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

Sustainable Bioenergy: Current Status and Outlook

Summary of recent results from the research project

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1 Introduction

Since Summer 2007, Öko-Institut (Institute for Applied Ecology) and IFEU (Institute for Energy and Environmental Research, a non-profit limited liability company, Heidelberg) are carrying out the project "Development of Strategies and Sustainability Standards for the Certification of Biomass for International Trade (**Bio-global**)" on behalf of Umweltbundesamt (Federal Environmental Agency) .

The study is based on the fact that the production of renewable raw materials (biomass) and their application range are significantly increasing at present as a result of ambitious growth objectives adopted in Germany, the EU, the U.S., as well as several developing countries. Low-cost imports from third countries are leading to a steady rise in global trade with biogenic resources and energy carriers. 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 avoid or at least significantly reduce potential conflicts of objectives of increasing biomass use.

The project is based on current research and is aimed at working out concrete proposals for standards and certification systems and their implementation at the national, European and global level in a dialog with relevant stakeholders as an input to international processes. Furthermore, ongoing national policy consulting as well as participation in and organization of national, European and international conferences and workshops are issues covered by the project team.

The present report summarizes the project results achieved so far in different subject-related chapters:

- Which international strategy holds promise for globally sustainable biomass (Chapter 2)?
- What is the **balance** of greenhouse gas (GHG) emissions from bioenergy with respect to possible land use changes (Chapter 3)?
- How can negative effects of biomass cultivation on **biodiversity** be successfully reduced (Chapter 4)?
- What are the effects of bioenergy on the resource of **water** (Chapter 5)?
- What is the potential of **unused areas** (Chapter 6)?
- How does global biomass **trade** develop, and what are **legal** framework conditions of such trade (Chapter 7)?
- Are **sustainability standards** for bioenergy the right answer (Chapter 8)?

Chapter 9 provides a short outlook on further work to be carried out until the end of 2009.

The **Annex** gives important abbreviations, strategy issues and working hypotheses as well as information on international cooperation and representation of the project, and finally a list of available working papers.

2 International Strategy for Global Sustainability of Biomass

Whereas the later chapters of this paper deal with drafting sustainability standards and related certification systems, the present one 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 hinder the process.

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 reference for critics (potential threats) and promoters (market potential), and structure the stakeholders according to their respective interests. In parallel, the analysis of the possible international governance structures is of importance[1].

The result of this work is a strategic focus on “globalization” and harmonization of GHG standards (convention on methods plus reduction goals) and the area-specific protection of biodiversity with respect to biomass cultivation. The positive trade-off between GHG standards and areas with high nature value outside of protected zones – or influenced by indirect land use – is of great importance (cf. Chapter 3.2). Of central importance are the working groups of the Global Bioenergy Partnership (**GBEP**) which goes way beyond the G8 – in GBEP, partners such as Brazil and China, Ethiopia, and Sudan participate, as well as UN and (bio)industry organizations. GBEP is a forum to identify benefits for developing countries which depend on the individual GHG objective and methods, and to address biodiversity by linking it to the issue of land use.

The GBEP is the **only** mechanism that enables global considerations on sustainability standards for GHG as well as biodiversity and social issues (food security, occupational safety and health...) on the basis of mutual exchange and coordination. It is envisaged to adopt a resolution concerning the “core catalogue” in July 2009 in the scope of the Italian G8 Presidency which would lay the global foundation for implementation.

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 of the UN Framework Convention on Climate Change (FCCC) offers developing countries incentives for bioenergy use by enabling provisions both on GHG balances, but needs explicit considerations of biodiversity issues – a consistent approach of global conventions must be demanded here. With a view to the next UN Climate Conference in December 2009, the discussion about REDD (reduced emissions from deforestation

[1] The view developed in the course of the project is provided in Annex A-2 and the working hypotheses derived from this view are given in Annex A-3

and degradation) is an additional option, as degraded areas are capable of absorbing large carbon, and bioenergy offers co-use opportunities for such land (see Chapter 6).

There are many developing countries interested in CDM and REDD, including Brazil, China and India, 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 9th meeting of the Conference of the Parties to the UN Convention on Biodiversity (**CBD**) in Bonn, Germany, in May 2008, 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 preparatory 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 the experience gained so far, it is decisive to integrate Brazil in this process, and for this reason, it is necessary to win partners there and to clarify the options for incentives.

In the long term, it will be necessary to develop the global conventions further, offering clear requirements for all parties involved and verifiable implementation in order to ensure effectiveness of all rules relating to sustainable bioenergy markets. As regards the FCCC 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 scope of CO_2 emission caps also includes global land use change, and biodiversity- rich areas were globally protected. For the time being, there seems to be no other approach than the global conventions by which indirect effects of increasing biomass cultivation can be kept under control.

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, thus, could address 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.

Similar to 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 providing incentives for the U.S. and Japan, for example, and making appropriate use of their voting rights in the multilateral financing institutions.

During an introductory phase of such project-specific sustainability standards, **voluntary** approaches such as the RSB would also be useful in order to collect practical experience with certification and “pave the way” for further 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.

3 Biomass and Climate Protection

3.1 Life Cycle Assessment and Direct Land Use Changes

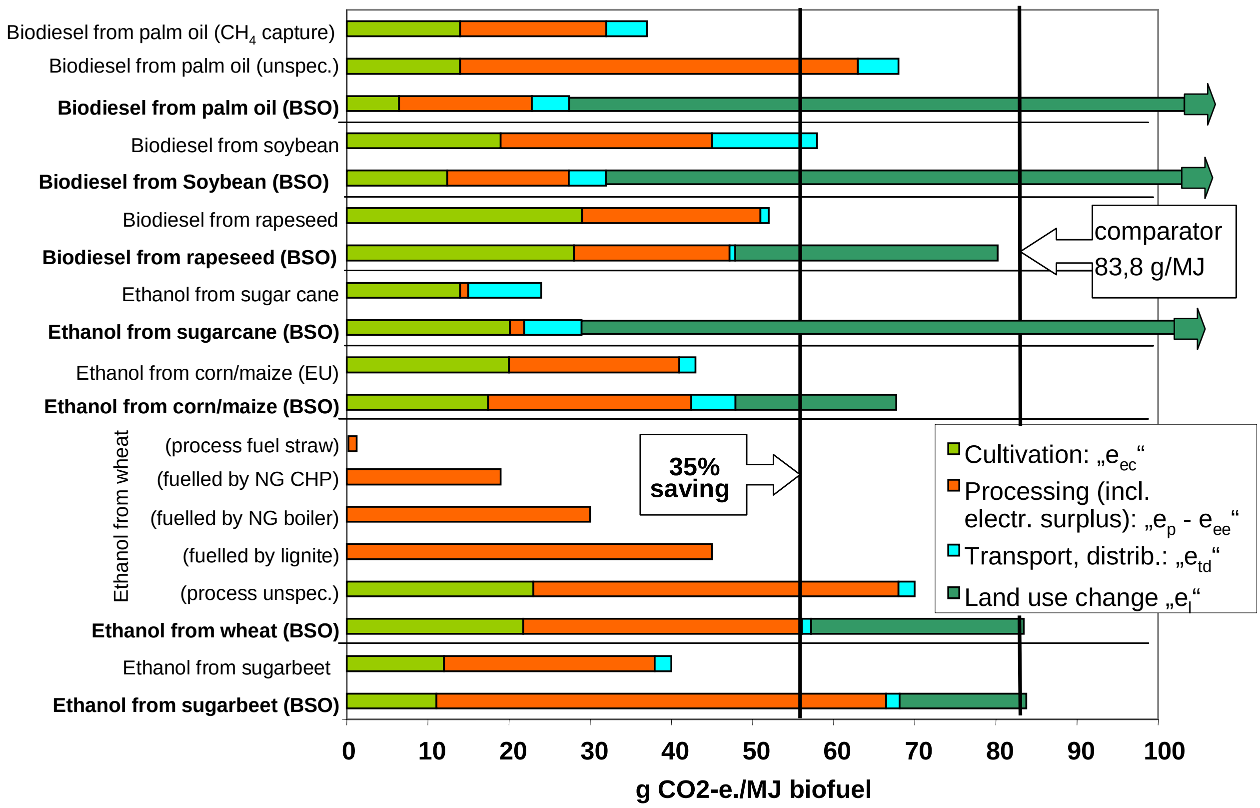
From the environmental policy point of view, the use of biomass as a measure for climate protection is justified. For this reason, giving proof that it contributes towards minimizing greenhouse gas emissions throughout its entire lifecycle is a crucial criterion.

