**Brief for GSDR 2015**

# Sustainable Biomass in the Context of Climate Change and Rising Demand

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| Key messages: |
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| • The important role of biomass in sustainable development is insufficiently addressed in the current set of the Sustainable Development Goals (SDGs). |
| • Plant-based biomass for food, feed, energetic and industrial purposes is a widely used resource in human development, by industrial and developing countries alike. |
| • The demand for plant-based biomass is constantly increasing. |
| • Yet, biomass is a limited resource. If not managed and governed appropriately, the production and consumption of biomass can aggravate environmental challenges and undermine social development. |
| • Biomass presents an excellent case to study the tradeoffs and linkages of different SDGs of the Post-2015 development agenda, and to holistically assess whether the proposed SDGs are in fact sustainable. |

**Summary**

The Rio+20 sustainable development conference launched a process to develop a set of Sustainable Development Goals (SDGs) and put the ambitious agreement on the global political agenda to strive for a development that works for the people and the planet (UN GA 2012).

This brief presents key scientific findings about the sustainability challenges of biomass production and use. On this basis, it argues that issues of natural resource governance deserve greater recognition in the SDG negotiations – as they are at the heart of the joint Rio+20 commitment "to ensure the promotion of an economically, socially and environmentally sustainable future for our planet and for present and future generations" (UN GA 2012, 1).

Land-based biomass, derived from plants, is used for food, feed, fuel, and industrial purposes. Its sustainable production and consumption is the prerequisite to continuously meeting basic human needs while safeguarding the environment. Therefore, the issue of sustainable biomass plays an important role in achieving key objectives of the Post-2015 development agenda, such as food security, energy security, biodiversity, and/or climate stability.

## The Scientific Debate on Sustainable Biomass – Finite Supply, Rising Demand, Sustainable Production and Consumption

Biomass is a crucial factor in human development. In 2005, approximately thirteen billion tonnes of biomass were harvested per year, whereby biomass for food and feed accounted for about 82 percent, biomass for fuel for about 11 percent and biomass for industrial purposes for 7 percent (Wirsenius 2007).

The demand for food and feed is projected to increase dramatically in the



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medium-term, due to population growth, growth in average incomes and changing dietary patterns (OECD-FAO, 2014). At the same time, biomass is also increasingly wanted for non-food and non-feed purposes. In addition to its use as a traditional energy source (wood and charcoal), the modern energy mix progressively relies on the combustion of biomass-derived agrofuels, such as biogas, bioethanol, and biodiesel, – largely in response to dwindling fossil fuel reserves, fluctuating prices, and the need to cut $CO_2$ emissions (IEA and OECD 2013). In Germany, for example, in 2014, approximately 12.5 percent of the total arable land was cultivated with crops used for energy purposes (FNR 2014). Biomass is also important in the chemical and pharmaceutical industries, often as part of a bigger trend towards replacing fossil fuel inputs with renewables.

Within the scientific debate, several themes have featured prominently in the context of the importance of biomass for human development:

- **Is it possible to increase biomass supply, and, if yes, how?**
- **Are there land reserves to expand cultivation, and, if yes, where?**
- **How does the competition for land play out**?
- **What are the social and ecological implications of increased biomass production for different purposes**?
- **What are core criteria, parameters and mechanisms to ensure the sustainable production and consumption of biomass**?
- **What are the global repercussions of national and local choices for biomass production and consumption**?

A major focus of the scientific debate has been the study of the sustainability implications of increasing biomass demand in view of land take, land use change, and the competition for land, and in the context of progressing deforestation, persistent land conflicts, declining biodiversity, and/or endangered food security.

The findings stress that the multiple types of biomass are a limited resource. If not managed and governed appropriately, the production and consumption of biomass can aggravate human development challenges, such as resource scarcities, biodiversity loss, and climate change (Searchinger et al. 2008), and it has the potential to undermine social development (Beringer et al. 2011). For example, the production of biomass for non-food purposes often results in a competition for land, and it can endanger food security, while the commercial pressure on land and/or the introduction of large-scale monocultures can negatively impact rural development, lock-in economic structures that are unfavourable for a country's medium-term development trajectory, and aggravate land governance challenges (Cotula et al. 2008; Peskett et al. 2007; German et al. 2013; Rossi and Lambrou 2008; Alves Finco and Doppler 2010). Land use changes can also increase greenhouse gas emissions (Searchinger et al. 2008; Fearnside 2000; IPCC 2014). And an intensified use of land resources may influence water and soil quality and availability and might negatively affect the global carbon and nitrogen biogeochemical cycles (Ribeiro and Quintanilla 2015).

