A joint initiative by

Öko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

Roundtable on Sustainable Biofuels

in collaboration with

CONSERVATION INTERNATIONAL

IUCN
The World Conservation Union

WWF

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 –

Darmstadt, June 2008

Authors:

Kirsten Wiegmann, Klaus J. Hennenberg, Uwe R. Fritsche

Öko-Institut, Darmstadt Office

Öko-Institut

Darmstadt Office

Rheinstr. 95

64295 Darmstadt. Germany

Phone +49 (0) 6151 - 81 91-0

Fax +49 (0) 6151 - 81 91-33

Freiburg Office

P.O. Box 50 02 40

79028 Freiburg. Germany

Street Address

Merzhauser Str. 173

79100 Freiburg. Germany

Phone +49 (0) 761 - 4 52 95-0

Fax +49 (0) 761 - 4 52 95-88

Berlin Office

Novalisstr. 10

10115 Berlin. Germany

Phone +49 (0) 30 - 28 04 86-80

Fax +49 (0) 30 - 28 04 86-88

www.oeko.de

Content

1 Bioenergy from Degraded Land and Abandoned Farmland

As a part of the overall debate on the sustainability of bioenergy and biofuels, the greenhouse gas (GHG) balance of bioenergy has become an issue of intense discussion by media, science, business, and politics.

This is driven by the increasingly acknowledged necessity to limit the use of fossil fuels, and to reduce GHG emissions from deforestation and other land-use change, as potential negative impacts of human-induced climate change are severe[1].

In that regard, the interest is in bioenergy systems which offer a high potential for net GHG emission reductions without inducing risks of indirect land-use change through displacement. Bioenergy feedstocks from organic wastes and residues from agriculture, forestry, industry and households are prime options for this, as they have very low GHG profiles, and no displacement risk.

Other possibilities are the cultivation of bioenergy feedstocks on degraded land or (for economic, political or social reasons) abandoned farmland (OEKO 2006; Searchinger 2008). The **key aspect of both is that there is no current cultivation on these lands.** Furthermore, such lands may be sensitive to cultivation, or extensively used by local people, and at least some of these areas might harbor high biodiversity and should belong either to Protected Areas or other biodiversity-relevant land.

Last but not least, the (partial) regeneration of degraded land toward natural habitats may be more beneficial to society than using such land for bioenergy feedstock production.

With that in mind, the lands being either abandoned or degraded must be evaluated with respect to their potential for sustainable use. Their use for bioenergy production is not “per se” a sustainable option.

Thus, a careful definition and identification of degraded land and abandoned farmland is an important step towards a potential sustainable use of such lands as prior bioenergy feedstock production areas.

[1] see for climate change impacts IPCC (2007); for food security FAO (2008), and for biodiversity CBD (2008).

2 Overview of Land Categories

This section gives an overview of common definitions for different land categories, and their relationship, transitions and intersections of categories is discussed.

2.1 Definitions of Land Categories

Used land and **unused** land refer to a gradual change from intensely used land towards land that is not influenced by any (anthropogenic) land-use form. Agriculture and forestry as well as infrastructure can clearly be considered as "use" of land to meet humans needs (food, feed, fibre, fuel, etc.), whereas **extensive** land-use forms (e.g. collection of medicinal plants or sporadic hunting, shifting cultivation with long periods of fallow) make it difficult to decide up to which use-intensity land is still considered as "unused" (OEKO 2008).

Land that is "unused" today can be grouped in two main categories:

- Areas of undisturbed wildlife, from rainforests to desserts, where no land use took place for an extended period ("long time", i.e. several decades).
  For biodiversity reasons and ecosystem services, land of this category may in general be excluded from biomass cultivation - at least, its use needs to go along with sound landscape planning.
- Abandoned land where former land-use activities have been given up (e.g., abandoned industrial sites, plantation, silvicultural land, and farmland).
  Abandoned farmland or other still-productive land will be in the focus for production of biomass.

2.2 Abandoned Farmland

Abandoned farmland is land – within a cultural landscape (Schäfer 1992) – that was previous used for agriculture or pasture, but that has been abandoned and not converted to forest or urban areas (Field et al. 2008). The agricultural activities have been stopped for economical, political or environmental reasons, e.g. set-aside-land (politically) or degraded farmland (environmentally) (OEKO 2008).