The question as to how a greenhouse gas balance should be methodologically designed for bioenergy was largely defined by a discussion led by experts throughout Europe already in 2007. The research institutions were intensely involved in these discussions. At the national level, the German government presented a first draft biomass sustainability ordinance (BSO) in late 2007 which defined the **methodological principles** and so-called **default values** for biofuels. In its proposal for a **Renewable Energies Directive (EU RES-D)**, the EU Commission closely followed the German methodological concept. In detail, the following concepts were adopted:

- the lifecycle 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); and
- the minimum emission savings of 35% (after 2017: 50%) compared to the life cycle of the fossil fuel substituted.

In the course of the project, the pan-European discussions during the year 2008 were proactively accompanied because the final draft of RES-D was adopted during this time period. While the basic principles outlined above were adhered to, it became obvious that these principles are insufficient for determining approximately unambiguous greenhouse gas balance values. Some of the default values listed in Annex V of RES-D substantially diverge from the values set forth in BSO (2007), despite the analogous approach taken. This is shown by the figure on the next page. It compares the default values stipulated by both legal frameworks (BSO values 2007 acc. to IFEU, in bold lettering).

The chart shows that the EU has not yet defined any default values for direct land use changes. For this reason, and in order to state the calculation more precisely, the EU will have to promote the process of identifying the details of the greenhouse gas methodology at short term, and will also require inputs and critical reviews from the present project for this purpose.



Source: own representation on the basis of EU RES-D (2008), BSO (2007)

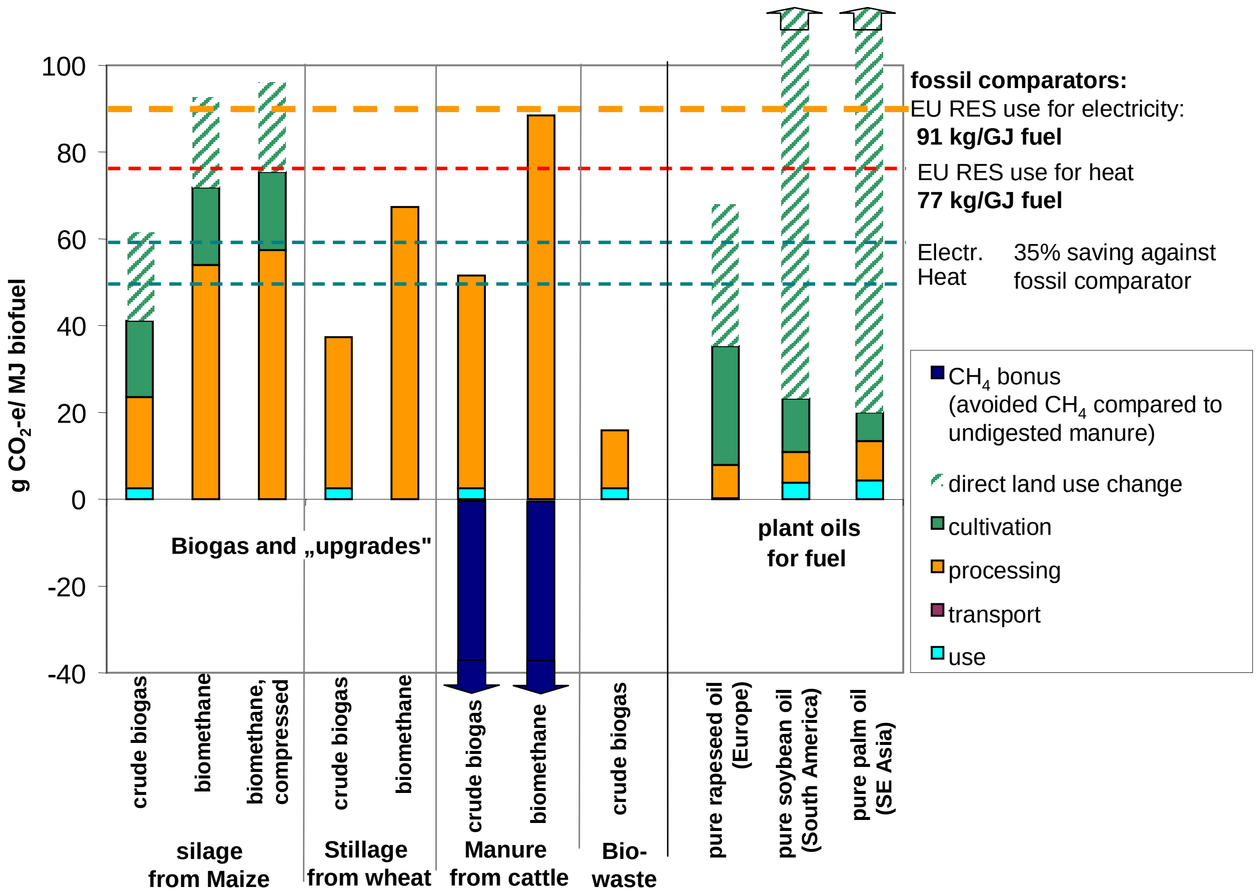
Another task to be accomplished in the course of the project is to define the methodology and the default values for the field of **stationary bioenergy use (electricity/heat)** and to work out the technical foundations for a sustainability ordinance amending the EEG (Renewable Energies Act). The European RES-D only contains very incomplete provisions concerning this field.

The following specific questions have not yet been sufficiently clarified by the restricted, biofuel-focused RES-D:

1. Is the **efficiency of use** (electricity/heat) to be accounted for?
   This is currently not envisaged by RES-D. Under the existing rules, pure power generation is eventually even preferred to cogeneration.
   By contrast, the research institutions consider it indispensable to account for the efficiency of use.
2. What **reference systems** should be used?
   If question 1 is answered positively, reference systems must be defined for electricity and useful heat. The research institutions propose the mean EU electricity mix for electricity and a common state-of-the-art technology for heat (e.g. natural gas firing).
3. How can **CHP** be accounted for if efficient use is a criterion?
   Since the RES-D provides for a reduction rate (35 or 50%), the savings shares of power and heat must be combined. This can be achieved by an allocation based on the greenhouse gas efficiency.