Furthermore, the necessity to cultivate more land to serve the different demands for biomass might imply moving agricultural production into areas, for example grasslands, savannahs, wetlands, and forests, that may either be unsuitable for agricultural production, or that present a biodiversity hotspot, or secure the livelihoods of rural communities (UNEP 2014; German et al. 2013; Cotula 2012; Mwakaje 2012; Scheidel and Sorman 2012). Existing projections suggest that the increasing productivity of current agricultural land (via yield increases, better technologies, better access to productive resources) will be insufficient to meet the rising demand for different types of biomass (Kampman et al. 2008; UNEP 2014). This is also underlined by historical trends. For instance, the conversion of forest land for crop production, livestock farming and logging explains the largest share (55 percent) of worldwide gross deforestation (European Commission 2013, 19 ff). Predictions are that



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future areas of land expansion for crop production will likely come from forest area which makes up 24 percent of the global area of land suitable for crop production (approximately 900 million hectares) (Kampman et al. 2008, 35). Simultaneously, the total arable land area available for biomass production is declining due to natural hazards, urbanisation and infrastructure development, as well as climate change (European Commission 2013, 19 ff; Millan 2008).

Finally, research emphasises the need to account for the global repercussions of regional or national land use choices as well as land use changes in the context of trade and investment. For instance, strengthening "domestic forest protection without simultaneously decreasing demand for wood necessitates an increase in foreign imports, introducing a negative impact on forest biodiversity elsewhere (…). On an international scale a net gain in forest protection is questionable if local protection shifts logging pressure to natural forests in less privileged areas of the world (…)" (Mayer et al. 2005, 359).

This fact is important when weighing the costs and benefits of biomass for non-food, non-feed purposes, which can result in land use change, overuse of ecosystems and resources, and net-export of ecosystem services. In particular, rising demand in industrial countries for biofuels might serve as an incentive in developing countries to produce for those markets – and contribute to overuse, land conversions, and the lock-in of economic structures unfavorable to long-term sustainable development (IPCC 2014).

**Implications for Sustainability Development Policy – Moving Forward**

Sustainable biomass production is essential to meeting basic human needs, protecting the environment, and establishing socio-economically sound and inclusive business prospects.

The current set of SDGs does not sufficiently acknowledge the importance of biomass for achieving core parameters of human development, such as food and energy security. It also does not account for interdependency dynamics, such as land use and resource competition, that different development targets might entail. However, the scientific debate stresses that meeting the globally rising demand for biomass in a sustainable way may be one of the most pressing sustainability-related challenges of our common future. On the positive side, the integrative analysis of the SDGs from the viewpoint of natural resources and ecosystems opens up deliberative space and encourages the search for more sustainable practices.

Transdisciplinary multi-stakeholder dialogues, organized by the Institute for Advanced Sustainability Studies (IASS), have concluded with the following recommendations for sustainable resource governance in a post-2015 development agenda:

- Reinforce targets that relate to sustainable biomass production, namely secure land tenure, biodiversity, the protection of underpinning ecosystems, and sustainable land management
- Establish multi-level mechanisms of sustainability governance that reduce the negative impacts of national decision-making on biomass futures for other countries' ecologies and societies
- Review existing institutions and mechanisms of international and global governance in view of their implications for sustainable biomass production and consumption
- Increase policy coherence on the topic of sustainable biomass to ensure positive synergies by producing it in a more people-centered and environmentally sustainable way
- Raise national, regional, and international awareness about resource efficiency and possible reductions in biomass production and consumption



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## References


Alves Finco M.V. and W. Doppler (2010). Bioenergy and sustainable development: The dilemma of food security in the Brazilian savannah, *Energy for Sustainable Development* 14, 194–199 pp.

Beringer T., W. Lucht, and S. Schaphoff (2011). Bioenergy production potential of global biomass plantations under environmental and agricultural constraints, *GCB Bioenergy* 3, 299–312 pp.

Cotula L., D. Dyer, and S. Vermeulen (2008). Fuelling exclusion? The biofuels boom and poor people's access to land. IIED, London.

Cotula L. (2012). The international political economy of the global land rush: A critical appraisal of trends, scale, geography and drivers, *Journal of Peasant Studies* 39, 649–680 pp.

