5.02.02

A Highly Resolved MRIO Database With LCIA Extensions for Transparency in Global Value Chains and Sustainable Policies

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Transparency on global value chains is crucial for sustainable policy making. Multi-regional input-output (MRIO) analysis plays a key role in providing this knowledge. However, current MRIO databases are limited in their spatial, sectoral, and temporal resolution and their LCIA coverage. Here, we present a highly resolved MRIO database with a set of environmental and socio-economic indicators and a new methodology that allows for more transparency in global value chains. We have merged the three most extensive global MRIO databases, namely EXIOBASE3, Eora26, and GTAP10, and integrated further data on commodity production and trade, as well as water and land use impacts. Our MRIO database covers 163 industrial sectors, 189 countries, time series from 1995 to 2015, and a set of environmental and socio-economic indicators, such as greenhouse gas emissions, particulate-matter related health impacts, water stress, land-use related biodiversity loss, value added, and workforce. Since the G20 are the driving force to tackle sustainable development, we use our database to assess key aspects of sustainability along G20's entire value chain of material resources (minerals, biomass, and fossil fuels). Our results show that G20's growing carbon footprint was mainly driven by the increased burning of coal and demand for minerals to build the infrastructure in emerging economies, mainly China. Together with India, China also strongly contributed to G20's increasing water stress, mainly due to the cultivation of wheat, rice, and other crops. High-income members contributed to G20's increasing environmental impacts by outsourcing their material resource production to lower-income regions with less strict environmental policies, higher water stress, and more biodiversity loss. Our results underline the importance of switching to renewable energy sources, substituting and reducing high impact minerals, and using regional comparative advantages to reduce the impacts on water and land. It further highlights the importance of extending environmental policies, such as the Paris Agreement, to a consumption perspective in order to address supply chain management in policy making. Our database and methodology allow for greater transparency in global value chains and the associated impacts to support sustainable policies.

5.02.03

Assessing Biodiversity Impacts of European Future Forest Management Strategies: Territorial and Footprint Perspective

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The preservation of forest ecosystems is fundamental to stemming the global loss of biodiversity. Since land use is the main driver of forest loss, when planning future land use strategies it is fundamental to assess their potential impacts on biodiversity. In this context, we assessed the impacts on global species loss due to EU future alternative forest management models (AFMs) from 2020 to 2100. The analyses were conducted projecting different future land- and forest- use scenarios with the "Global Biosphere Management Model" (GLOBIOM) and estimating the potential global loss of species with the LC Impact method for land stress. A comparison of several EU forest management scenarios was performed. This was done modelling the adoption of more multifunctional management (low-intensity, close to nature practices) and set-aside on different portions of EU forest area, while considering the consequential changes in wood trade with other regions. The forest management scenarios were nested into two different climate mitigation pathways. Given the EU new strategy for biodiversity preservation, this study provides evidence-based insights in support of future EU forest management strategies. Our results showed that the more ambitious climate mitigation scenario had least impacts on species loss over time; nevertheless, biodiversity decreased in both climate mitigation pathways. When considering the impacts of EU forest management strategy, species loss in 2100 could potentially decrease with the introduction of AFMs, compared to the continuation of current practices. However, the impacts greatly depended on the type of AFM adopted, the location of imports and future demand for wood. The adoption of more multifunctional managements and set-aside on most of the EU's suitable area could decrease impacts on territorial biodiversity due to internal forest management. On the other hand, this would produce an increase of wood imports to meet EU forest biomass demand and a potential leakage of impacts within more vulnerable regions outside the EU. Therefore, in most cases, the expansion of the AFMs to smaller areas (between one quarter and half of the suitable area) turned out to be more beneficial for simultaneously maintaining territorial biodiversity and reducing the EU forest biomass global biodiversity footprint. Model improvement and proactive policies should help overcome such trade-offs between EU and global biodiversity goals.

