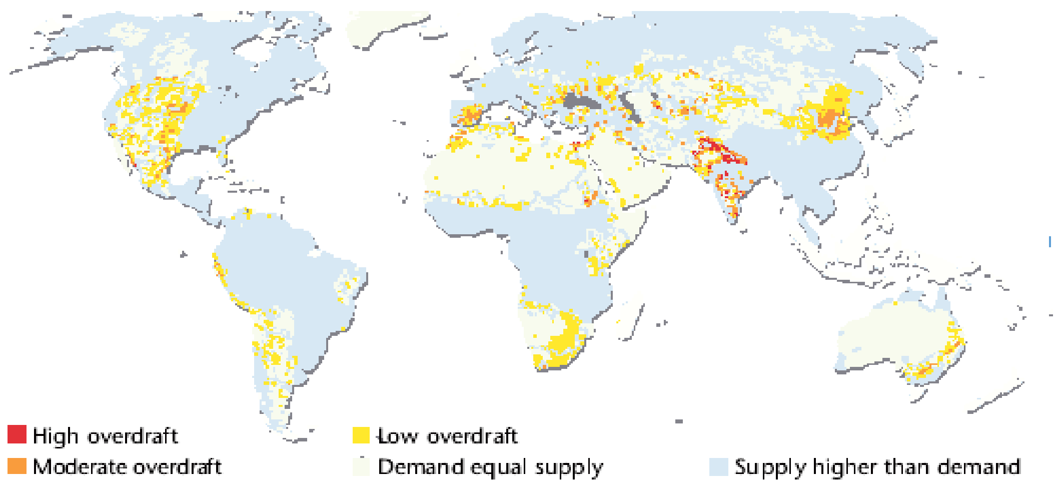
- Increase or induction of water competition and the potential conflicts resulting from such competition
  a) between water users of the various segments (agriculture, industry, private households) and between riparians or various groups of the population
  b) with respect to environmental and nature conservation objectives (water protection, ecosystem protection, biodiversity)
- Pollutant emissions to water bodies
- Negative environmental consequences of (inappropriate) irrigation.

In the Bio-global research project, practical criteria and indicators were developed for an assessment of these problem issues. These project-related test criteria primarily refer to the requirements of the RED relating to water (Art. 17-18), under which the Member States shall require the economic operators to report on **measures** taken

- for soil, **water** and air **protection**,
- for the avoidance of **excessive** water consumption in areas where **water is scarce**

and to document these measures (Article 18, No. 3, Para. 2).

Figure 6-1 Global water use



Source: Millennium Ecosystem Assessment (2005)

An analysis of the worldwide water scarcity clearly shows the regional character of this problem. In the map above, those regions stand out in which the water resources available are under stress already today because of **irrigation practices** in agriculture.

A further rise in water use – for food production or for biomass as an energy carrier – will further aggravate the situation in these areas in which water is visibly scarce already today.

6.2 Recommended Solutions

Quantitative requirements – standards, criteria

The term "**water scarcity**" is discussed in detail in the project report on water (cf. CD-ROM). Hence, water scarcity can mainly be quantified in the context of bioenergy production by two possible concepts:

1. The unavailability of the defined water resources required per person per year; a value below 1,700 m^3 is referred to as water stress, a value of less than 1,000 m^3 means water scarcity.
2. The relation between water consumption and available water resources (water stress index); if this value exceeds 0.4, severe water stress is to be assumed; between 0.2 and 0.4 is defined as mid water stress, and up to 0.2 as low water stress.

Both concepts offer specific advantages. For this reason, they are both proposed as possible indicator approaches. The first concept has been applied in the flow chart provided below as an example.

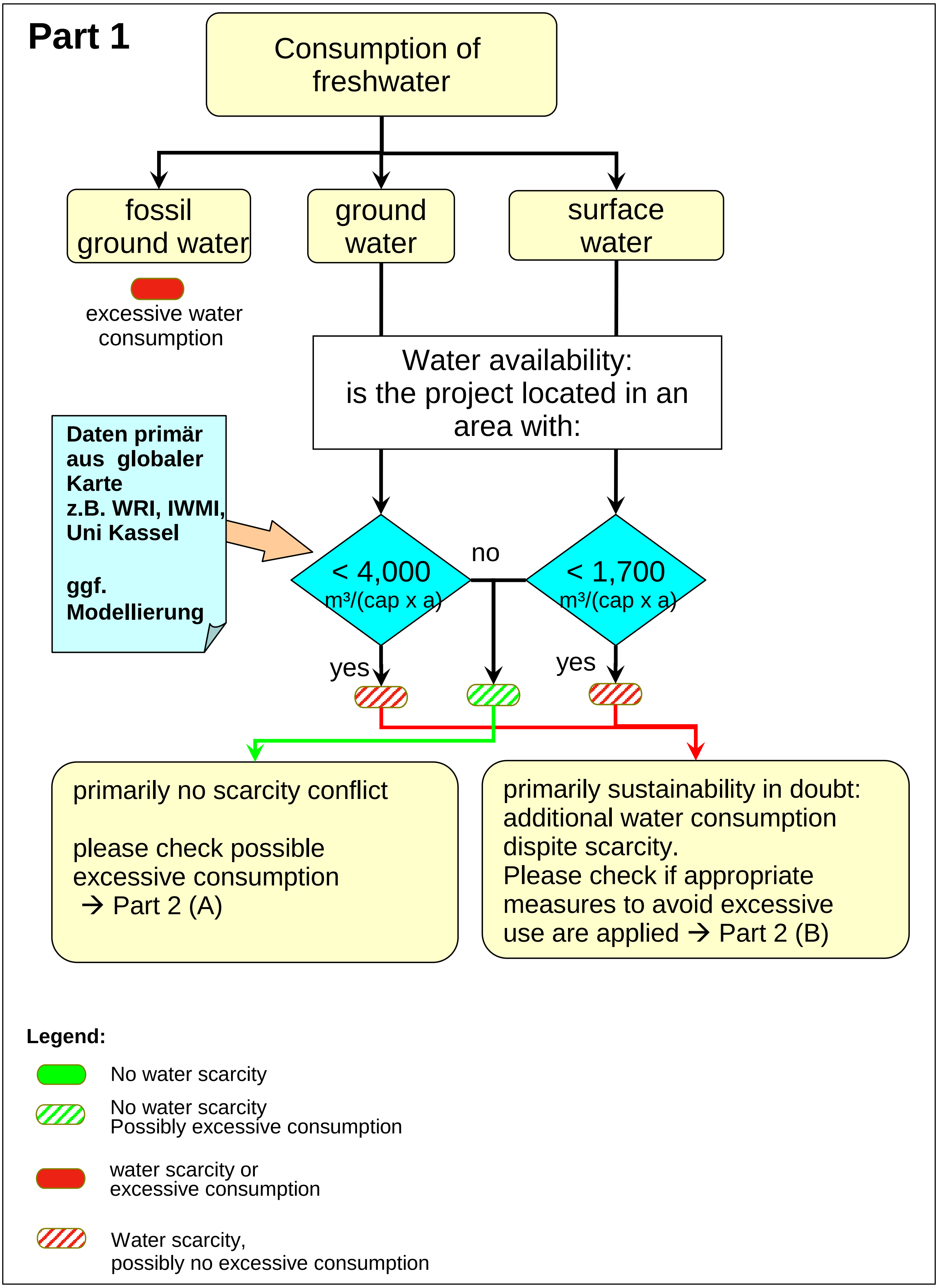
The following criteria of "**excessive water consumption**" are recommended at this point:

1. Primary condition: Water is used through withdrawal, i.e. irrigation or water consumption in a process. However, the definition of water consumption does not include classical rain-fed farming.[25]
2. Where fossil groundwater is used, consumption as such is to be considered "excessive" because regeneration does not take place, and sustainability is excluded from the hydrology point of view
3. If (non-fossil) groundwater is used, stricter requirements have to be made on the availability (exclusion of scarcity);
   the fact that groundwater is used instead of surface water leads to the assumption that surface water is already scarce
4. Any type of water use has to be accompanied by measures to minimize consumption; for irrigation, especially efficient, resource-saving irrigation techniques and irrigation management are to be applied

The following two figures show charts that shall serve to verify excessive water consumption in areas where water is scarce.