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 RES-D without a clear definition. The research institutions recommend a definition that is based on the market situation (price ratios, marketing ratios).
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 available is not sufficient for recommending default values.
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 of avoiding methane emissions from unfermented wet manure.

In the beginning of the project, the need for default values for the EEG was defined for 14 cases (biogas, solid and liquid biofuels). The values determined so far (cf. chart below) must be adjusted to the data structure for calculation under RES-D. Currently, consistent EU default values were defined for pure soybean oil, pure palm oil and jatropha oil to promote the rapid implementation of the sustainability ordinance for bio-electricity (NachV-BioSt).



Source: chart based on own calculations

3.2 Approaches to Address GHG Effects of Indirect Land Use Changes

Indirect land use changes (iLUC) occur if a **different** use (such as food or feed cultivation) previously prevailed on areas designed for biomass cultivation, and is “crowded out” (displaced) by the biomass cultivation. Since there still is demand for food or feed formerly produced on the land, their production is now relocated to **different** areas. These different areas may have a high carbon stock (e.g. forests, moors) which is reduced if used for the cultivation of displaced food or feed. 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 where and how the displacement will occur.

How to Analyze Indirect CO_2 Emissions?

The CO_2 balance of crowded-out land use exactly corresponds to that of direct LUC. However, the question arises as to **which** areas are concerned. The following table gives regional types and their potential C emissions from direct LUC.

	Assumptions for C from dLUC (acc. to IPCC)			
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
U.S., corn vs. grassland	6,3	63	69	254
BR, sugar cane vs. savannah	66	68	134	491
ID, palm oil vs. rainforest	165	100	265	972

Source: own calculations

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 **models**. From a global point of view, only those countries are affected 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 proportionate areas required for agricultural exports by world regions and the relevant C release by the LUC there (cf. table below).

	Cultivable land in "world mix"	
Region, culture vs. land type	**simplified shares**	**weighted land use specific GHG emission from LUC, in t CO_2/ha**
EU, rapeseed/wheat vs. grassland	20%	51
U.S., corn vs. grassland	25%	64
Brazil, sugar cane vs. savannah	50%	246
Indonesia, palm oil vs. rainforest	5%	49
	weighted total	**400**
	annual [t CO_2/ha*a]	**20**

Source: own calculations

The theoretical iLUC factor gives approx. 400 t CO_2/ha of indirect land use change. When dividing this amount over a period of 20 years according to IPCC, the resulting theoretical iLUC factor is 20 t CO_2/ha*a. This factor will **not** materialize in reality because **not all** of the biofuels result in iLUC: some of the resources are produced on set-aside land and through intensification where **no** indirect effects are observed. In addition, 2nd generation biofuels (lignocellulose ethanol, BtL) which will use biogenic **residuals** (straw, logging residues) for economic reasons so that for those, no iLUC will have to be accounted for[2].

As a conservative “minimum”, therefore, only 25% of the theoretical iLUC factor should be used. A “medium” of 50%, and a “maximum” of 75% of the theoretical iLUC factor should be used. The corresponding GHG values for selected biofuels from different regions are shown in the following table.

	kg CO_{2eq}/GJ with iLUC factor			relative to fossil diesel/petrol		
Biofuel, incl. allocation	**max**	**med**	**min**	**max**	**med**	**min**
Rapeseed to RME, EU	260	188	117	**201%**	**118%**	**35%**
Palm oil to PME, Indonesia	84	64	45	-3%	-25%	-48%
Sugar cane to EtOH, Brazil	48	42	36	-44%	-52%	-59%
Corn to EtOH, USA	129	101	72	**50%**	**17%**	-16%
Wheat to EtOH, EU	144	110	77	**67%**	**28%**	-11%
SRC/switchgrass to BtL, EU	109	75	42	**26%**	-13%	-51%

Source: own calculations

It is quite obvious that rapeseed, wheat and corn would not reach the 35% reduction goal of the RES-D even at a "minimum" iLUC factor and **without** direct LUC, whereas biofuels made of palm oil and sugar cane as well as BtL from short-rotation coppice or switchgrass would achieve significantly **higher** reductions than required.

In the course of the EU discussions on the RES-D, an iLUC “mark-up” was replaced with a **bonus** of 29 kg CO_2/GJ for biofuels cultivated on degraded areas which is based on the iLUC factor approach. In the year 2010, a report from the Commission will deal with the further treatment of iLUC.

It is strategically important to note that **no** GHG emissions would occur from iLUC effects of biomass cultivation if the UN Climate Convention was further developed to include CO_2 from LUC in **all** countries as well as the corresponding emission caps or reduction obligations. However, it is to be expected that this can be achieved in the medium term only, so that approaches such as the iLUC factor should continue being pursued.

2 However, some of these residuals will no longer be available for the biomass shares needed for power and heat generation (which will rise in parallel due to EEG and EEWG - Renewable Energies Heat Act), resulting in a possible implicit competing use which in return may result in iLUC.

4 Bioenergy and Biodiversity

The effects of biomass cultivation on biodiversity are addressed in the project by working out foundations for (political) control measures which are tested in the sub-project on "potentials of unused areas" (see Chapter 6), and by providing input of the results into political processes such as the CBD. For this purpose, the project has worked out a **risk minimization strategy** to protect biodiversity in the context of biomass use which consists of three core issues.

4.1 Conservation of Land with Significant Biodiversity Value

The loss of valuable habitats continues to be the key factor in endangering species and in the trend of declining biodiversity. In order not to additionally worsen this trend, it is necessary to protect high-biodiversity areas when cultivating biomass. These areas include the existing protection zones, but there are many other areas deserving 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 regional identification of these areas developed in the project together with partners[3] is based on georeferenced data from remote sensing (GIS) and is being tested in country case studies on degraded areas (see Chapter 6). In the course of our cooperation with FAO, the method was successfully tested in a desktop study using the example of Tanzania (cf. the following figure).

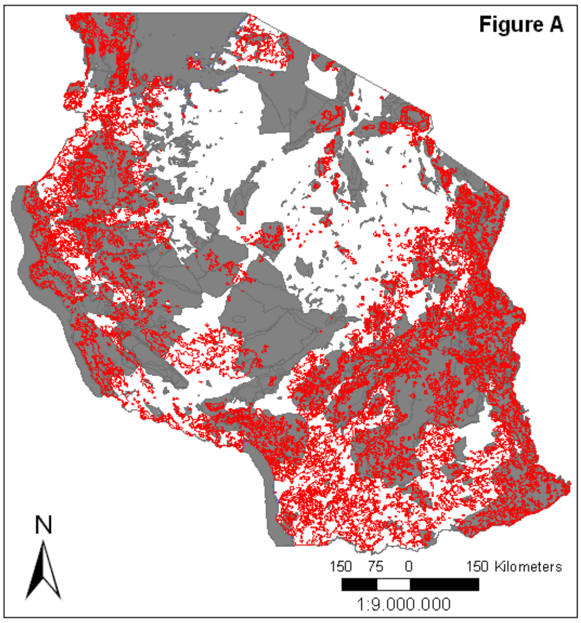


Figure A. Legend
Forest and Woodland (without plantations)
Critical Ecoregions, Hotspots, KBA, Ramsar, World Heritages, Nation Protected Areas catalogued or not by IUCN, Wetlands.