On marginal land agriculture *can* be given up for economical reasons (Schroers 2006). But this definition is not exact as it ignores subsistence agriculture (see Section 2.1.4).

Abandoned farmland should not be mixed up with *fallow*. The latter describes the temporary suspension of cultivation for one or several vegetation periods to achieve a recovery of soil fertility (Schäfer 1992). Fallow is a part of crop rotation.

→ *Abandoned Farmland is a land use related term.*

2.3 Degraded Land

There can be found several slightly different definitions on degraded land, e.g.:

- Land degradation is a long-term loss of ecosystem function and services, caused by disturbances from which the system cannot recover unaided (UNEP 2007).
- Land degradation is the decline of natural land resources, commonly caused by improper use of the land (Bergsma et al. 1996).

These definitions agree in principle, but there are differences and open ends concerning

- cause of degradation processes: is land degradation only human-induced or both human and naturally induced?
- system recovery – is restoration/succession aided or unaided?
- time horizon: over which period the status of land is observed/considered?

This section only gives a short overview of different land-use categories, the mentioned aspects will be discussed later (see Section 3.2).

However, all forms of land degradation will ultimately lead to a reduction of soil fertility and productivity. The general effect is reduced plant growth, which in turn causes loss of protective soil cover and increased vulnerability of soil and vegetation to further degradation (El-Beltagy 2000). This leads directly to a possible indicator for land degradation, such as applied in the LADA definition on degraded land:

Land degradation is a long-term decline in ecosystem function and productivity and measured in terms of net primary productivity (Bai/Dent 2006).

→ *The term degraded land is related to land productivity potential.*

2.4 Idle Land

The terms unused land and idle land can be used synonymously. Idle land comprises all types of unused land (see above), i.e., abandoned farmland, degraded land, devastated land and waste land as well areas of undisturbed wildlife (OEKO 2008).

→ *Idle land is a term related to the economic potential of land.*

2.5 Marginal Land

Marginal land is defined as an area where a cost-effective production is not possible, under given side conditions (e.g., soil productivity), cultivation techniques, agriculture policies as well as macro-economic and legal conditions (Schroers 2006).

Evidently, the term *marginal land* is an economic approach which does not factor in subsistence agriculture. Hence, marginal land might supply food, feed, medical plants, fertilizer or fuel to local people, but not through a structured, market-based approach. Further, land classified as marginal is often subject to tenure issues where disputes arise on rights of those who use these areas.

→ *Marginal land is an economic term.*

2.6 Waste Land

Waste land is characterized by natural physical and biological conditions that are per se unfavorable for land-associated human activities (Oldeman et al. 1991). Within this category, land without appreciable vegetative cover or agricultural potential is

included. These areas cannot be cultivated under **any** conditions and, therefore, are not suitable for bioenergy production.