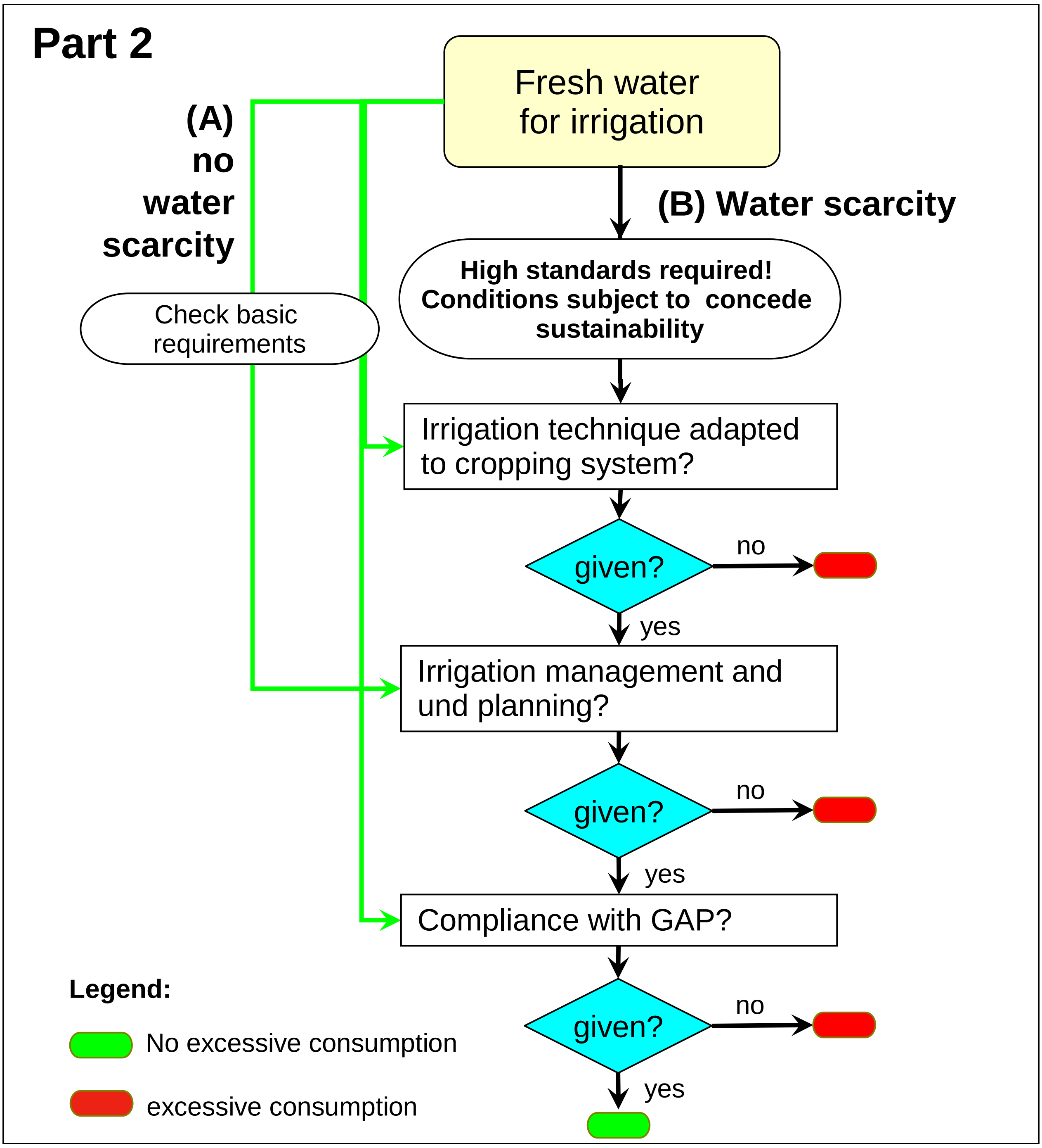
[25] Special cases in which the type of culture alone may have negative effects on hydrology even without irrigation (e.g. eucalyptus plantations) have been excepted for the time being and require more profound investigations.

Figure 6-2 Flowchart illustrating water use for bioenergy – Part 1



Source: own presentation

Figure 6-3 Flowchart illustrating water use for bioenergy – Part 2



Source: own presentation

Quality requirements – standards, criteria

Quality impacts on water can basically be traced back to three groups of causes which will be outlined below together with the possible criteria / indicators:

a) **Agricultural production**:

The water protection requirements in connection with agricultural production can mainly be derived from the "Cross Compliance" provisions of the EU. The proof of compliance with the principles of *good agricultural and ecological* conditions (GAEC) and the *statutory management requirements (SMR)* should provide sufficient indicators for ensuring compliance with the quality requirements on biomass cultivation. If biomass is produced outside the EU, alternatively, proof of compliance with the FAO requirements (2003a) on good agricultural practice (GAP) may also provide suitable evidence. The test chart on “excessive water consumption” has already accounted for this, because by referring to GAP, both quality and quantity requirements are complied with.

b) Discharge of process wastewater

Compliance with both national and international limits or recommended values is the primary benchmark. The Annexes to the EU Water Framework Directive (WFD) concerning limit values in the wastewater of various industries provide suitable guidance, for example. It must be noted that national legislation of the producing countries (e.g. provisions in the state of Sao Paulo/Brazil concerning the wastewater of sugar and ethanol plants) is to be observed in many cases.

c) Use of possibly contaminated wastewater for irrigation

Wastewater use is to be examined not only under the aspect of “water consumption”, but mainly with respect to possible pollution. If wastewater is used for irrigation, it must be proven that the wastewater used does not exceed the statutory (national or international) limit values. These quality requirements on wastewater must be identified, evidenced and documented on a case-to-case basis (according to type of wastewater).

6.3 Open Questions

The applicable indicators or indicator models proposed in the present report with direct reference to the requirements of the RED and evidence of their compliance must be examined for their practical application.

It is assumed that a large portion of biomass production projects can be assessed with sufficient accuracy on the basis of the global data available on water availability with a comparatively good regional resolution (IWMI, WaterGap etc.). It is currently unclear whether sufficient approaches can be developed which also account for the numerous borderline situations. This refers to cases in which, e.g.,

- water is not yet scarce, although an additional irrigation project could cause such scarcity on the basis of the quantities involved. In such a case, one would have to find out in how far the biomass project would be the decisive factor
- a particularly large irrigation project might aggravate a situation of real scarcity to the disadvantage of other users or the hydrological situation although a very well adapted irrigation technique and design and well adapted irrigation management are applied
- an irrigation project would develop general water supply opportunities, thus mitigating the *economic* water scarcity of the population

7 Land Use and Potential of Unused Land

The consequences of land use changes associated with the provision of renewable resources are closely connected to the aspects of climate protection (chapter 4), biodiversity (chapter 5), water (chapter 6) as well as land use rights and the living and working conditions of the rural population. Therefore, land use is a **cross-sectional topic** that is to be considered under several aspects. In addition to direct land use changes, indirect consequences play a special role that can potentially be avoided by utilizing **previously unused** land (chapters 4.2 and 5.2).

Accordingly, one focus of the research project was on the global potential of using unused land for biomass cultivation. The areas in focus include unused, **degraded** land (bio-physical reasons) and land that is no longer used for political (set-aside) or economic reasons (locations with marginal return). The scientific challenge is to locate such areas using minimum effort and a reliable method.

For this purpose, the suitability of existing data and the inclusion of (satellite-based) remote sensing data were subject to methodological discussion in the project and the way in which this data can be upgraded by geographic information systems (GIS) was examined. In addition, country studies were performed in Brazil, China, and South Africa together with local partners[26] whose results can be summarized as follows:

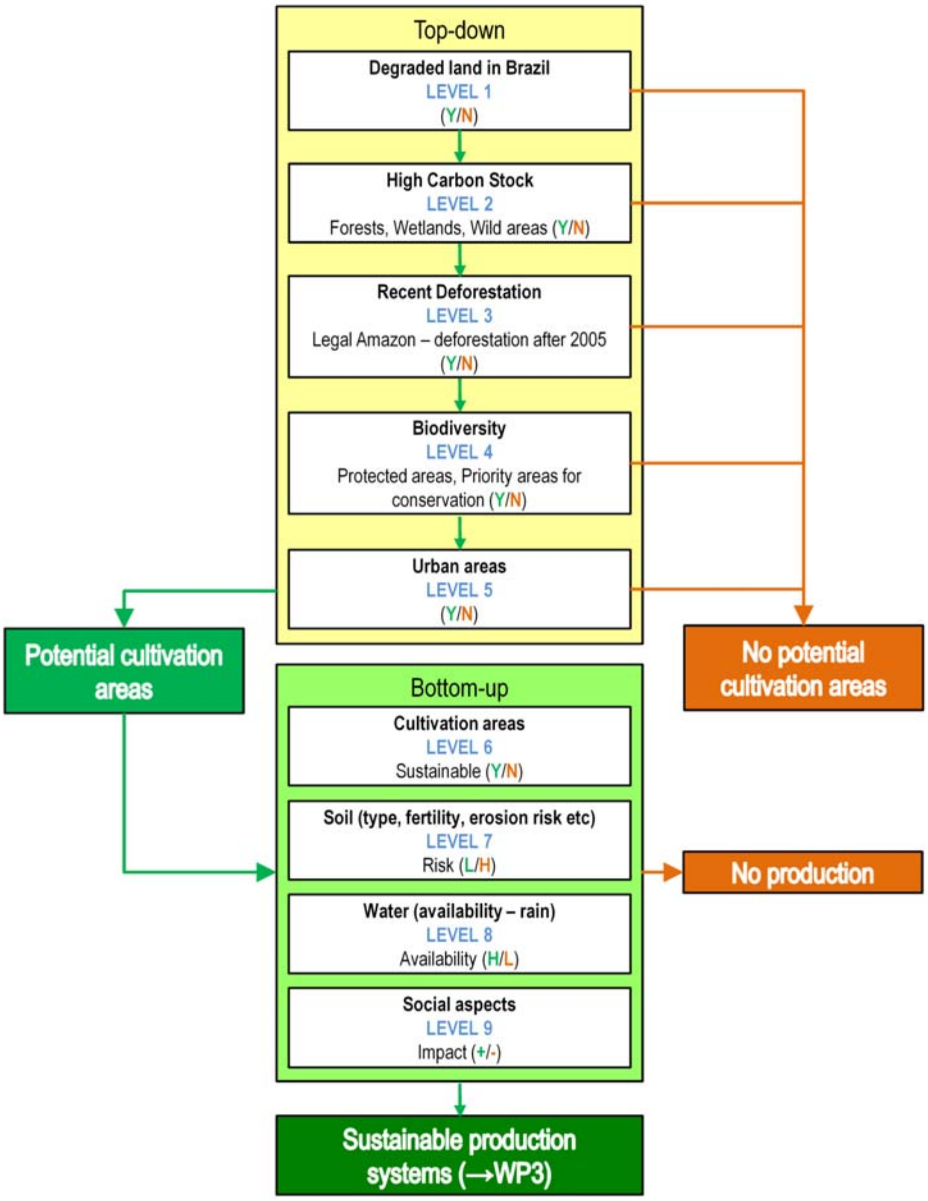
Short overview of the availability of spatial data

The availability of national and global data for identifying formerly used and degraded land was evaluated. Other aspects included data relating to biodiversity, land use, suitability of cultivation methods, soil quality and social indicators (land use rights, population density).