Synthetic survey of Tanzanian areas relevant for biodiversity, produced by superimposition of GIS data on Critical Ecosystems, Biodiversity Hotspots, Key Biodiversity Areas, Ramsar World Heritage Sites, Protected Areas catalogued by IUCN, and for national nature conservation zones as well as Wetland Database which are available globally and nationally.

A further imposition of data concerning agricultural areas already used today shows even more potentially available areas without relevance for nature conservation.

Source: current work under the "Bioenergy Environmental Impact Assessment (BIAS)" FAO project

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

This approach has also been used by, e.g., Ecofys and the RSB, and was included in the biodiversity-related provisions of the RES-D.

However, more work is necessary to complete the globally available GIS data concerning biodiversity-rich areas. 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.

4.2 Minimizing Negative Effects from iLUC

In the scientific debate, both negative effects from direct LUC and from indirect effects play a key role. They occur as soon as the production of biomass displaces prior land uses. For example, cultivating rapeseed for biodiesel production may have the effect that soybeans are displaced, and are cultivated on high-biodiversity tropical areas because the demand for animal feed is undiminished (see Chapter 3.2).

In order to minimize this type of negative effect, biomass production must be focussed on options posing low iLUC risks.

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 global commons in need of protection.

4.3 Agricultural Practice with Low Biodiversity Impacts

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

Such practices comprise the following principles: Use of domestic species and local varieties, avoiding monocultures, giving preference to 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 included (or preserved) on cultivated land in order to improve the exchange of species between 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.

5 Bioenergy and Water

5.1 Possible Conflicts between Water as a Subject of Protection and Bioenergy

Both biomass cultivation designed for high productivity and the conversion plants for biofuels need water. As a result, valuable water resources may be affected by two mechanisms of bioenergy activity:

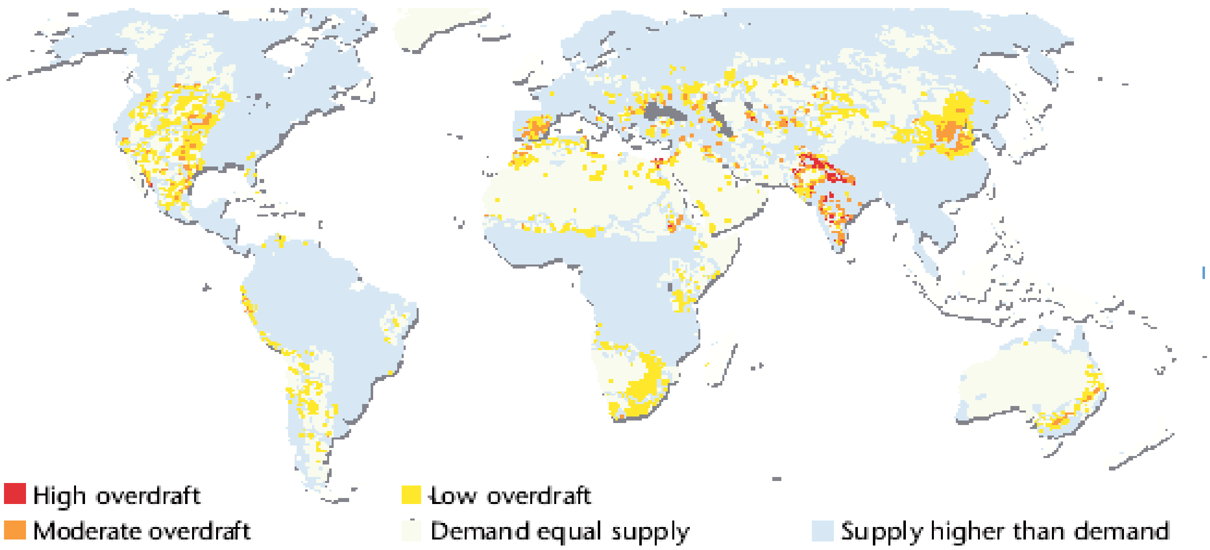
a.) by (excessive) water use and the **water competition** that may result from it including possible conflicts, in particular, in **areas with scarce water resources**:

- between water users of the various segments (industry, private households and agriculture)
- between riparians or various groups of the population
- with respect to environmental and nature conservation objectives (water protection, ecosystem protection, biodiversity)

b.) by **pollutant emissions to bodies of water** and the resulting quality impacts.

The study focuses on the quantitative aspect, i.e. possible water scarcity or scarcity induced or increased by bioenergy. However, the aspect of water quality will not be neglected.

An analysis of the issue of water scarcity clearly shows the regional character of this problem. In the map provided below, those regions stand out in which there is currently considerable water stress 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 already visibly scarce.



Source: Millenium Ecosystem Assessment (2005)

5.2 Possible Solutions

The objective is to use verifiable criteria and indicators to prove that water-related sustainability conflicts caused by biomass cultivation or bioenergy use can be excluded on a case-to-case basis. The fundamental requirements can also be derived from Article 17 and Article 18 of EU RES-D stipulating reporting and documentation requirements with respect to **measures**

- **for the protection** of the soil, **water** and air (quality requirements)
- to avoid **excessive water consumption** in **areas where water is scarce** (quantitative requirements).

Quality Requirements – Standards and Criteria

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

a) **agricultural production**: Emission of **fertilizers** (pesticides) to groundwater and surface waters.
   The criteria can be derived and defined from the following requirements:

   - Cross Compliance:
     Implementation of compliance with the limit values of the Nitrates Directive (91/676/EEC) and the groundwater Directive **against pollution caused by certain dangerous substances** (80/68/EEC), application of the "good agricultural and ecological conditions" (GAEC)
   - IRENA (EEA indicator project): Operationalizes a number of indicators for water and soil pollution from fertilizer or pesticide emissions.

b) the discharge of process wastewater;
   The criteria can be derived and defined from the following requirements:

   - The Annexes to the EU Water Framework Directive (WFD) concerning limit values in the wastewater of various industries.
   - National legislation of the producing countries (e.g. provisions in the state of São Paulo/Brazil concerning the wastewater of sugar and ethanol plants).

c) the use of possibly contaminated wastewater for irrigation.
   The following criterion can be applied:

   - Compliance with the WHO *Guidelines for the Safe Use of Wastewater, Excreta and Greywater (Volume II)*

Quantitative Requirements – Standards and Criteria

For the purpose of EU RES-D, an initial understanding or definition has to be made concerning

- **excessive water use** and
- the **regions affected by water scarcity**.