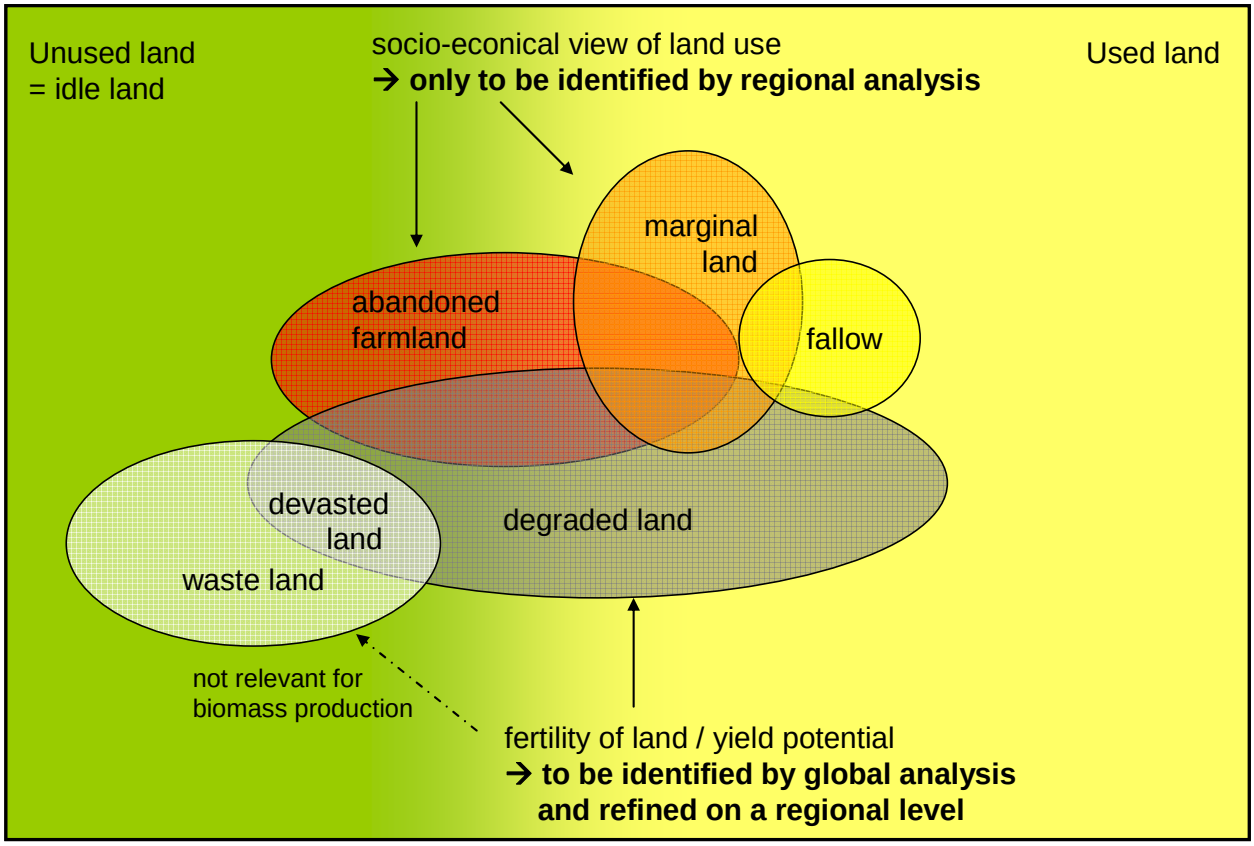
In the GLASOD map, six types were recognized: active dunes, salt flats, rock outcrops, deserts, ice caps and arid mountain regions.

→ The term waste land is related to land productivity potential.

2.7 Relationship of Land Categories

The following figure summarizes relationships and overlap of land categories.

Figure 1 Methodical approach to identify land categories and their relationship



Source: Öko-Institut

As mentioned above the cultivation of biomass on degraded land or abandoned farmland has the potential to safeguard against negative indirect land-use change effects from bioenergy development.

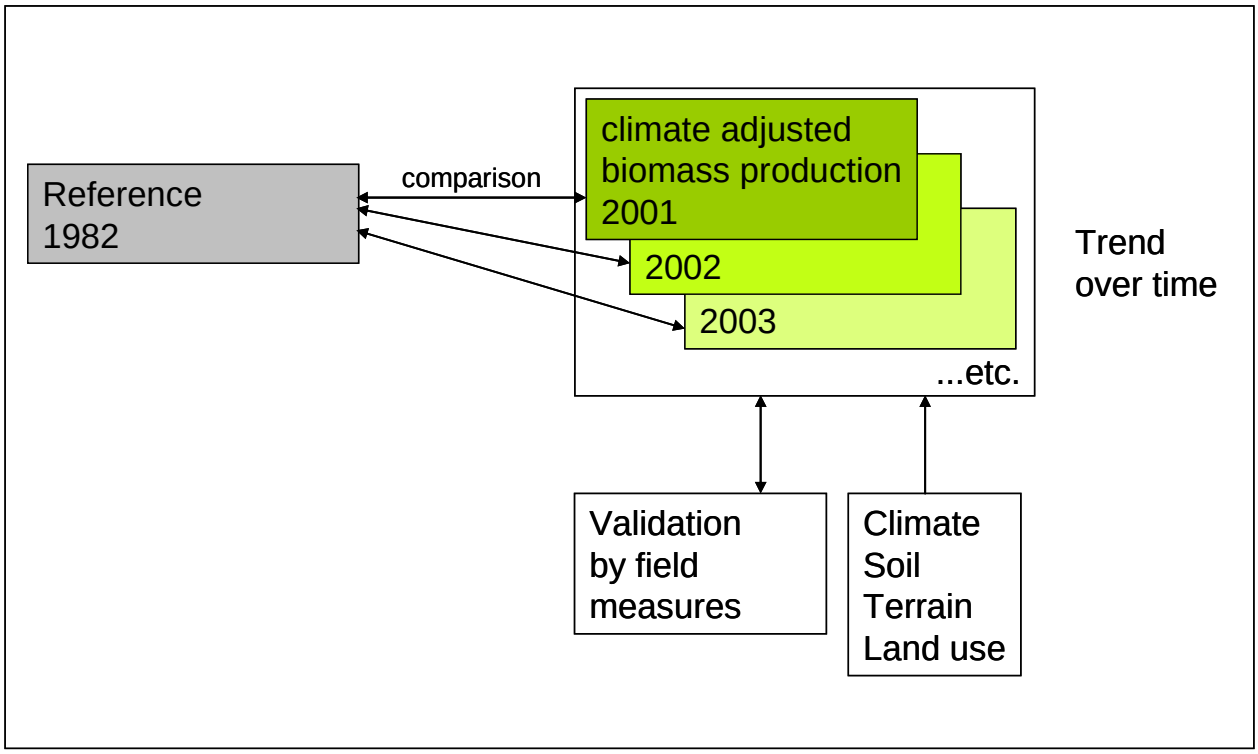
A first step in this direction would be the identification of degraded land on a **global level**. In following steps, a further differentiation of degraded land has to be carried out concerning biodiversity, and land use has to be delivered on the **regional level** (for example abandoned farmland, contribution to food supply or high nature value and neighborhood to undisturbed wildlife etc.).