The analysis has shown that in general, no data is available in sufficient resolution with respect to *abandoned land*, land use or other social aspects. In South Africa, both national and global data was available for most of the suitable records, which enabled a direct comparison of the scale spectra. In Brazil, a combined use of global and national data was required, whereas in China, no national data was available as a result of political restrictions and/or cost.

[26] The reports covering the country studies as well as a summary of the most important results can be found on the attached CD-ROM.
In July 2009, the status of the case studies and the discussion on methods were presented for further debate at the 2nd international workshop on "Biodiversity and potentials of degraded areas" held in cooperation with UNEP, FAO and other partners in Paris, where the results of parallel projects conducted by other research institutions were also included (cf. the corresponding workshop documentation on the enclosed CD-ROM or http://www.bioenergywiki.net/index.php/2nd_Joint_International_Workshop_Mapping.

Figure 7-1 Flowchart for the identification of potentially suitable cultivation areas (Brazil)



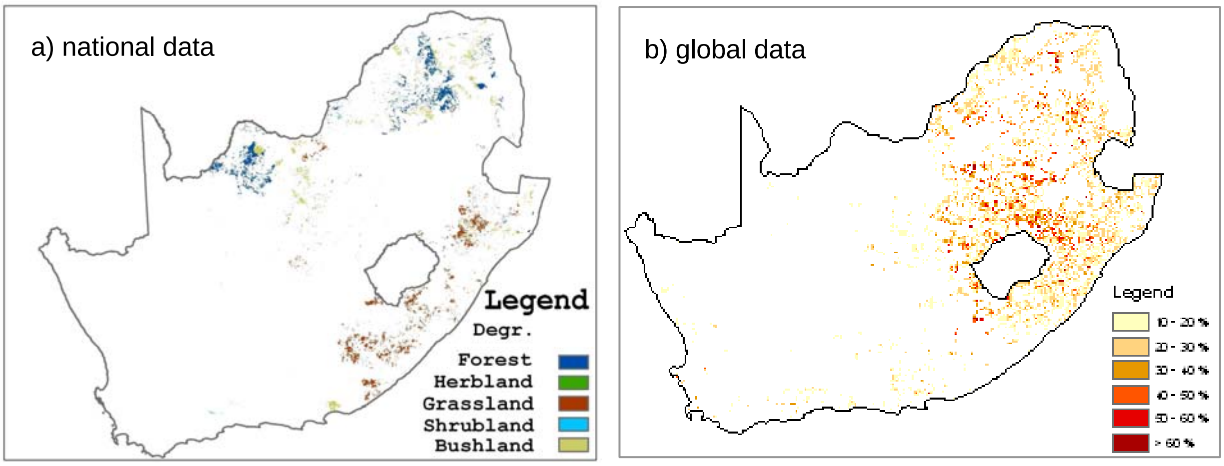
Source: own presentation

Spatial identification of potential areas for biomass production

A decision tree was developed for each country for the identification of areas that can **potentially** be used for biomass production by identifying suitable areas on the basis of the records that had previously been found to be suitable. The decision tree accounts for the EU sustainability standards (RED) and country-specific requirements. In particular, degraded areas were included, with negative effects on the environment (GHG, biodiversity, water, soil) and local population (food safety, local land use) to be minimized. Suitable records were selected for a *top-down* analysis depending on the data available (refer to Figure 7-1). The aspects for which no sufficient data was available must be verified on location using a *bottom-up* analysis – together with the information obtained from the *top-down* records (cf. Figure 7-1 and local inspection further below).

As an example, the potentially suitable areas in South Africa have been depicted in the following figure on the basis of national and global data. The clear differences between the results demonstrate the limited suitability of the global data (for more details, refer to the country studies).

Figure 7-2 Potentially suitable cultivation areas in South Africa



The top-down analysis is based on (a) national data and (b) global data. Degraded areas were included, however, high-carbon and high biodiversity areas were excluded.

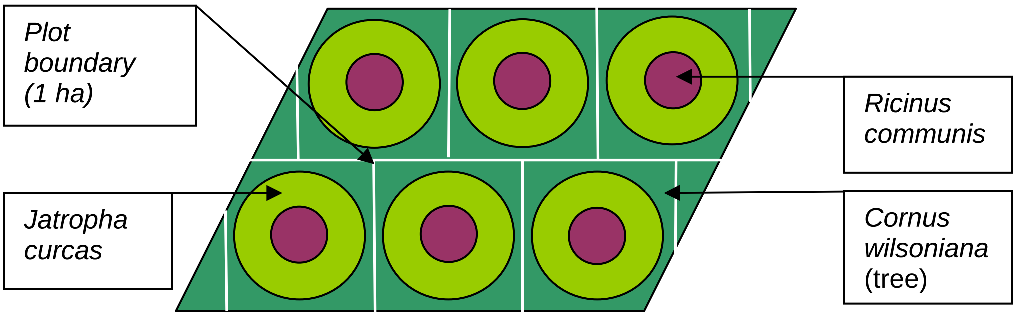
Cultivation methods and calculation of biomass potentials

Suitable crops were identified and described in detail in each country case study. The selected species comprised both highly popular energy plants such as rapeseed and soy beans, as well as rather seldom species (e.g. *Ricinus* and *Canna*) and perennial cultures such as Jatropha and Eucalyptus. For the selected species, the cultivation practices (inputs, machinery use, harvest), investment and operating costs, yields and income, as well as their environmental impact (GHG, biodiversity, soil, water) were described.

Sustainable biomass cultivation systems which can be used for biomass production on potentially suitable areas were identified in each country. Their range is from improved rotation systems for annual crops up to agroforestry systems (Figure 7-3).

The assessment of national biomass potentials turned out to be difficult, however. This was mainly due to the uncertainty surrounding the question as to how many potentially suitable cultivation areas (*top-down*) would eventually remain suitable for cultivation after a *bottom-up* review. In addition, the yields of different cultivation practices differed considerably, with resulting further deviations. On the assumption that only 20% of the potential cultivation areas are eventually suitable, biomass potentials of 0.35 to 1.4 tons per year were calculated for South Africa. For China, potential estimates amounted to approx. 7 million tons of biomass per year (approx. 790 million liters of biofuel).

Figure 7-3 Agroforestry system in China



Agroforestry system for the production of biofuel and other products (wood, feed) on slopes with a gradient of 15-25°