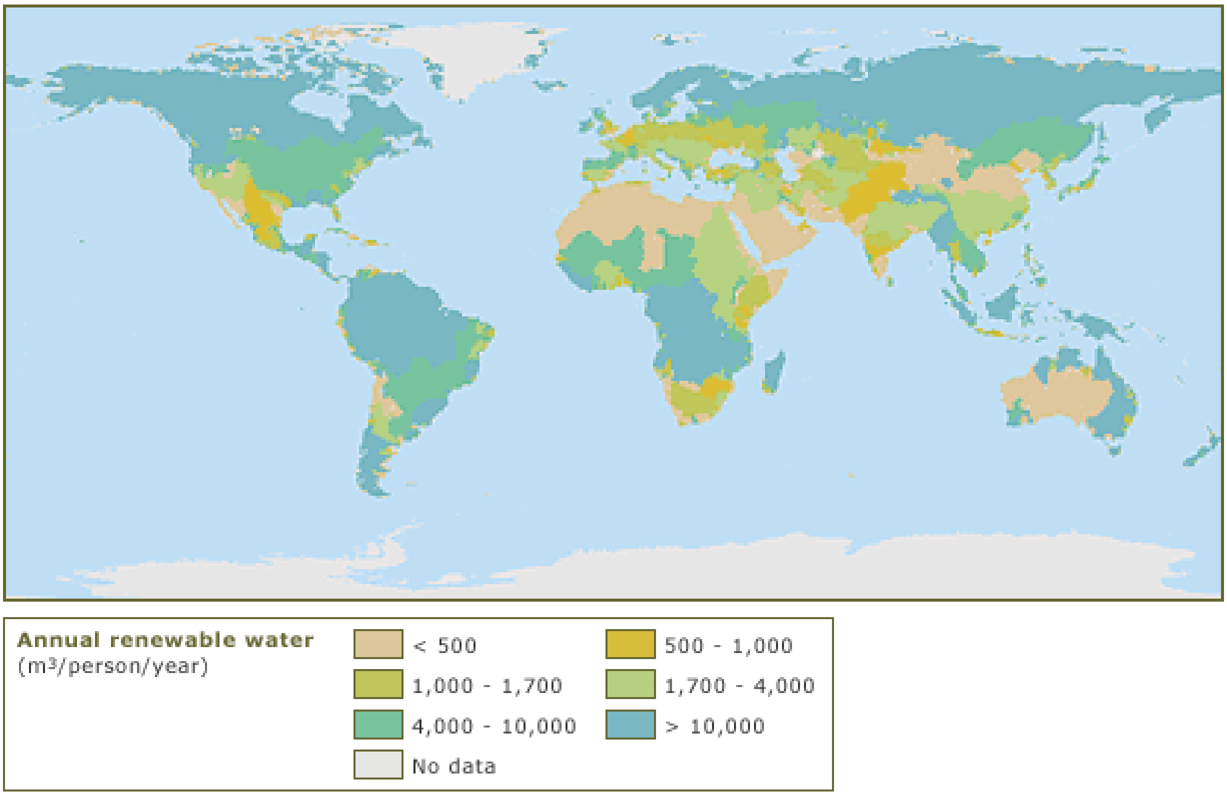
For the first item, the following practical criteria are proposed:

- In biomass cultivation, water is used for **irrigation**, i.e. rainfed farming entirely rules out excessive use *per se*.
  (It remains to be seen whether this also applies to fast-growing energy wood, e.g. SRC, eucalyptus plantations, etc.)
- The use of **fossil groundwater quantities** as such is not sustainable.
- If irrigation is practiced, it must be assessed with respect to **efficient technology and management**. Inadequate, inefficient practices are indicators of excessive water use. Conversely, even if water is scarce, excessive use may be excluded if good irrigation practices can be evidenced.

With respect to the identification of the **regions affected by water scarcity**, the following can be proposed:

- The term "water scarcity" should focus on **physical scarcity**. Social water scarcity means that the amount of water available is generally sufficient, but its supply to major parts of the population is economically infeasible. Irrigation projects do not result in direct water competition in this situation, but may even serve as a means of improving supply, provided that they are not followed by additional price increases.
- Different concepts can be applied with respect to indicators for physical water scarcity. UNEP refers to the concept of Malin Falkenmark[4] who defined **water stress** as less than 1,700 m³ of renewable water resources per person per annum. A quantity of less than **1,000 m³** is defined as **water scarcity**.
  We recommend referring to this value when defining the **regions affected by water scarcity**.
- The only data available concerning regions suffering from water scarcity refers to major regions only (large river basins, country level, refer to map below). This may be sufficient for an initial allocation. For a more detailed resolution, the level of the so-called "watersheds" (26 to 260 km^2) can be considered significant.
  The map below shall just give an example. The represented data provided by World Recourses Institute (WRI) will need further consideration and adjustment to more recent data sources.

4 Falkenmark, M., Widstrand, C, 1992: Population and Water Resources: A Delicate balance. Population Bulletin 47 (3), Washington, DC, 1992



Source: Earthtrends - World Resources Institute (WRI)

The data base of WRI shown here as an example is subject to further analysis and assessment before a decision can be made to use this as a base for implementation.

With respect to the EU reporting requirements, the aspect of "**excessive water use**" (= irrigation without optimized water management measures or use of fossil water) and agriculture in **regions affected by water scarcity** (< 1,000 m^3 of water per person per annum or additional scarcity caused by irrigation) can be presented in this form.

6 Land Use and Potentials of Unused Land

The consequences of land use changes associated with the provision of renewable resources are closely connected to aspects of climate protection (Chapter 3), biodiversity (Chapter 4), water (Chapter 5), as well as land use rights and the living and working conditions of rural populations. Therefore, land use is a **cross-sectional issue** that is to be considered under several aspects. In addition to direct LUC, indirect consequences play a special role that can be potentially avoided by utilizing **previously unused** areas (chapters 3.2 and 4.2).

Accordingly, one focus of the project is on the global potential of 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 (marginal land). The scientific challenge is to identify and locate such areas using minimum effort and the most universally applicable methodology possible, while avoiding negative biodiversity and social impacts.

For this purpose, the suitability of existing data and the inclusion of (satellite-based) remote sensing data are subject to methodological discussion in the project and the way in which this data can be upgraded by geographic information systems (GIS) is examined. In addition, country studies are being performed in Brazil, China, India, and South Africa together with local partners with respect to the following issues:

Short overview of the availability of spatial data
The availability of national and global data for identifying previously used and degraded land is being evaluated. Other aspects include data relating to biodiversity, land use, suitability of cultivation methods, soil quality and social indicators (land use rights, population density).

Spatial identification of potential areas for biomass production
A decision tree is being developed for the identification of areas that can potentially be used for biomass production in order to identify suitable areas on the basis of the data determined before. The case study for China, which has already made good progress, has provided interesting additional aspects in this context.

The decision tree will account for the EU standards (RES-D) and country-specific requirements. The subsequent identification of the potential cultivable areas focuses on degraded and unused agricultural areas, with negative effects on the environment (GHG, biodiversity, water, soil) and the local population (food security, local land use) to be kept to a minimum.

Cultivation methods and calculation of biomass potentials
Several sustainable biomass cultivation systems are to be identified in each country case study which can be used for biomass production on potentially suitable areas. Another standardized decision tree will be developed for the selection.

Three cultivation examples that can be used on the largest possible portion of the areas identified must be described in detail with respect to cultivation methods (crop, inputs, machinery use), investment and operating costs, yields and income as well as their environmental impact (GHG, biodiversity, soil, water). This data will be used to assess the corresponding biomass potentials in the countries.

Exemplary verification of the reliability of the top-down identification of potential areas for biomass cultivation through local inspections

One fundamental problem is the reliability and resolution of the global and national GIS data available. An exemplary verification is conducted by selecting areas sized 100 ha, each, in two selected regions characterized by a high share of potentially suitable areas. Afterwards, the verification is carried out in the form of a local inspection together with relevant stakeholders such as political decision-makers, NGOs and representatives from the local population.

In July 2009, the status of the case studies and the discussion on methods will be presented for further debate at a 2nd international workshop on “Biodiversity and potentials of degraded areas” to be held in cooperation with UNEP, FAO and others in Paris, where the first results of parallel projects conducted by other research institutions will also be dealt with.

