

The Water-Energy-Food Nexus of Bioenergy Consumption and Production in Brazil at State Level

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Brazil plays a major role in the global biofuel economy as the world's second largest producer and consumer and the largest exporter of ethanol. On one hand, the biofuels sector in Brazil is interlinked with the main socio-economic system at the regional scale, and on the other hand, increasing demand for bioenergy products has been also largely driven by exports to other economies such as the USA, the EU or Japan, and demand is expected to increase in upcoming years.

However, biofuel crops require significant amounts of water and land resources that could otherwise be used for the production of food, urban water supply or energy generation. This is particularly important in Brazil where, despite the general believe of its comfortable situation with respect to water, there is an uneven spatial distribution of water resources among regions like the water-rich region in the North and West and the water-scarce South and Northeast. For example, the Sao Paulo Metropolitan Area (44 million people and 33% of national GDP) had undergone a severe water crisis in 2014, and other main Brazilian cities in the semi-arid Northeast region (i.e. Recife's metropolitan area) are suffering of increasing droughts that lead to competition for water resources among main economic sectors. Just these two regions alone account for 70% of the national ethanol production, which in 2007 was responsible for 60% of water irrigation use compared to 14% for other crops, nationally.

In this study we use an environmentally extended inter-state MRIO table for 2011 (149 sectors; 18 for agriculture, 3 for primary energy, 7 for power generation and 2 for biofuel production) combined with a global database for water footprint to assess the geographical distribution of green, blue and grey water and land footprints at the state level (27) associated with sugar cane-based ethanol production, responsible for 80% of bioenergy production in the country. The results from our study may better inform policy-making for proper water allocation among states and sectors with regard to biofuel production.