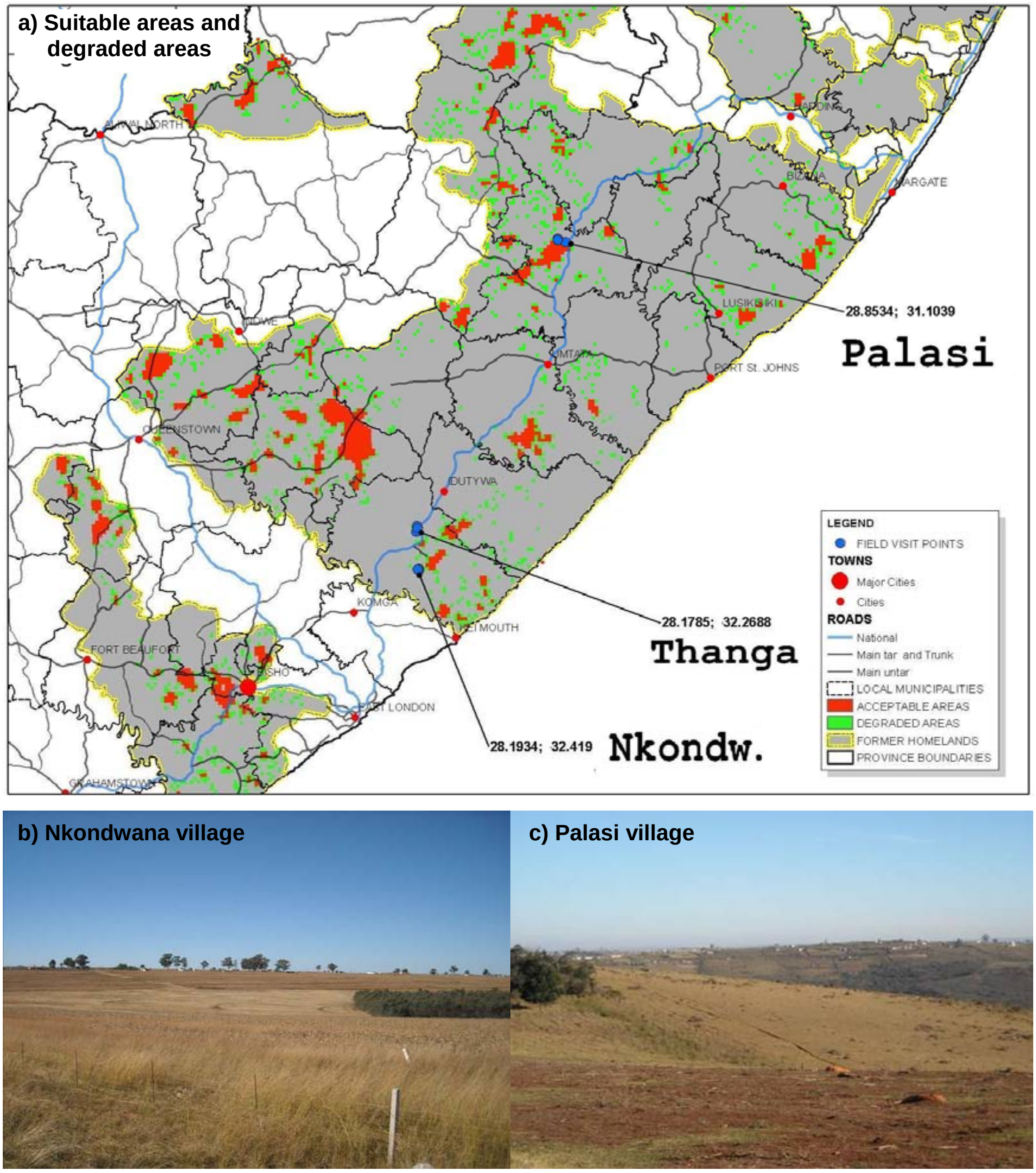
Exemplary verification of the reliability of the *top-down* identification of potential areas for biomass cultivation through local inspections (*bottom-up*)
One fundamental problem of this approach is the reliability and resolution of the global and national GIS data available. An exemplary verification was conducted by selecting areas with a minimum size of 100 ha in two selected regions characterized by a high share of potentially suitable areas in each of the two countries. These areas were examined through a local inspection involving relevant stakeholders such as political decision-makers, NGOs, and representatives of the local population.

In general, the exemplary verification of the *top-down* analysis yielded a "hit-to-miss ratio" of 50-80% with respect to degraded areas, depending on the country. High-carbon areas were largely excluded, whereas higher uncertainties were obviously observed for high biodiversity areas. This was also the case with respect to the existing land use: Farming was practiced in a large proportion of the areas investigated, and the areas were available to a certain extent only. Nevertheless, numerous suitable areas were identified, e.g., in the Xingyi District (China) or the focal areas of Thanga and Nkondwana (South Africa).

Conclusions
The country studies have shown that the combined *top-down* and *bottom-up* approach can basically be used to identify areas suitable for biomass cultivation for the purpose of the project. The hit-to-miss ratio depends on the quality of the data used. In addition, one has to expect that suitable areas can be found outside the preselected areas. In summary, a *top-down* analysis by itself is not sufficient, and a local inspection is indispensable for arriving at reliable conclusions.

The evaluation of the country studies has shown that suitable species and cultivation methods are available for biomass cultivation on degraded areas, however, the economic efficiency of cultivation is doubtful on some surfaces because of poor yields.

Figure 7-4 Local data collection in South Africa



(a) Map showing the focal regions in Eastern Cape. (b) Surface area of a large-scale corn project, forest area and grazing land, (c) slopes with eroded topsoil

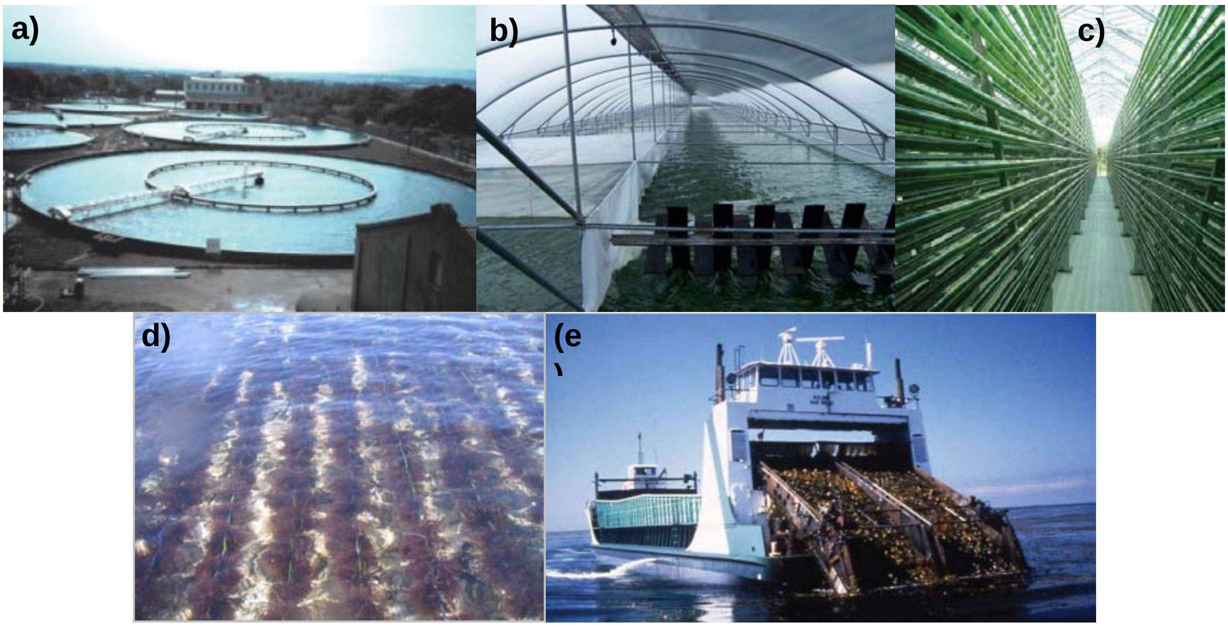
In literature, the global potentials of degraded areas are estimated at 430 to 2,540 million hectares. In view of the results of the country studies, these estimates of potential areas appear exaggerated, even though no correction factor can be specified due to the low number of samples taken.

Nevertheless, the country studies have shown that suitable areas actually exist – although on a smaller scale – which could yield environmental and socio-economic benefits in combination with an adapted management of biomass cultivation.

8 Sustainable Bioenergy from Algae: Status and Perspectives

In the year 2007, the worldwide production of macroalgae amounted to approx. 16m tons. In return, the microalgae production only amounted to 10,000 t. Macroalgae, which are mainly used as food and feed and as industrial raw materials, are almost exclusively cultivated in the sea or harvested from natural crops at the moment. On the contrary, microalgae are produced in land-borne systems (Figure 8-1). Microalgae are primarily used for manufacturing high-quality products (medicine, cosmetics). The **energy** use of algae currently is in the research and development stage.

Figure 8-1 Cultivation of microalgae and macroalgae



Microalgae: (a) open system (Taiwan), (b) semi-open system (Argentina), (c) closed system (Germany); macroalgae: (d) offshore cultivation (Indonesia), (e) harvesting boat (Mexico)

Aquatic biomass, in particular if obtained from microalgae, is assumed to be capable of making increasing contributions towards the provision of bioenergy.

The reason for this, it is said, is that algae can reach up to ten times higher **yields per hectare** than terrestrial plants. Expert literature quotes information confirming that the production of algae-based biofuels requires less than 3% of the surface area needed by corn or sugar cane, for example.[27]

In many cases, the information concerning this type of extremely high yields per hectare is based on the extrapolation of laboratory results, although their

[27] Groom, M. J./Gray, E. M./Townsend, P. A. 2008: Biofuels and biodiversity: Principles for creating better policies for biofuel production; in: Conservation Biology vol. 22, p. 602-609

transferability to practice is not realistic.[28] The biology of algae (e.g. exploitation of light) as well as technical aspects (e.g. shadowing-off) clearly put a limit to the calculated extremely high yields. Nevertheless, algae could certainly achieve high biomass yields in tropical coastal waters.

The potential macroalgae production in coastal zones with suitable climates is estimated at 7,400 million tons of biomass at maximum (corresponding to approx. 3% of the worldwide energy demand).[29] To what extent these potentials can actually be exploited is questionable for environmental reasons (protection of coastal waters) but also for technical and economic reasons.

An international **algae workshop** was organized in late 2009 as part of the research project which focused on the issue of bioenergy from algae and offered researchers and business stakeholders dealing with the issue of algae a forum for mutual exchange. The algae workshop focused on the assessment and evaluation of biomass potentials, the state of the art, economic aspects, and environmental impacts of algae.

An input paper summarized the current status of the use of algae as energy carriers, and key issues of the workshop were identified (refer to CD-ROM). The key results of the workshop will be summarized below, for details, refer to the contributions to the workshop in the documentation (cf. CD-ROM):

From the **economic point of view**, the production of microalgae or macroalgae as a raw material for bioenergy is not economically viable at the moment due to low prices of fossil energy. The cultivation and extraction of biomass from microalgae is mainly obstructed by technical problems.