On the basis of the results of the methodological discourse and the country case studies, types of areas where bioenergy cultivation is associated with distinct positive and low negative effects will be determined in conclusion. These types of areas will be included in a “positive list” in order to facilitate the subsequent identification of areas in neighboring regions[5].

The work concerning the use of GIS data for area characterization is not only relevant with respect to the potentials of unused areas, but also forms an important basis for the practical implementation of the rules developed for protecting biodiversity in general (cf. Chapter 4) that must occur through real certification systems.

With respect to these issues, the project team cooperates with partners abroad working on comparable approaches, as well as the ISCC project on pilot certification sponsored by the German Federal Ministry of Food, Agriculture and Consumer Protection (BMELV)[6].

5 It must be remembered, however, that the inclusion of a type of area on the positive list still requires a verification of the conditions on location before an area is actually used.

6 International Sustainability and Carbon Certification, refer to http://www.iscc-project.org

7 Biomass Trading and Legal Framework Conditions

7.1 Biomass Flows in Trade

The increasing production and use of bioenergy creates a growing international biomass market that more and more also includes developing countries. The following table provides a quantitative impression of the significance of classical agricultural and forestry products in comparison to bioenergy carriers.

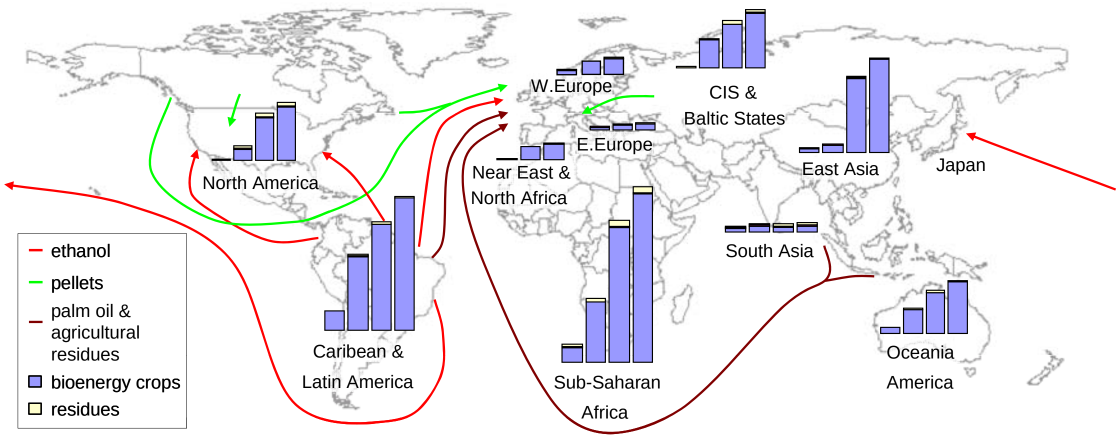
Product	World production	Internationally traded	Unit	Intern.trade/World production
Industrial wood and forestry products				
Industrial logs	1646	120	Mllion m³	7%
Wood chips and chippings	197	37	Mllion m³	19%
Saw logs	416	120	Mllion m³	31%
Cellulose pulp	189	42	Million t	22%
Cardboard and paper	354	100	Million t	31%
Agricultural products				
Corn	727	83	Million t	11%
Wheat	630	118	Million t	19%
Oats	154	22	Million t	14%
Barley	26	2,5	Million t	18%
Rye	18	2	Million t	11%
Rice	608	28	Million t	5%
Palm oil	37	23	Million t	62%
Rapeseed	46	8,5	Million t	18%
Rapeseed oil	16	2,5	Million t	16%
Bioenergy				
Ethanol	41	3-4 (90 PJ)	Mllion m³	9%
Bio diesel	3,5	< 0,5 (20 PJ)	Million t	14%
Firewood	1772	1,9 (16 PJ)	Mllion m³	8%
Charcoal	44	1,4 (28 PJ)	Million t	2%
Pellets	4	1,2 (24 PJ)	Million t	28%
Indirectly traded bioenergy carriers				
Industrial logs		410	PJ	
Wood chips and chippings		130	PJ	
Total bioenergy		**718**	**PJ**	

Source: according to EUBIONET, data for 2004-2005, m^3 data in solid cubic meters, a= incl. 10% bark, b=mean density 0.8 t/m^3, 0.45% conversion to solid bioenergy carrier with LHV = 9.4 GJ/t

Today, world trade in bioenergy is below 1 EJ (approx. 2%), but it may rise to 80 to 150 EJ in the long term. Major future exporters include Latin America (Argentina, Brazil) as well as south-east Asia (Indonesia, Thailand), southern Africa (especially Mozambique, Congo) as well as the central and east European states (Bulgaria, Romania, Ukraine, Belarus).

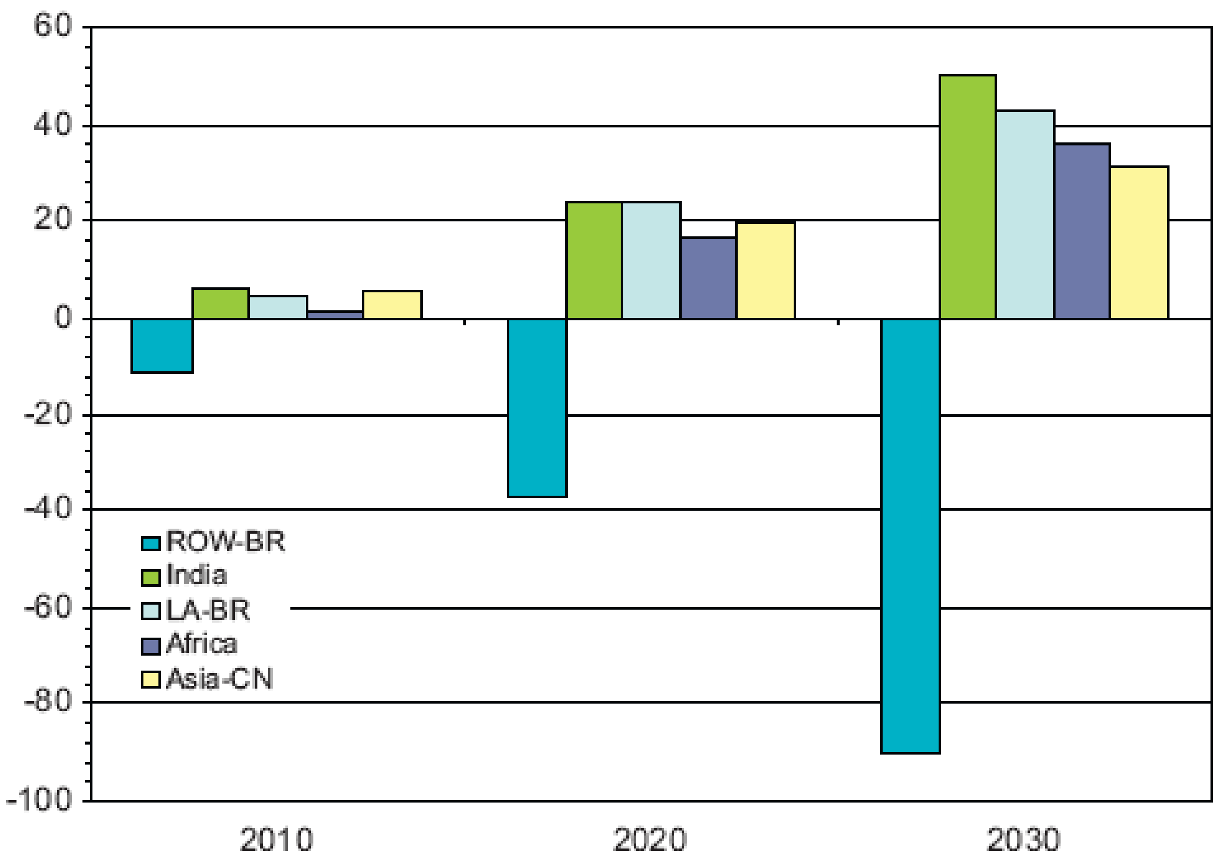
The following figure shows the future major trade routes as well as the regional bioenergy potentials by different scenarios.