5.02.04

LCA of Pesticide-Free Agriculture: A Swiss Case of Ex-Ante Evaluation of Political Decisions

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The use of pesticides in agriculture is increasingly questioned by the public. A Swiss Popular Initiative, which will be voted on in 2021, requests that only farmers who preserve biodiversity and have a pesticide-free production and a livestock population which can be fed with the forage produced on the farm receive direct payments. Agroscope showed that adopting this "Drinking-Water Initiative" (DWI) would lead to changes in land use and livestock numbers, as well as domestic production and income in the Swiss farming sector. We also assessed the environmental impacts of implementing the drinking-water initiative in a reference and 18 DWI scenarios. Our question was: How does the implementation of the drinking-water initiative affect the overall water pollution and biodiversity impact of the Swiss food basket? The system boundary encompassed agricultural production within Switzerland as well as imports. Thus we illustrated the impact of the sum total of agricultural raw products consumed in Switzerland. We calculated freshwater ecotoxicity of organic and inorganic pollutants, biodiversity, aquatic eutrophication with nitrogen and phosphorus, terrestrial eutrophication, and acidification as target impacts. As trade-offs, we analysed global warming potential, stratospheric ozone depletion, tropospheric ozone formation, non-renewable energy demand, abiotic resource demand, land competition, deforestation, and water scarcity. Implementing the drinking-water initiative lead to a decrease of inland freshwater ecotoxicity of organic substances by 51-75%.The other environmental impacts of domestic production decreased by 0-22%. But the environmental burden was shifted abroad: In the sum of domestic production and imports, the drinking-water initiative improved only freshwater ecotoxicity of organic substances. All other environmental impacts were similar or increased vis-à-vis the reference. The deviation was highest for water scarcity and deforestation, owing to higher imports of animal-based foods. Implementing the drinking-water initiative could reduce the pesticide and nutrient pollution of water in Switzerland as well as slightly improve domestic biodiversity. Thus, the political goal of the initiative is achievable. However, the overall impacts of the food basket would significantly increase, owing to rising food imports. For politics and society, this means that other levers have to be implemented at the same time so as to reduce these undesirable effects.

5.02.05

Employing the Consumer Footprint Indicator to Assess Circular Economy Strategies: From Product to Macro-Scale

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Circular economy has been highlighted as a pathway towards ensuring a sustainable development with the goal of not only re-using and recycling the generated waste but also preventing its generation. At the EU level, the new Circular Economy Action Plan (CEAP) was published in 2020 towards setting the next steps for transitioning to a sustainable and competitive EU economy focusing on key value chains and intermediate products, thereby enhancing the need to consider a supply-chain approach and to focus efforts on reducing the consumption footprint. However, the environmental benefits of circular economy strategies are still under debate, e.g. closing the loop of materials might not result in a complete substitution of primary materials due to market demand leading to a circular economy rebound. Due to the relevance of value chains in circular economy, Life Cycle Assessment (LCA) can support the environmental assessment of circular economy strategies by paying attention to the entire life cycle of products. This paper aims at exploring the benefits of circular economy strategies in the EU production and consumption system while discussing the advantages and limitations of employing LCA for such assessment. 12 different circular economy statregies were evaluated covering the key value chains and intermediate products highlighted in the new CEAP. The strategies were modelled in the Consumer Footprint indicator, which was developed to evaluate the environmental impacts of EU consumption. The results of three of the scenarios are presented as examples of strategies focusing on recycling, waste prevention, and re-use. Assessing circular economy strategies is key to identify the most promising actions to be promoted and upscaled at the policy level and LCA is a comprehensive method to evaluate different typologies of circular economy strategies. However, the scenarios evalution unveiled different advantages and limitations on assessing the benefits of circular economy and the use of LCA for this purpose, including the marginal benefits of strategies at the EU macro-scale, the potential trade-offs between impact categories, the complexity of addressing combined strategies, and the limitaitons of the market context and the potential