However, the use of **residuals** from existing microalgae or microalgae production for energy production may be economically viable already today.

The **environmental risks** associated with the cultivation of algae in open waters and terrestrial systems are diverse. Cultivating macroalgae in the sea is primarily limited to coastal regions which are subject to high utilization pressure and high environmental impacts in many parts of the world already today.

In addition, especially coastal zones are characterized by high biodiversity and ecosystems worth protecting.

Nevertheless, the cultivation of macroalgae may also have positive environmental effects, e.g., if macroalgae are used as biofiltering systems for aquacultures.

The main risks of terrestrial systems are the associated land usage and water consumption.

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[28] For example, the extrapolation of short-time measurements for *Chlorella vulgaris* in summer leads to clearly exaggerated yields of 130-150 t/ha/a (Pulz, O. 2001: Photobioreactors: production systems for phototrophic microorganisms; in: Appl. Microbiol. Biotech. vol. 57, p. 287-293).

[29] FAO (UN Food and Agricultural Organization)/Ecofys 2009: Algae-based biofuels: A review of challenges and opportunities for developing countries; Rome ftp://ftp.fao.org/docrep/fao/011/ak333e/ak333e00.pdf

The use of genetically modified species is to be regarded critically, because even in closed systems, it cannot be avoided that the genetically modified algae may enter the environment.

Another key result of the workshop is that a significant contribution of aquatic biomass cannot be expected **earlier** than in 10 to 20 years given the current state of the art and the present energy cost. However, the economy of the production systems would have to be significantly improved for this purpose by at least a factor of **10**.

Additional work should focus on

- the optimization of algae cultivation (e.g. identification of productive algae species, harvest and extraction techniques),
- the potential impairment of natural ecosystems by the production of macroalgae,
- water pollution by nutrients, and
- the energy and GHG life cycle assessment and the water consumption (of microalgae),

because few data and findings are available in this connection, but without this information, the sustainability of algae biomass cannot be assessed.

9 Sustainable Biomass: Transferability of Standards and Criteria to Renewable Raw Materials in General

Another question raised by the research project which goes **beyond** the bioenergy issue was the question of transferability of the sustainability criteria and standards to internationally traded biomass **as a whole** – including its use as a (raw) **material**.

As regards food and feed as well as forestry products, a number of voluntary sustainability standards have been defined, mainly for products from organic farming and from "fair" trade, which account for a small market share only. **No relevant standards** have so far been stipulated for renewable raw materials (RRM) for industrial use.

The following table shows the current RRM use in Germany.

Table 9-1 Types and quantities of material use of biomass in Germany

Raw materials	**Quantity (t)**	**Applications**
Wood	45 million	Construction timber, furniture, packaging, wooden materials (chipboard, WPC, etc.), paper
Dissolving pulp	300.000	Cellulose fibers (viscose, lyocell), cellulose derivatives, biopolymers
Vegetable oils, animal fat, glycerin	approx. 1.25m*	Lubricants, tensides, thickening agents, polymers and polymer additives, lino, platform chemicals
Proteins: gelatine, casein, etc.	approx. 30,000	pharmaceutical products (haemangioma, blood substitutes), paper coats, glues, paints, polymers
Sugar, molasses, syrup	approx. 50,000**	Platform/fine chemicals, biopolymers, pharmaceuticals, concrete binder
Starch and starch derivatives	approx. 500,000**	Paper starch, glues, bonding agents, biopolymers, textile starch
Natural fibers (including yarns/fabrics)	160.000	Textiles, technical textiles, insulating materials, natural fiber reinforced plastics, special papers
Natural rubber	270.000	Car and truck tires, rubber gloves, etc.
Cork	35.000	Bottle cork, cork products, cork compound materials
Medicinal plants	up to 24,500	Ingredients for drugs, health food, cosmetics
Dye plants, resins, wax, tannins	37.500	Textile dyes, paints, tannins, etc.

*Source: own calculations on the basis of " Development of instruments for promoting the material use of renewable raw materials in Germany"; Nova-Institut on behalf of BMELV; FKZ: 22003908; Hürth 2009; * = including glycerin from biodiesel; ** = without BioEtOH*

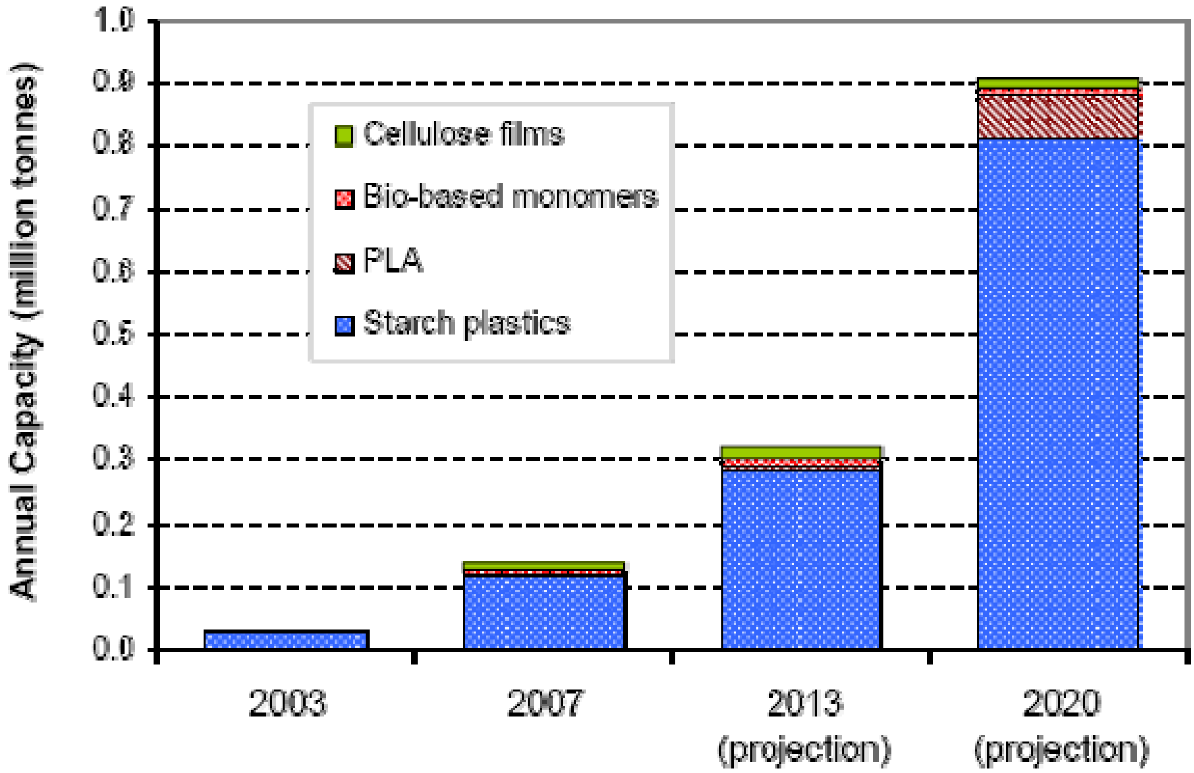
The most important RRM in terms of quantity are wood and wood products, which have their own sustainability standards as regards forestry production (FSC, PEFC), however, these standards do **not** satisfy the requirements of the RED.

In return, the sustainability standards for liquid fuels (biodiesel) or their raw materials set forth in the RED **could** be applied to the second largest group of vegetable oils/animal fats and the products made from them, although the question of the reference system for GHG reduction would remain unsolved.

The remaining, quite diverse RRM are made or processed from a wide variety of different biomass cultivation systems and methods, and target quite diverse sectors of consumption.

Especially noteworthy in this respect are starch plants and pulp as well as rubber to which the sustainability requirements relevant for bioethanol or biodiesel production could **basically** be applicable as well, although the question of reference systems for GHG reduction remains unanswered again. According to various studies, the possible future extension of RRM (except wood and vegetable oils) will mainly take place in the field of **starch-based plastics** (cf. the following figure).

Figure 9-1 EU market potential for bio-based plastics



Source: Product overview and market projection of emerging bio-based plastics - PRO-BIP; Copernicus Institute; Utrecht University 2009

This leads to the conclusion that in the medium term, the **additional** market potential of "new" RRM in the EU (except wood and vegetable oil) will be relatively limited unless their use is specifically promoted.

As the sustainable bio**mass** potentials in Germany (approx. 100 million tons) and in the EU (more than 600 million tons) by the year 2030 are comparatively high, therefore, there is no direct competing use that would be relevant in terms of quantity – even if the use of "new" RRM (without wood and vegetable oil) was significantly increased[30].

The discussions within the project have shown that the sustainability standards and criteria obtained for bioenergy can **basically** be transferred to **all** RRM, including the land-related aspects (in particular, GHG emissions from LUC).

However, **three specific** problematic issues have to be observed:

- No reference system has so far been defined for the formulation of GHG reduction goals for RRM[31].
- RRM feature a greater variety of co-products than energy uses, which sometimes feature small material flows, but a high economic value. For this reason, the use of energy-based allocation is questionable. Multiple material use (cascading, down- and recycling) has also to be considered in that regard.
- In the **future**, RRM may potentially play an important role with respect to "green" genetic engineering, combined with the corresponding risk potential associated with the release of GMO[32].This also applies to **algae** which are currently being used as raw materials, but will also be used for energy production in the future and will also raise issues of GMO.

