Integrated Modeling of the Land Use, Water and Energy Nexus of Brazilian Biofuels Expansion under Climate Change

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Biofuels have come under scrutiny due to adverse impacts on water resources, biodiversity, and food security. In this context, Brazilian biofuel production is considered a success story given low GHG emissions, little induced deforestation, and social inclusion targets for family farmers. However, sustainable expansion of Brazilian biofuels is put to a test as biofuels demand is rising and climate change is predicted to affect agricultural productivity and water resources. The lack of empirical evidence on this nexus continues to be a major challenge for climate policy and planning. This study aims to inform policymakers and stakeholders on the potential biofuels expansion scenarios in Brazil under climate change until 2030 in order to mitigate adverse impacts on water resources, land use, and food security while promoting sustainable production of biofuels.

This analysis is done through a multi-institutional modelling effort that integrates basin-scale water resources assessment, land-use change and economy-wide modelling of socioeconomic and GHG impacts due to biofuels use. A hybrid input-output table was developed to feed the Computable General Equilibrium (CGE) Model IMACLIM-Brasil. The CGE model determines, along with the transportation model (LEAP), the level of demand for biofuels in 2030. A land use model (BLUM) allocates the expansion of sugar cane and soya production over the Brazilian territory, allowing a basin-scale modelling of water resources. BLUM returns to the CGE model the effects on the price of land. The land price variation impacts on the revenues and wages of different household classes and on the price of agricultural goods – revealing the risk of “food insecurity” faced by the poorest class in each scenario of the study.