

Environmental impacts of increased ethanol demand in Brazil

Department: Copernicus Institute

Research group: Energy & Resources

Supervisor: Anna Duden

Email address: a.s.duden@uu.nl

Project description:

Global consumption of energy is projected to increase by over 25% by 2040 (IEA, 2019) due to expected economic and population growth. The share of modern bioenergy in final energy consumption is projected to increase strongly: from 5% in 2016 to 16% in 2050 (IRENA, 2019). Brazil, a frontrunner in renewable energy, currently has the largest area of sugarcane cultivation in the world, and is the second largest producer of ethanol, and Brazilian ethanol production is expected to increase strongly in the future. The projected increase in ethanol production will require additional land for sugarcane cultivation, resulting in changes in land use which are both direct, when sugarcane replaces an area previously occupied by another land use, or indirect, when the expansion of sugarcane induces changes in land use elsewhere (e.g. Adami, 2012). Modeling studies show an expansion of about 35 thousand km² of sugarcane between 2012 and 2030, plus about 20-78 thousand km² indirect land-use changes due to sugarcane expansion.

These land-use changes are projected to occur mostly in the Cerrado and Atlantic Forest biomes (van der Hilst, 2018), which are both biodiversity hotspots under severe threat. Expansion of sugarcane leads to habitat loss and subsequent impacts on biodiversity. Additionally, agriculture is responsible for over 70% of global water withdrawals, one of the key sustainability concerns related to biofuel production is its potential impact on water resources (Guarengi, 2016). Sugarcane production is currently concentrated in south-eastern Brazil, which has sufficient rainfall for rainfed sugarcane production. However, future expansion of sugarcane into dryer areas may result in hydrological impacts. Therefore, concerns have been raised about the potential impacts of sugarcane expansion in Brazil on droughts (de Cerqueira Leite, 2009).

Previous studies within the department have assessed potential environmental impacts of increased ethanol demand in Brazil between 2010 and 2030. These scenarios were translated into spatially explicit land-use change scenarios, which were then used as input in several models assessing environmental impacts. As a result, maps of biodiversity, carbon storage and hydrology are available for scenarios of ethanol demand. We were able to assess the environmental effects (both positive and negative) of potential increases in ethanol production. Now, we would like to combine these results and assess the synergies and trade-offs between different environmental services. To this end, the research assistant will visualize hotspots and quantify synergies and trade-offs in the impacts on hydrology, biodiversity and carbon stocks using overlay-assessments in GIS. Assistant and supervisor will meet once every one or two weeks, either in person or through Teams. The work can be carried out on campus or remotely.

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Job requirements:

Required skills: The student assistant has (basic) experience working with GIS, either with ArcGIS or QGIS. A temporary license for ArcGIS will be provided if necessary. Preferred skills: additionally, (basic) Python programming skills are preferred.