The envisaged future extension of sustainability standards to **all** types of biomass, including flowers, feed/food, coffee, paper, tea, textiles, etc., appears to be viable **in principle**, however, the issues of GHG reduction goals, allocation and GMO again should not be neglected.

Therefore, the practical design and implementation of sustainability requirements on RRM – and especially also on biomass in general – will require a much more complicated and comparatively **long-term** process of discussions compared to biofuels, and raise a number of open research issues (cf. chapter 10).

[30] The EU potentials were derived from EEA studies (2005-2007). In addition, the cascaded use mentioned in chapter 2.1 would take effect, i.e. primary use as raw material and "subsequent" use of residuals and waste for energy production which are obtained during the production or at the end of the use as raw material, thus avoiding competing uses.

[31] However, a conversion of the energy-related requirements to material-related reference variables is basically possible using the calorific value of fossil fuels.

[32] This statement mainly refers to improvements of the **structural properties** of RRM-supplying plants through genetic modification (e.g. higher oil content of soybeans, starch-optimized potatoes, wood poor in lignin, etc.). In the field of bioenergy carriers, GMO are not entirely ruled out, either (e.g., rapeseed), however, they have not played a major role in this field so far because higher yields (e.g. "biogas corn") and tolerances, e.g. to salt, can be achieved by conventional cultivation methods for the time being.

Due to the increased **links** between biomass markets (agriculture, energy, forestry), consistent – although not necessarily identical – sustainability requirements **still** appear to be the **silver bullet** in order to avoid shifts and "transfers" between markets.[33]

Under **strategic** aspects, however, the problem arises that there are numerous different market stakeholders and governance structures that will be difficult to bundle in an "alliance of interests" due to distinct market conditions.

Again, this supports the notion that a very time-consuming process will be required in order to arrive at consistent sustainability requirements.

More consistent sustainability standards for biomass could be **obtained** in the **nearer future** by harmonizing criteria for promotion and/or rules for market access.

[33] The consistent application of the GHG life cycle assessment to all biomass types would especially solve the problem of "indirect" effects of growth in one sector on related submarkets, and thus the issue of GHG emissions from indirect LUC (cf. chapter 4.2).

10 Open Questions and Outlook

The questions and tasks set forth in the project goals were pursued in the course of the process by focusing on the contents and a large number of discussions at – own and third-party – events offering many opportunities for an exchange of opinions and views. From the authors' point of view, this productive format should also be used in the future to deal with any additional questions that may arise.

The legally binding specification of sustainability standards for biogenic liquid energy carriers **at the EU level** (RED) at the end of the project leads to some important issues concerning concrete details and their implementation which have already been discussed in connection with the GHG life cycle assessment in chapter 4.

With respect to the land-related criteria for biodiversity protection, the project – with the support of a more profound project of BMU and inputs from BfN – was able to provide significant impulses for the design, which do, however, need to be implemented at the EU level.

The recent report of the EU Commission concerning the (voluntary) **extension of the RED standards to bioenergy as a whole** must be reviewed critically with respect to its acceptance by the European Parliament and the Council as well as its implementation by Member States – and the same applies to the **Commission report on iLUC** expected for late 2010, and the subsequent consultation at the EU level.

The work of CEN and RSB being finalized and the beginning activities of ISO concerning **voluntary sustainability standards** for bioenergy open up significant fields of activity in order to contribute what has been achieved in the EU also to a broader international context.

This also applies to the work of the **GBEP Sustainability Task Force**, the scientific support of which is ensured by a parallel BMU project.

The suggestions and own contributions made by the project for the inclusion of criteria for sustainable biomass – in particular, bioenergy and biofuels – in the UN **Convention on Biological Diversity** must be further pursued, and should be maintained in the discussion with a view to the Tenth Meeting of the Conference of the Parties to the Convention taking place in Japan in October 2010.

No major progress was achieved at the 16th Meeting of the UN Commission on Sustainable Development (CSD), which dealt with land use issues in May 2009, with respect to the **global land use policy** called for by WBGU with respect to bioenergy[34], likewise, the question as to "general" sustainability standards for biomass has not been answered at all so far.

[34] see footnote 3

In addition, three **substantial sets of questions with future relevance** could be marginally addressed by the project only:

- Which life cycle related GHG emissions are associated with the cultivation of **algae** for bioenergy generation, and what effects on biodiversity are to be expected, in particular, from macroalgae? Are any reasonable combinations with aquaculture systems possible in order to use wastes and organic loads from fish farms for algae production?
- What about the sustainability – in particular, GHG emissions and risk issues of GMO – of the **material use of biomass**, which reference systems are to be applied, and which methods are to be used in connection with by- and co-products?
- Which improvements in the efficiency of use can be achieved by biorefineries[35] which promise to overcome the separation between energy and material use of biomass – at least in concept?

In addition to the further pursuit of the processes outlined above by which sustainability requirements will be established and substantiated in the EU and in the international domain, these questions constitute significant challenges that can be met by properly designed and funded additional studies only.

Since the importance of these issues reaches far beyond the borders of Germany, they should be addressed by a study with international orientation.

[35] Small national R&D projects promoted by BMU and BMELV are already under way, and at the EU level, a special project cluster was instituted in the 7th Research Framework Programme.

Executive Summary

The increased production of renewable raw materials for bioenergy and bio-materials needed to meet the ambitious targets of Germany, the EU and other countries implies tradeoffs which could oppose sustainability requirements.

The project "*Development of strategies and sustainability standards for the certification of internationally traded biomass (Bio-global)*", sponsored by the German Federal Ministry for Environment (BMU) through the Federal Environment Agency (UBA) and carried out by Öko-Institut in cooperation with IFEU (Institute for Energy and Environment Research), aimed at

- working out the scientific base of and developed proposals for sustainability requirements for biomass and their implementation on national, European and global levels,
- in dialogue with relevant actors and
- providing inputs into respective processes.

For that, discussions with experts from more than 20 countries were held, international networks created and extended, and political decision-makers supported.

Besides developing a strategy for sustainable biomass, the project work focused on the following issues:

- greenhouse gas balances - calculation of GHG emissions from direct **and indirect** land use changes; for this, methodological approaches for, among others, the EU Renewable Energy Directive and the subsequent German Sustainability Ordinances for Biofuels and Bioelectricity were worked out, and possible extensions to all bioelectricity in the German feed-in law were considered, as well as the concept of the "**iLUC factor**" for GHG emissions from indirect land use changes was developed and quantified.
- biodiversity - a globally applicable risk minimization strategy was developed and tested in three country case studies in Brazil, China and South Africa for the example of degraded lands, in collaboration with local partners,
- water scarcity and water quality – here, requirements for biomass cultivation were developed
- trade law and sustainability – the result of work on this issue is that the protection of global common goods (biological diversity, climate) could substantiate import restrictions into the EU for non-sustainable biomass.

The majority of project results – though not all - was successfully implemented in legal and standardization processes (e.g., German Sustainability Ordinances for bioenergy, EU renewable energy directive, European Committee for Standardization, Global Bioenergy Partnership) and both scientific and environmental and development questions were discussed with – not only governmental – actors.

The next steps should be the extension of the approaches developed to other biomass (especially for material use) and the critical review of the further implementation.

Synthèse

La production croissante de matières premières renouvelables, impliquée par les objectifs ambitieux de l'Allemagne, de l'UE et d'autres pays, conduit à des arbitrages potentiellement contradictoires avec les exigences de durabilité. Le projet, intitulé « *Développement de stratégies et standards de durabilité pour la certification de biomasse pour le commerce international (Bio-Global)* », a été subventionné par le Ministère Fédéral de l'Environnement (BMU), au travers de l'Office Fédérale de l'Environnement, (UBA), et réalisé en coopération entre Öko-Institut et IFEU. Il a eu pour objectifs :

- d'élaborer une base scientifique et des critères de durabilité pour la biomasse,
- de développer des propositions pour leur mise en pratique aux niveaux national, européen et mondial, en coopération avec les acteurs pertinents,
- d'apporter des contributions aux processus respectifs.

A cette fin, des discussions d'experts de plus de 20 pays ont été tenues, des réseaux internationaux constitués et développés, et un appui offert aux décideurs politiques. En plus du développement d'une stratégie pour la production et l'utilisation durable de biomasse, les activités du projet ont été centrées sur les questions suivantes :

- bilans de gaz à effet de serre (GES) - calcul d'émissions de GES provenant de changements directs **et indirects** de l'occupation des sols : pour cela, des approches méthodologiques destinées, entre autres, à la Directive Européenne sur l'énergie renouvelable et à sa transposition au niveau de l'Allemagne ont été développées, une potentielle extension de la loi allemande de promotion des énergies renouvelables à l'électricité produite avec la biomasse a été prise en compte, et le concept du « **iLUC factor** » pour les émissions de GES provenant de changement d'occupation des sols a été élaboré et quantifié.
- biodiversité : une stratégie de minimisation du risque qui serait applicable pour le monde entier a été développée et testée pour le cas de sols dégradés dans trois exemples avec des partenaires locaux : au Brésil, en Chine et en Afrique du Sud.
- pénurie et qualité de l'eau : des exigences pour la production de biomasse ont été élaborées.
- droit commercial : sur ce point, les recherches et réflexions ont abouti à ce que la protection de biens communs globaux (climat, biodiversité) puisse justifier une interdiction de l'importation au sein de l'UE des biomasses non-durables.