Theoretical bioenergy potentials and main trade routes



Source: acc. to IEA Bioenergy Task 40

According to a study of IEA Bioenergy Task 40, the role played by developing countries and transition countries in the export of biofuels will massively increase by the year 2030, as shown by the following chart for bioethanol:



Source: *Arnaldo Walter et al.: Perspectives on fuel ethanol consumption and trade; in: Biomass and Bioenergy (2008), doi:10.1016/j.biombioe.2008.01.026; data in billion liters; ROW-BR = World without Brazil; LA-BR= Latin America without Brazil; Asia-CN=Asia without China*

7.2 Legal Issues

Especially the trade law implications of regulating biomass markets were investigated in the course of the 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, the member states may also impose import bans on grounds of 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 whether or not 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 for 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.

8 Sustainability Standards – the Silver Bullet for Sustainable Bioenergy?

Since the beginning of the project in summer 2007 and until the end of 2008, 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, leading to the **mandatory** certification of biofuels[7]. The draft German Biofuels Sustainability Ordinance (BSO) submitted in December 2007 was the first of its kind that set forth legal compliance requirements with respect to sustainability, and was followed by the draft RES-D at the EU level in January 2008[8].

After the RES-D was adopted by the European Parliament and Council in December 2008, concrete application rules now have to be worked out for the sustainability standards, and the RES-D has to be implemented in Germany and the other EU Member States. Germany is also working on a sustainability ordinance for biomass under the renewable electricity feed-in law (EEG), and in 2010, the EU will decide upon extending the RES-D to all bioenergy carriers.[9] The new U.S. administration announced that it will no longer prevent the draft biofuel laws submitted in California, and Brazil is actively working on its own sustainability seal for ethanol.

This quick development must be called positive and needs to be supported further, especially with respect to the developing countries (cf. Chapter 9) and overall “globalization” (cf. Chapter 2). However, it must not be overlooked that so far, there are **no efficient rules** concerning indirect LUC effects or the consequences for food security. Certification systems – especially mandatory ones – have not yet been able to provide sufficient guidance concerning the broader environmental and social impacts because this would result in trade law problems (see Chapter 7.2). 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 also has to be transferred to the other biomass segments – but this development has only just started.

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[7] In parallel to these statutory provisions, RSPO and RSB drafted voluntary sustainability standards – that even reach beyond RES-D – and the European standardization organization CEN is also working on its own draft. From the point of view of the research organizations, it is to be expected that RSB will present itself as an **independent certification system** in early 2010 and cover the “market” for voluntary sustainability standards.

[8] Both drafts are 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).

[9] 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.

9 Outlook and Planned Activities

Following the adoption of the EU RES-D in December 2008, the project is called upon providing support to adjusting the German Sustainability Ordinance under the Biofuel Quota Act and the corresponding one for the EEG, as well as to prepare input to concretize the EU RES-D regulation.

In addition, the project will contribute to the EU Commission report on indirect land use changes scheduled for 2010, and the extension of the EU sustainability criteria to the entire bioenergy use in Europe.

In parallel, results of the work and case studies concerning area-specific biodiversity protection related to bioenergy will have to be contributed to the preparations of the 10th CBD Conference of the Parties of in 2010. In this context, the project will hold a 2nd international workshop in cooperation with UNEP, FAO and others in summer 2009 in Paris.

Other upcoming specific workshops with input papers relate to

- Algae and other aquatic biomass – potentials and ecological issues
- Water and bioenergy
- Social implications of biomass.

In the global framework, the current project will continue providing specific support to the work of GBEP[10]. The new U.S. administration has also expressed its interest in both national and international rules on sustainable bioenergy, especially in the field of biofuels, therefore, the transatlantic cooperation will increasingly move into the focus.

Another topic that will be dealt with in cooperation with GTZ is supporting developing countries in discussing and preparing their own rules on sustainable bioenergy and their inclusion in the EU certification system.

And finally, the transferability of the sustainability criteria and standards to international trade with biomass **in general** – including its use as a (raw) **material** – will be of interest and will lead to corresponding conclusions with respect to the recently started "biorefinery" debate.

In addition to documenting research results, open questions will be presented at the end of the project, and approaches for addressing them will be outlined.

[10] A separate project will be started in cooperation with UNEP that will hold specialized working meetings with international partners in order to facilitate a broader specialized input to GBEP.

Annex

A-1 Important Abbreviations

BMU	Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
BioNachVO	also: BSO: Verordnung über Anforderungen an eine nachhaltige Erzeugung von Biomasse zur Verwendung als Biokraftstoff (Biomass Sustainability Ordinance)
BMELV	Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz (Federal Ministry of Food, Agriculture and Consumer Protection)
CBD	UN Convention on Biological Diversity
CCD	UN Convention to Combat Desertification
CDM	Clean Development Mechanism
CEN	Comité Européen de Normalisation (European Committee for Standardization)
CoP	Conference of the Parties (to a UN Convention or Protocol)
EBRD	European Bank for Reconstruction and Development
EEA	European Environment Agency
EEG	Erneuerbare Energien Gesetz (Renewable Energies Act)
EEWG	Erneuerbare Energien Wärme-Gesetz (Renewable Energies Heat Act)
EIB	European Investment Bank
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FCCC	Framework Convention on Climate Change
GBEP	Global Bioenergy Partnership
GHG	Greenhouse gas
GIS	Geographic Information Systems
IEA	International Energy Agency
IFI	International Finance Institutions
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for the Conservation of Nature and Natural Resources
KfW	Kreditanstalt für Wiederaufbau (German promotional bank)
REDD	Reduced Emissions from Deforestation and Degradation
RES-D	EU Directive for the Promotion of Renewable Energy Sources

RSB	Roundtable on Sustainable Biofuels
RSPO	Roundtable on Sustainable Palm Oil
UBA	Umweltbundesamt (German Federal Environmental Agency)
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
WWF	World-Wide Fund for Nature

A-2 Long-term Globally Sustainable Biomass

The key formula of a long-term strategy for sustainable biomass reaching beyond the year 2030 is that renewable resources are primarily used as **raw material** whereas biogenic wastes and residues are primarily used as **energy** sources.

With a share of up to 20%, sustainable bioenergy can account for a **relatively** small share in the global energy input because its area-specific energy input remains significantly below that of solar systems, and because land needed for biogenic cultivation systems and the material inputs generated are limiting factors.

