# Monitoring the sustainability of the German Bioeconomy

Topic: Input-Output Analysis: Sustainable Production and Consumption Policies - XI
Author: Saskia Reuschel
Co-Authors: Johannes TÃ¶bben, Lara Ahmann, Martin Distelkamp, Christian Lutz, Mark Meyer

Bioeconomy (BE) is seen as an important strategy to promote sustainable development and to contribute to achieving climate goals. Against this background, many countries and organizations have published bioeconomy-related strategies. However, BE is not sustainable per se, but needs to be designed in a sustainable way. Based on the food vs. fuel debate the discussion of trade-offs has expanded to include such as global equity, water scarcity, soil degradation, and land use change (Dietz et al., 2018). Previous research identified synergies and trade-offs for nearly all Sustainable Development Goals (SDGs) (Ronzon and SanjuÃ¡n, 2020).

Approaches to measuring and evaluating the bioeconomy should be developed, as inadequate monitoring and lack of impact assessment can lead to over- or under-regulation of the bioeconomy (Dietz et al., 2018). To be able to assess the sustainability of the bioeconomy, monitoring of not only the direct but also indirect environmental, social and economic effects along global biomass related value chains is necessary. The German government has also adopted a national bioeconomy strategy and started to establish a suitable bioeconomy monitoring system. In this context several footprint indicators have already been developed and calculated for the bioeconomy in Germany (Bringezu et al., 2021a; Hennenberg et al., 2022; Egenolf et al., 2021; Bringezu et al., 2021b), but these only consider the environmental dimension, and the data and methods still offer potential for further development.

The aim of this paper is to calculate the ex-post socio-economic footprints of the German BE between 1990 and 2020 based on an improved MRIO database and footprint calculation considering throughflows in addition to production and consumption-based accounting (Beaufils et al., 2023). We expand the footprint indicators to further dimensions of sustainability considering labor volume and wages by gender and skill-level. While the global environmentally-extended multi-region input-output (EE-MRIO) database EXIOBASE (Stadtler et al., 2018) was used for the previously mentioned footprint calculations, here the global EE-MRIO database GLORIA (Lenzen et al., 2021) is applied. GLORIA offers the advantage of a higher spatial resolution and is expected to be continuously updated.

The improved footprint calculation developed in Beaufils et al. (2023) is based on the Hypothetical Extraction method (HE), which allows to assess the German contribution to the footprints of other countries as a producer of intermediate bio-based products. We fully extract agriculture, forestry and fishery sectors as primary producers of biomass as well as the food industry and apply partial extractions to other manufacturing sectors based on their shares of sub-industries handling biomass.

Our results improve the monitoring of the German bioeconomy and thus supported policy making with regard to a sustainable design of the relevant strategies and measures, such as the ban of palm oil from energetic use in the EU. This is particularly relevant since only a minority of countries with bioeconomy strategies have mentioned the potentially negative impacts of biobased transformation on sustainable development (Dietz et al., 2018). Where particular attention is required for the SDGs 2 (Zero Hunger), 8 (Decent Work and Economic Growth), 9 (Industry, Innovation and Infrastructure) and 12 (Responsible Consumption and Production) (Ronzon and SanjuÃ¡n, 2020).

Literature

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