La plupart des résultats du projet a pu être intégrée avec succès à des processus législatifs et de normalisation (par exemple le décret allemand sur la bioénergie, la Directive Européenne sur l'énergie renouvelable, CEN, GBEP), et il a également été possible de débattre des aspects scientifiques ainsi que des questions d'environnement et de développement avec de nombreux partenaires, au-delà des seuls acteurs–gouvernementaux. L'étape suivante devrait consister à étendre les approches développées pour d'autres types d'utilisation de la biomasse (en particulier l'utilisation matérielle), et procéder à un examen critique des futures réalisations.

Resumen

El aumento en la producción de materias primas destinadas a bioenergía y a biomateriales necesario para alcanzar las ambiciosas metas de Alemania, la UE y otros países implica un conflicto de intereses, que podría ser contrario a requisitos de sostenibilidad. El proyecto „„Desarrollo de estrategias y estándares sostenibles para la certificación de biomasa en el comercio internacional (Bio- global)", financiado por el Ministerio Alemán de Medio Ambiente a través de la Agencia Federal de Medio Ambiente y llevado a cabo en cooperación con el „Instituto para la Investigación Energética y Ambiental" (IFEU), tiene como objeto

- aportar una base científica y desarrollar propuestas para los requerimientos de sostenibilidad para biomasa a nivel nacional, europeo y global
- consultando a actores importantes e
- introduciendo la información obtenida en los procesos correspondientes.

Para ello se discutió con expertos de más de 20 países, se constituyeron y ampliaron redes de contacto a nivel internacional y se asesoró a políticos responsables en la toma de decisiones. Junto al desarrollo de una estrategia de biomasa sostenible, el proyecto abarca los siguientes temas:

- Balance de gases invernadero – Cálculo de emisiones de gases debido a los cambios directos **e indirectos** de los usos del suelo; para ello se desarrollaron y se cuantificaron enfoques metodológicos, entre otros, para la directiva europea de Energías Renovables y su transposición alemana, también para la posible inclusión de la electricidad procedente de biomasa en la mencionada directiva y el concepto del **„iLUC factor"** para las emisiones de gases invernaderos procedentes de cambios indirectos de usos del suelo.
- Biodiversidad – a tal efecto se elaboró una estrategia de minimización de riesgos aplicable a nivel mundial y se probó la misma en tres países – casos de estudio – (Brasil, China y Sudáfrica), en cooperación con socios locales y tomando las áreas degradadas como ejemplo.
- Calidad y escasez de agua – para ello se trabajó en un catálogo de requisitos para el cultivo de biomasa
- Derecho comercial – el resultado del proyecto en este aspecto concluyó que la protección de bienes comunes globales (clima, diversidad biológica) puede justificar la prohibición de importación en la UE de biomasa no sostenible.

La mayoría de los resultados del proyecto, aunque no todos, fueron considerados e introducidos en leyes y procesos de normalización (por ej., los Decretos alemanes de Sostenibilidad para Bionergía, la directiva europea de energías renovables, el Comité Europeo de Normalizacion, Global Bionergy Parnership) y tanto cuestiones científicas como ambientales y de desarrollo fueron discutidas con diversos actores – no sólo del ámbito político. Quedan pendientes, como pasos a seguir, la ampliación de los enfoques propuestos a otras biomasas (sobre todo para el uso material) y la revisión crítica de posteriores transposiciones.

Annex

A-1 Important abbreviations

AGEB	Arbeitsgemeinschaft Energiebilanzen e.V. (Working Group on Energy Balances)
AGEEStat	Arbeitsgruppe Erneuerbare Energien Statistik (Working Group on Renewable Energy Statistics)
BioNachVO	Verordnung über Anforderungen an eine nachhaltige Erzeugung von Biomasse zur Verwendung als Biokraftstoff (Biofuels Sustainability Ordinance)
BioNachSt	Nachhaltigkeitsverordnung für flüssige Bioenergieträger zur Verwendung in der Stromerzeugung nach dem EEG (Sustainability Ordinance on Liquid Bioenergy Carriers for Electricity Generation under the EEG)
BMELV	Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz (Federal Ministry of Food, Agriculture and Consumer Protection)
BMU	Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety)
BSI	Better Sugarcane Initiative
CBD	UN Convention on Biological Diversity
CCD	UN Convention to Combat Desertification
CDM	Clean Development Mechanism
CEN	Comité Européen de Normalisation (Europäisches Komitee für Normung)
CoP	Conference of the Parties (to a UN Convention or Protocol)
CSD	UN Commission on Sustainable Development
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EEA	European Environment Agency
EIB	European Investment Bank
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FCCC	Framework Convention on Climate Change
FNR	Förderagentur Nachwachsende Rohstoffe (Agency for Renewable Resources)

FSC	Forest Stewardship Council
GATT	General Agreement on Tariffs and Trade
GBEP	Global Bioenergy Partnership
GIS	Geographic Information Systems
GMO	Genetically Modified Organisms
IEA	International Energy Agency
IFI	International Finance Institutions
ILO	International Labour Organization
IPCC	Intergovernmental Panel on Climate Change
ISO	International Standardization Organization
IUCN	International Union for the Conservation of Nature and Natural Resources
IWMI	International Water Management Institute
KfW	Kreditanstalt für Wiederaufbau (German promotional bank)
LUC	land use changes
RRM	Renewable Raw Materials
PEFC	Pan-European Forest Certification
RED	EU Directive for the Promotion of Renewable Energy Sources
REDD	Reduced Emissions from Deforestation and Degradation
RSB	Roundtable on Sustainable Biofuels
RSPO	Roundtable on Sustainable Palm Oil
RTRS	Roundtable on Responsible Soy
GHG	Greenhouse gas
UBA	Umweltbundesamt (German Federal Environmental Agency)
UNEP	United Nations Environment Programme
UNEP-WCMC	United Nations Environment Programme World Conservation Monitoring Centre
UNIDO	United Nations Industrial Development Organization
WBGU	Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen (German Advisory Council on Global Change)
WFD	EU Water Framework Directive
WWF	World-Wide Fund for Nature

A-2 Overview of the Documentation on the CD-ROM

Working papers

Working package 1

- Statuspapier zu globalen Entwicklungen im Bereich nachhaltiger Bioenergie (Sommer 2007, mit nachfolgenden Aktualisierungen Ende 2007, 2008 und Ende 2009) (Status paper on global developments in the field of sustainable bioenergy (summer 2007, with subsequent updates in late 2007, 2008 and late 2009)
- Matrix der Standardwerte zu Treibhausgasemissionen bei der Herstellung von Biokraftstoffen (2007) (Matrix of default values for greenhouse gas emissions from the production of biofuels (2007))
- The Sustainability Ordinance for the German Biofuel Quota Law - Informal Summary (2007)
- Greenhouse Gas Balances for the German Biofuels Quota Legislation - Methodological guidance and default values (2007)
- GHG Accounting for Biofuels: Considering CO_2 from Leakage (2007)
- Nachhaltigkeit Biokraftstoffe – CO_2 aus indirekter Landnutzung (Sustainable biofuels – CO_2 from indirect land use) (2007)
- The iLUC Factor Approach formerly knows as “Risk Adder” (2008)
- Greenhouse Gas Balances for Biomass: Issues for further discussion; Issue paper for the informal workshop, January 25, 2008 in Brussels
- Comparing EU Renewable Energy Sources Directive and German Biomass Sustainability Regulation in terms of Sustainability Criteria and GHG method (2008)
- The iLUC Factor: A Simplified Approach to Assess GHG Implications of Indirect Land Use Change from Bioenergy (2009)
- The “iLUC Factor” as a Means to Hedge Risks of GHG Emissions from Indirect Land Use Change Associated with Bioenergy Feedstock Production (2010)
- Working paper on "water focus" (2008)
- Aquatic Biomass: Sustainable Bioenergy from Algae? issue paper (2009)
- Criteria and Indicators to Identify and Map High Nature Value Areas – Issue Paper for the Joint International Workshop on High Nature Value Criteria and Potential for Sustainable Use of Degraded Lands, Paris, June 30-July 1, 2008
- Degraded Land and Sustainable Bioenergy Feedstock Production – Issue Paper. Joint International Workshop on High Nature Value Criteria and Potential for Sustainable Use of Degraded Lands, Paris, June 30-July 1, 2008
- Bioenergy and Biodiversity: Potential for Sustainable Use of Degraded Lands. Briefing Paper for the Information Event at CBD-COP9 on May 27, 2008

- Land Categories and Identification of Priority Areas for Sustainable Bioenergy Cultivation (2008)
- Sustainable Biomass Production from Degraded Lands – Summary of Country Studies (2010)

Working package 2

- International biomass trading working paper (2007)

Working package 3/4

- Endbericht zu rechtlichen Fragen nachhaltiger Biomasse (2009) (Final report on legal issues of sustainable biomass)

Working package 5

- Internationaler Handel mit Biomasse (International biomass trading working paper) (2007)

Working packages 6, 8-10

- various internal presentations and input papers for project workshops (cf. below)

Working package 7

- Methodische Fragestellungen zum Arbeitsschwerpunkt „Defaultwerte für das EEG“ (Methodological issues of the "Default values for the EEG" focus of work) (2008)