Industrially used biogenic resources should primarily be cultivated on areas that are not used, or whose use is limited from the point of view of food and feed production, and which have no negative nature protection aspects. Preferred are perennial plants requiring low input in agro-chemicals and water and have a broad genetic basis.

After having used biogenic resources as raw materials, they should be used as energy carriers for producing either electricity and/or heat or fuels. Due to the increased electrification of vehicles, the boundary between the sectors of bioenergy will diminish. When processing biogenic resources, integrated concepts ("biorefineries") involving multiple product use may be significant.

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

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

The currently prevailing cultivation of biomass for direct conversion to bioenergy for electricity, heat and fuels will thus be replaced by **cascading uses** which largely **disconnect** the production of food and feed from that of renewable resources both with respect to the plant varieties, and the land used.

Therefore, cultivating food and feed plants for producing energy or as raw materials is a **medium-term transitional** strategy only.

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.

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 **spatially unlinked** (e.g. through bioethanol and liquefied gas tank ships or supply to natural gas networks).

A-3 Working Hypotheses for Strategy Formation

Thesis 1: Binding international sustainability standards must be accompanied by project-specific and bilateral agreements

Biomass-specific sustainability standards must be made binding through official requirements in order to provide consistent guidance to the markets' stakeholders. On the other hand, **no** WTO-compatible inclusion of important problematic areas (soil, water, social aspects) in binding standards will be possible in the short or medium term (cf. theses 4 and 5).

Therefore, supplementary **project-specific** sustainability standards must be adopted for international (bilateral and multilateral) financing institutions, the so-called IFI. First preliminary work on biofuels has already been completed by an initiative of the Inter-American Development Bank.

In parallel, agreements on sustainability standards should be made in the form of **bilateral** agreements with important biomass exporting countries which should further develop WTO-critical aspects and demonstrate "good practice".

Thesis 2: Mandatory sustainability standards for biofuels have a positive effect on the entire agriculture and forestry business

Since biomass producing stakeholders are expected in the short and medium term to decide **after** the harvest - for economic reasons - whether they should sell their products on the food and feed markets or on the (emerging) markets for biofuels in order to obtain the maximum profit, there is a "spill-over" effect of rules governing the cultivation of bioenergy carriers: Only if these rules are complied with can the biogenic resource be sold on the regulated markets – regardless of whether or not it is actually sold there.

The impact of the spill-over effect increases from annual to perennial cultures up to forestry (with harvesting times of several decades after "seeding").

It can be expected that the status of protected zones and high conservation value areas will **rise** as a result of mandatory sustainability standards because for a recognized certification system, it will be necessary to designate the exact location of the areas to be protected (a requirement that is seldom observed at the moment, globally speaking) and to restrict biomass withdrawal in line with the protection goals.

The spill-over effect described above will also result in increased compliance with the protection requirements.

Thus, an indirect characterization of biomass (even if not used as an energy source) and the areas to be protected as well as the conservation of nature in general will tend to take place – bioenergy is an important "lever".

Thesis 3: Project-specific sustainability standards for IFI have an implicitly positive effect on financing of biomass projects in general

In analogy to the spill-over effect in agriculture and forestry, mixed financing systems of IFI on the one hand and the prudence review of private banks on the other (risk hedging strategies) can also be expected to have implicit effects on project-specific standards, and thus on the **entire** – governmental and private – project financing by finance and fund providers. This effect could be strengthened by an explicit endorsement by the UNEP Financial Initiative and its inclusion in the equator principles.

Germany can actively contribute to the implementation of standards for bilateral and multilateral financing not only through the government-owned KfW development bank but also through its Board seats in the IFI.

Thesis 4: In the short term, binding international standards can only be achieved with respect to GHG emissions and regional biodiversity protection

In the international sphere – i.e. outside the EU – binding sustainability standards for GHG and existing protected zones can be negotiated and achieved from today's point of view until 2010, however, this judgment is based on optimistic assumptions concerning the work of GBEP and UN-Energy (especially UNEP and FAO).

The GHG standards should be tightened in the medium term (higher reduction obligations), must be "directionally safe" as regards biodiversity and the protection of high conservation value areas outside existing protected zones, and should be (capable of being) connected[11].

Thesis 5: In the medium term, binding international standards on climate and biodiversity issues could be integrated in a global regime

In the run-up to the CBD-COP in 2010, it should be tried to achieve not only “toleration” by the transition countries, but rather – through incentives – a positive attitude towards international biodiversity standards as well; one **might** be able to arrive at agreements on **binding** standards for biodiversity protection within 3-5 years at least for selected countries (BR, MZ, TH, ZA – but probably not for Indonesia). Historically fair provisions would have to be found that offer BR, MZ, TH, ZA etc. real chances.

Of key **short term** importance for this thesis are the creation or identification of “best practices”, flexible (yet substantially viable) draft biodiversity rules as well as the cutting-edge role of IFI mentioned in thesis 1.

11 refer to discussion on indirect land use, priorities for residuals and waste biomass, nonfood crops and unused land.

A-4 International Cooperation and Representation

Based on its goals, the project is proactively seeking discussions with researchers and society concerning the issues at stake and promotes the international dissemination of its (interim) results through corresponding forums and events.

The key issue is its participation in the CoP meetings of the UN Conventions on Climate, Biodiversity protection and to Combat Desertification (as well as their preparation and follow-up), and the GBEP and active involvement of the project team in GBEP's working groups on GHG and sustainability.

In addition, there is cooperation with the UN special agencies FAO, UNEP and UNIDO with whom expert exchange is frequent and for whom input is prepared for their international forums.

In addition, the project partners are involved in discourse and workshops under IEA Bioenergy (Task 38: GHG balances, Task 40: Trade) as well as the general strategy discussion at the meetings of the IEA Executive Committees.

The partners contribute project results to CEN TC 383 that is working out a voluntary European standard on sustainable bioenergy, and to the Roundtable on Sustainable Biofuels that aims at a global, voluntary standard.

The activities finally also include participation in a large number of conferences, meetings and workshops in order to disseminate the results achieved, as well as the performance of our own international workshops for debates on relevant interim results[12].

12

A-5 Selected Working Papers of the Project

- Status of international processes concerning the topic of "sustainable biomass"
- Strategy on the topic of "sustainable biomass"
- Greenhouse Gas Balances for the German Biofuels Quota Legislation - Methodological Guidance and Default Values
- Greenhouse Gas Balances for Biomass: Issues for further discussion at the informal workshop, January 25, 2008 in Brussels
- Sustainable biofuels – CO_2 from indirect land use
- GHG Accounting for Biofuels: Considering CO_2 from Leakage
- Methodological issues of the "Default values for the EEG" focus of work
- The “iLUC Factor” as a Means to Hedge Risks of GHG Emissions from Indirect Land Use Change Associated with Bioenergy Feedstock Production
- Development of deforestation in Brazil and soybean cultivation
- Bioenergy and Biodiversity: Potential for Sustainable Use of Degraded Lands; Briefing Paper for the Information Event at CBD-COP9 on May 27, 2008
- 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 for the Joint International Workshop on High Nature Value Criteria and Potential for Sustainable Use of Degraded Lands, Paris, June 30-July 1, 2008
- International biomass trading working paper
- Legal implications of biomass trade
- Legal implications of bilateral and multilateral agreements on sustainable biomass
- Working paper on "water focus"
- Sustainability Standards for Biomass: Status in Germany, the EU, and global Perspectives