3 Degraded Land

3.1 Identification Procedure of Degraded Land by Existing Models/Data

The Global Assessment of Land Degradation and Improvement (GLADA) project attempts to identify the status and trend of land degradation. For this hot spots and status of land degradation is identified by trend analysis of the last 25 years' biomass production which is derived from satellite measurements by means of changes in net-primary production (NPP). Since biomass production depends on several factors other factor (soil, climate, land cover, cultivation practices) a negative trend in NPP does not necessarily indicate land degradation. Especially in dry lands, precipitation is a dominant growth factor. Therefore, in the GLADA approach biomass productivity was climate adjusted by a combined index for rain use efficiency.

Figure 2 Relationship of land categories to each other and methodical approach to identify land categories



Source: Öko-Institut

As can be seen in the figure above, a **reference date** is needed to determine a trend of net primary (biomass) production over time. The definition of this date depends on available satellite data – for the GLASOD and GLADA data, it is 1981/82. Therefore, areas of historical land degradation such as the Mediterranean or West Asia cannot be identified by this method.

Box: Some Details on Existing Databases on Degraded Land (GLASOD, GLADA)

For a global identification of degraded land it is necessary to know where and to what extend GIS-based data on land cover and land use are available from which degraded land can be derived. The following description of the existing data is based on UNEP (2007) and Nachtergaele (2005):

Until today, the only comprehensive source of information about land degradation has been the Global Assessment of Human-induced Soil Degradation (GLASOD), which assessed the severity and kind of land degradation for broadly defined landscape units at a scale of 1:10 million. But this approach had several methodological weak points and furthermore was invaluable as a first global assessment.

A new, quantitative global assessment has started under the GEF/UNEP/FAO project Global Land Degradation Assessment in Drylands (GLADA) – GLADA is embedded in the wider LADA program. In GLADA, preliminary work has been undertaken to improve the GLASOD data. Especially there were some more recent data available for Central and Eastern Europe (SOVEUR) and for south-east Asia (ASSOD).

Nearly 60 countries have produced in lesser or greater detail an overview of the status, causes, and impacts of land degradation nationally. Currently validations for Kenya, North China and Bangladesh are underway.

Results:

18 per cent of land degradation by area is associated with cropland, 25 per cent is in broad-leaved forests and 17 per cent in boreal forests (this is consistent with trends in forest degradation). This preliminary analysis will need to be validated on the ground by the country-level case studies.

3.2 Aspects for a Detailed Definition on Degraded Land (Global Level)

In the context of the identification method of degraded land by GIS-based models, a detailed definition of degraded land is essential. As mentioned above, there are still some questions to be dealt with. The following aspects and arguments have to be seen strictly in the foreground of sustainable biomass production on degraded land.