Working package 11

- Strategie zum Thema „nachhaltige Biomasse“ (Strategy on the topic of "sustainable biomass") (2008)

Working packages 12-14

- A Global Land-Assessment Strategy Regarding Sustainability Standards for Biomass Production (2007)
- Biodiversity and Land-Use (2008)
- CBD-COP9 Agenda item 3.1 Agricultural Biodiversity: Biofuels and Biodiversity (2008)

Interim reports

- Interim report (2008)
- Nachhaltige Bioenergie: Stand und Ausblick; Zusammenfassung bisheriger Ergebnisse des Forschungsvorhabens (2009)
- Sustainable Bioenergy: Current Status and Outlook; Summary of recent results from the research project (2009)

Project workshops

- *Workshop on Sustainable Biofuels, Brussels, January 25, 2008:*
  At this workshop, the project's first propositions were presented to a European expert public, with a focus on GHG life cycle assessment for "indirect land use change" and "biodiversity". It involved critical discussions with representatives of the EU Commission and others concerning the working draft of the sustainability directive on biofuels.
- *Information Event at CBD-COP9, Bonn, May 27, 2008*
  At this event, possible risks for biodiversity posed by bioenergy production and the concept for minimizing risks were presented. One focus was on the possibility of using land that had formerly been used for other purposes (abandoned farmland, unused degraded land) for bioenergy cultivation because this is expected to yield positive effects (e.g. increase in soil carbon stocks, no crowding-out of prior use).
- Support of the EEA Expert Workshop "Life-Cycle Assessment Methodologies for Greenhouse-Gas Emissions of Bioenergy: Beyond biofuels", June 10, 2008, by own contributions and preparing a follow-up meeting in January 2009.
- *Joint International Workshop on High Nature Value Criteria and Potential for Sustainable Use of Degraded Lands, Paris, June 30-July 1, 2008:*
  The workshop dealt with biodiversity-related standards and mapping approaches as well as social aspects in connection with bioenergy production. Another focus was on the sustainable production of bioenergy on degraded areas.
- *2nd Joint International Workshop on Bioenergy, Biodiversity Mapping and Degraded Lands. Paris, July 7-8, 2009*
  At the follow-up workshop, first results of the country case studies on degraded areas conducted by the project as well as similar activities of third parties were put up for discussion, and a general methodology was drafted.
- *Expert workshop on "Water issues in the context of sustainability requirements on bioenergy", Sept. 14, 2009 in the UBA, Berlin*
  At this meeting with a national focus, recent project results were presented and discussed among a group of selected experts on the water resources/water scarcity issue. The aim was to critically reflect on the methods proposed by the project and to follow up on constructive recommendations of the experts.
- *International Workshop "Aquatic Biomass: Sustainable Bioenergy from Algae?", November 2, 2009, UBA Berlin*
  This workshop performed in cooperation with the conCISEnet project of BMBF featuring more than 30 experts from Asia, the EU, Israel, Latin America and the U.S. discussed the status and perspectives of the energy use of microalgae and macroalgae with respect to economic and sustainability aspects. The report on the results of the workshop is a documentation of all contributions and discussions as well as the conclusions drawn.

Selected contributions to meetings and workshops not organized by the project itself

- Support of the **Task Force GHG Methodology** established by GBEP in late 2007 (meetings in Washington D.C., Rome, Sao Paulo und Heidelberg), leadership of the subgroup on *solid biomass/biogas*“ as well as support of the **Task Force Sustainability** established in June 2008 (meetings in Rio, Rome, Sao Paulo, Paris, Heidelberg)[36].
- Support of the "Sustainable Bioenergy" NGO platform and inputs for opinion-building in the framework of the "Bioenergy Network" of DUH.
- Expert Consultation “Bioenergy and Food Security” der FAO, Feb. 5-6, 2008, Rome
- 100 days until DBD-COP9, international action conference in Berlin on Feb. 8, 2008 (speech)
- Workshop on Sustainability criteria for biofuels, European Parliament, March 4, 2008, Brussels (speech)
- SBSTTA-13 meeting, FAO, Feb. 18-21, 2008, Rome (support of the German delegation)
- WIREC side events of BMU (moderation) and GBEP (speech/panel seat), March 4 & 5, 2008, Washington D.C.
- World Biofuels Markets Congress, March 11, 2008, Brussels (speech)
- Preparatory conference for CBD-COP9, March 13-14, 2008, Vilm island (speeches, working group leader)
- Bellagio Sustainable Bioenergy Consensus, March 25-28, 2008, Bellagio Forum (discussion input)
- Public hearing on "Opportunities and limits of biomass use", April 23, 2008, in the state parliament of Baden-Württemberg (speech)
- International Consultation on Pro-Poor Jatropha Development, International Fund for Agricultural Development (IFAD), April 10-11, 2008, Rome
- Participation in BMU journey to Brazil (May 2008): Discussions with representatives of the Brazilian government and the Brazilian sugar cane industry (UNICA) on sustainability and greenhouse gas life cycle issues
- UBA/NATO conference on "Biomass" on May 8, 2008, Berlin (speech)
- IEA Bioenergy Executive Committee Meeting, May 14, 2008, Oslo (speech)
- 16th European Bioenergy Conference, June 4-5, 2008, Valencia (speech)

[36] As of January 2009, the GBEP Sustainability Task Force was directly supported by a dedicated BMU project.

- EEA Expert Workshop „Life-Cycle Assessment Methodologies for Greenhouse-Gas Emissions of bioenergy: Beyond biofuels", June 10, 2008, Copenhagen (speeches)
- COMPETE Workshop „Sustainable Bioenergy in Sub-Saharan Africa", June 16-17, 2008, Arusha (speech)
- Internal consultations with EU Commission (DG ENV + TREN) and representatives of the European Parliament on RED; July 31, 2008, Brussels
- UNIDO Expert Group Meeting Bioenergy Capacity Building Programme (BIOCAB), August 7, 2008, Vienna (critical review)
- DIN NAGUS meeting NA 172-00-10 AA, "Sustainably produced biomass for fuel and energy production applications", function of a vice-chairman and delegation to the working groups of the corresponding TC383 with CEN, Berlin, Sept. 2, 2008
- Workshop Early experience on implementing biofuel certification – GTZ Workshop for Policy Makers and Practitioners. Brussels, September 15, 2008 (contribution by participating in a panel discussion)
- SCOPE Biofuels Workshop, Sept. 24-26, 2008, Gummersbach (critical review, workshop input)
- World Conservation Congress (IUCN) in Barcelona (Oct. 07-09, 2008). Speech: Risk Mitigation for Biodiversity: Sustainability Standards for Biofuel Production (Panel 1236 - Biofuels - Potential, Challenges and Solutions IUCN Commission on Environmental Law / Pace University Center for Environmental Legal Education, Oct. 8, 2008)
- Expert Workshop on Developing Practical Measures to Avoid the Negative Consequences of Indirect Land-use Change organised by UK's Renewable Fuels Agency (London Nov. 11, 2008)
- 2nd Int. Symposium on Energy from Biomass and Waste, November 17 - 20, 2008, Venice (speech)
- Workshop "Certification of Biomass and Bioenergy – ISCC Pilot Project" (meó Consulting, Dec. 3, 2008, Cologne)
- In cooperation with JRC Ispra: Participation in expert workshop in Malaysia in December 2009 on land use change issues

A-3 Social Standards for Sustainable Biomass

The issue of social standards was pursued as a partial aspect of sustainable biomass at the margin only, in compliance with the focus defined, however, expert inputs were given to the work on degraded areas (cf. chapter 7) and ongoing international processes (RSB, BGEP). In addition, social standards were addressed and documented by a site inspection carried out in Brazil on questions surrounding the "social biodiesel program" in cooperation with ILO.

Social aspects are most prominently included in the standards and criteria of the Roundtable on Sustainable Biofuels (RSB) which in return are based on prior studies of the FSC, ILO, Low Carbon Vehicle Partnership, Roundtable on Sustainable Palmoil, Renewable Transport Fuel Obligation, etc.

The RSB set of sustainability standards for liquid biofuels currently is in a pilot stage during which various stakeholders will test the standard. This voluntary standard explicitly includes social aspects, whereas the EU RED leaves social standards aside and only provides for reporting duties of the Member States and the EU Commission.

The "Social Impacts" working group of RSB deals with the development of principles and criteria formulating fundamental requirements on the production of liquid biofuels. The following principles were defined with a view to social aspects:

- **Counseling, planning and monitoring:** Biofuels projects shall be designed and operated under appropriate, comprehensive, transparent, consultative, and participatory processes that involve all relevant stakeholders.
- **Human and labor rights:** Biofuel production shall not violate human rights or labor rights, and shall ensure decent work and the well-being of workers.
- **Food security:** Biofuel production shall not impair food security.
- **Rural and social development:** Biofuel production shall contribute to the social and economic development of local, rural and indigenous peoples and communities.
- **Economic efficiency, technology, and continuous improvement** Biofuels shall be produced in the most cost-effective way. The use of technology must improve production efficiency and social and environmental performance in all stages of the biofuel value chain.
- **Land rights:** Biofuel production shall not violate land rights.

In the further course of its work, RSB will consolidate, improve and adapt the provisions of the standards with respect to the definition of indicators. By participating in the "Social Impacts" sub-group, the project actively contributed to the discussion during its term.