European Commission, DG ENV (2013). The impact of EU consumption on deforestation: Comprehensive analysis of the impact of EU consummation on deforestation. European Commission, Brussels.

Fachagentur Nachwachsende Rohstoffe e.V. (FNR) (2014). Flächennutzung in Deutschland. http://mediathek.fnr.de/grafiken/daten-und-fakten/anbau/flachennutzung-in-deutschland.html. Accessed 20 January 2015.

Fearnside, P.M. (2000). Global warming and tropical land-use change: greenhouse gas emissions from biomass burning, decompositions and soils in forest conversion, shifting cultivation and secondary vegetation, *Climatic Change* 46, 115-158 pp.

German L., G. Schoneveld, and E. Mwangi (2013). Contemporary Processes of Large-Scale Land Acquisition in Sub-Saharan Africa: Legal Deficiency or Elite Capture of the Rule of Law?, *World Development* 48, 1–18 pp.

Intergovernmental Panel on Climate Change (IPCC) (2014). Climate Change 2014: Mitigation of Climate Change. Working Group III Contribution to the IPCC 5th Assessment Report – Changes to the underlying scientific/technical assessment. Cambridge.

International Energy Agency (IEA) and The Organisation for Economic Co-operation and Development (OECD) (2013). World Energy Outlook 2013. Paris.

Kampman, B., F. Brouwer, and B. Schepers (2008). Agricultural land availability and demand in 2020: A global analysis of drivers and demand for feedstock, and agricultural land availability. CE, Delft.

Mayer A.L., P.E. Kauppi, P.K. Angelstam, Y. Zhang, and P.M. Tikka (2005). Importing Timber, Exporting Ecological Impact, *Science* 308, 359-360 pp.

Millan M. (2008). Climate change and the water cycle in Southern Europe: the role of critical thresholds and feedbacks. Presentation, Water and Land Expo. Zaragoza, Spain.

Mwakaje A.G. (2012). Can Tanzania realise rural development through biofuel plantations? Insights from the study in Rufiji District, *Energy for Sustainable Development* 16, 320–327 pp.

Peskett, L., R. Slater, C. Stevens, and A. Dufey (2007). Biofuels, Agriculture and Poverty. *Natural Resource Perspectives* 107. Overseas Development Institute (ODI), London.

Ribeiro, B. E., & Quintanilla, M. A. (2015). Transitions in biofuel technologies: An appraisal of the social impacts of cellulosic ethanol using the Delphi method, *Technological Forecasting and Social Change* 92, 53-68 pp.

Rossi A. and Y. Lambrou (2008). Gender and equity issues in liquid biofuels production. Minimising the risks to maximise the opportunities. The Food and Agriculture Organization of the United Nations (FAO), Rome.

Scheidel A. and A.H. Sorman (2012). Energy transitions and the global land rush: Ultimate drivers and persistent consequences, *Global transformations, social metabolism and the dynamics of socio environmental conflicts* 22, 588–595 pp.

Searchinger T., R. Heimlich, R.A. Houghton, F. Dong, A. Elobeid, J. Fabiosa, S. Tokgoz, D. Hayes, and T.-H. Yu (2008). Use of U.S. Croplands for Biofuels Increases Greenhouse Gases through Emissions from Land-Use Change, *Science* 319, 1238–1240 pp.

The Organisation for Economic Co-operation and Development (OECD) and the Food and Agriculture Organization of the United Nations (FAO) (2014).OECD-FAO Agricultural Outlook 2014-2023. OECD and FAO, Paris and Rome.

United Nations Environment Programme (UNEP) (2014). Assessing Global Land Use: Balancing consumption with sustainable supply. A Report of the Working Group on Land and Soils of the International Resource Panel. Bringezu S., Schütz H., Pengue W., and O´Brien, M., Garcia F., Sims R., Howarth R., Kauppi L., Swilling M., and Herrick J.

United Nations, General Assembly (2012). The future we want. Resolution adopted by the General Assembly on 27 July 2012, 66/288, A/RES/66/288. http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/66/288&Lang=E. Accessed 19 January 2015.

Wirsenius, S. (2007). Global Use of Agricultural Biomass for Food and Non-Food Purposes: Current Situation and Future Outlook. Department of Energy and Environment. Chalmers University of Technology. Conference paper. http://www.sik.se/traditionalgrains. Accessed 15 August 2014.




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