Cause of Degradation:
There are arguments to focus only on direct human-induced degradation of land: “natural” degradation may occur in natural habitats with spare canopy which can nevertheless harbor high biodiversity. Furthermore, this land most probably is hardly productive (nearly waste land). Hence, it is not likely that this land category will be used for biomass cultivation[2]. The focus on human-induced degradation does not lead to a sole focus on degraded farmland (arable and pasture).

[2] This might change if incentives are given for biological carbon fixation, as currently discussed in the REDD scheme of the post-Bali climate negotiations.

The definition includes degraded land such as logged forests, overgrazed savannah etc. However, the cause of degradation is not described by available GIS data.

Land-Use Change
Shifting cultivation could have very long rotation periods, which needs to to considered in the time horizon for assessing changes of NPP (→ short term plus and long term decline).

→ Degraded land is defined by the decline of climate-adjusted biomass production in a given area (relative or absolute) during a given period.

The respective "benchmarks" need to be defined for each agro-environmental zone (AEZ) and land-cover type.

4 Land for Biomass Production

To identify degraded land and abandoned farmland which could potentially be used for sustainable biomass production, a further differentiation of "degraded" is needed:

First step:

Identification of degraded land

Second step:

Identification of abandoned farmland in order to verify that the land does not contribute to food/feed supply or well-being of local people
→energy crop cultivation possible (if land fertility is adequate)

Third step:

Check possible overlap with HNV areas (including buffer zones, and corridors)
→ land should be converted toward natural habitat

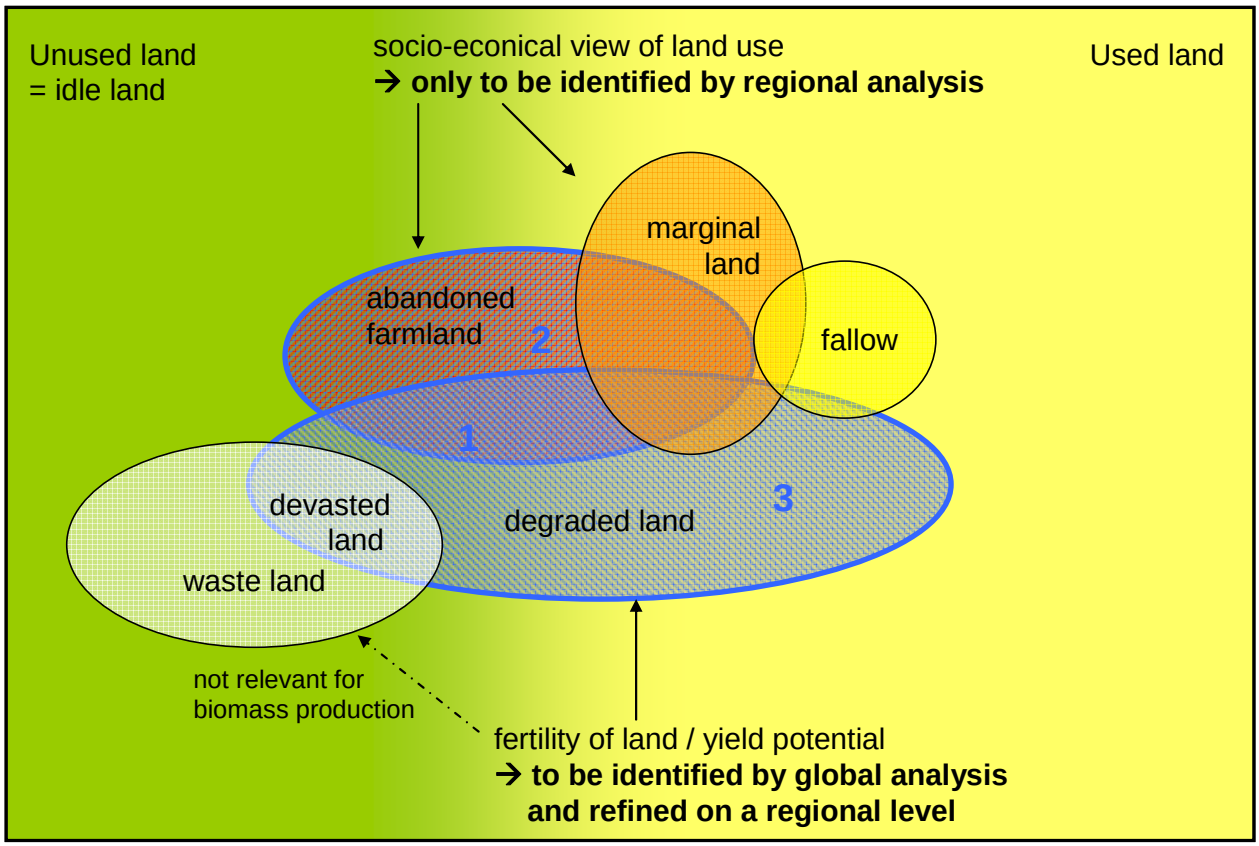
Fourth step:

Check if biomass production on land under consideration might halt ongoing regeneration, and if its conversion to natural habitats would be a more beneficial use.

The following figure depicts the three-step approach of the identification of degraded land and abandoned farmland.

The fourth step refers to the expected effects of the intended energy cultivation on soil carbon and ecosystem function. Hence, the fourth step is not part of the identification process, and not shown in the figure.

Figure 3 *Steps to indentify degraded and abandoned farmland for potential bioenergy feedstock production*



Source: Öko-Institut

References

Bai, Z.G./Dent, D.L. 2006: Global Assessment of Land Degradation and Improvement: Pilot Study in Kenya; ISRIC Report; Wageningen http://lada.virtualcentre.org/eims/download.asp?pub_id=97480

Bergsma, E. et al. 1996: Terminology for Soil Erosion and Conservation; International Society of Soil Science; Vienna

CBD (Secretariat of the Convention on Biological Diversity) 2008: The potential impacts of biofuels on biodiversity - matters arising from SBSTTA recommendation XII/7; Note by the Executive Secretary; UNEP/CBD/COP/9/26 (draft)

El-Beltagy A. 2000: Land Degradation: A Global and Regional Problem; in: Conference Proceeding for the International Conference United Nations and Global Governance in the New Millennium, 19-21 January 2000, Tokyo http://www.unu.edu/millennium/environment.html

FAO (Food and Agriculture Organization of the United Nations) 2008a: The State of Food and Agriculture 2008 - Biofuels: prospects, risks and opportunities; Rome (forthcoming)

Field et al. 2008: Biomass energy: the scale of the potential resource; in: Trends in Ecology and Evolution vol. 2 (2008) p. 65-72

IPCC (Intergovernmental Panel on Climate Change) 2007: Climate Change 2007: The 4th Assessment Report of the IPCC; New York

Nachtergaele, Freddy 2005: Introduction to the Land Degradation Assessment in Drylands (LADA) project; presentation held on the Regional Workshop to Present PAP/RAC - FAO Experiences in Combating Land Degradation in Mediterranean Coastal Areas, 10-12 October 2005, Rome ftp://ftp.fao.org/agl/agll/faopaprac/topic1/LADAIntroduction.pdf

OEKO (Oeko-Institut – Institute for applied ecology) 2006: Sustainability Standards for Bioenergy; prepared for WWF Germany; Darmstadt/Berlin/Frankfurt http://www.oeko.de/service/bio/dateien/wwf.pdf

OEKO (Oeko-Institut et al.) 2008: Bioenergy Environmental Impact Analysis (BIAS) - Analytical Framework; prepared in collaboration with IFEU and Copernicus Institute for FAO; Darmstadt/Heidelberg/Utrecht (forthcoming).

Oldeman, L et al. 1991: World map of the status of human-induced soil degradation: an explanatory note; International Soil Reference and Information Centre/UNEP; Wageningen/Nairobi http://www.isric.org/isric/webdocs/Docs/ISRIC_Report_1991_07.pdf

Schäfer, M. 1992: Wörterbuch der Biologie – Ökologie; Jena (3 ed.)

Schroers J.O. 2006: Zur Entwicklung der Landnutzung auf Grenzstandorten in Abhängikeit agrarmarktpolitischer, agrarstrukturpolitischer und produktions-technologischer Rahmenbedingungen. University of Giessen, Germany. http://geb.uni-giessen.de/geb/volltexte/2007/4511/

Searchinger, Tim et al. 2008: Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land Use Change; in: Science

(published online 7 February 2008)
www.sciencexpress.org;10.1126/science.1151861

UNEP (United Nations Environment Programme) 2007: Global Environment Outlook (GEO-4); Nairobi http://unep.org/geo/geo4/media/