



Impacts of Biofuel Production on Water Resources: Case Study of Ethanol Production from Sugarcane in the Paranaíba Hydrographic Basin



Sustainable Development Goals Addressed



Organization, Institution or Company
Energy Planning Program, COPPE (Alberto Luiz Coimbra Institute for Graduate Studies and Research in Engineering), Federal University of Rio de Janeiro, Brazil and International Atomic Energy Agency (IAEA)
Location of project site, Country
Paranaíba River Basin, Brazil
Brief narrative description of objective/project/activity/initiative
<p>Brazil has long been a leader in biofuel production, which helps to displace fossil fuels and reduce energy import dependence. However, increasing biofuel demands have led to production moving into new areas, raising concerns about the potential for detrimental impacts on food and water security. In addition, changing climate conditions are expected to affect water availability and requirements, creating an additional threat to water security. These factors are playing out in the Paranaíba River Basin in the Central West and Southeast Regions of Brazil, where there have been significant changes in land and water use due to expanding bio-ethanol production.</p> <p>The IAEA supported national experts in Brazil to develop capacity to integrate linkages between water, agriculture and energy planning using the integrated CLEW (Climate, Land, Energy and Water) framework. Experts analysed the potential impact on water and land resources of alternative future scenarios of sugarcane cultivation (for biofuel production) in the Paranaíba River Basin, accounting for the impact of climate change. Key inputs to this analysis include the water footprint of sugarcane ethanol (i.e. the volume of water used in the agricultural stage of production), including green (i.e. precipitation) and blue (i.e. irrigation) water requirements estimated according to different climatic conditions using the CROPWAT and CLIMWAT methodologies. Three sugarcane expansion scenarios were analysed in the study, accounting for changing water requirements with different climatic conditions under the IPCC A2 and B2 climate scenarios.</p>
Economic, environmental and climate benefits, challenges and lessons learned
<p>The water balance for the Paranaíba River Basin already exhibited some degree of impairment in 2010, in terms of both water withdrawal demands and consumption demands. By 2022, the three sugarcane expansion scenarios are likely to lead to further impairment of the basin's water resources, potentially leading to critical water balance conditions (with close to 100% percent of authorized flows being withdrawn).</p> <p>While the study did not account for factors that could change productivity such as soil management or genetic improvements to crops (nor, conversely grey water management issues related to toxicity, biodegradability or effluent treatment), the results identify some of the challenges of expanding sugarcane cultivation in regions of water deficit and water use conflicts, such as the Central West Region in Brazil. Such challenges need to be balanced against the need to mitigate climate change and pursue other aspects of energy sustainability, highlighting the value of (further) integrated resource assessment to identify a sustainable growth path for biofuel production in Brazil: specifically, to aid the selection of appropriate basins and zones for ethanol expansion that minimize impairments to water resources. Such an integrated approach can provide input to decision makers at federal and state levels, including state banks seeking to support the expansion of biofuel production.</p>
Additional information: website addresses and contacts
FACHINELLI, N.P., PEREIRA, A.O., Impacts of sugarcane ethanol production in the Paranaiba basin water resources, <i>Biomass Bioenergy</i> 83 (2015) 8–16

N.P. Fachinelli and A.O. Pereira Jr, Impacts of Biofuels Production on Water Resources: Case Study of Ethanol Production from Sugarcane in the Paranaíba Hydrographic Basin, Final Report, IAEA Coordinated Research Project on Assessing Interdependencies between Energy, Water, Land use and Climate Change, Energy Planning Program, COPPE (Alberto Luiz Coimbra Institute for Graduate Studies and Research in Engineering), Federal University of Rio de Janeiro, Brazil.

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IAEA (2018). IAEA Methodologies and Models for Sustainable Energy Planning, IAEA Brief, Vienna, Austria, <https://www.iaea.org/sites/default/files/19/02/iaea-methodologies-and-models-for-sustainable-energy-planning.pdf>

See also, <https://www.iaea.org/topics/energy-planning/capacity-building>

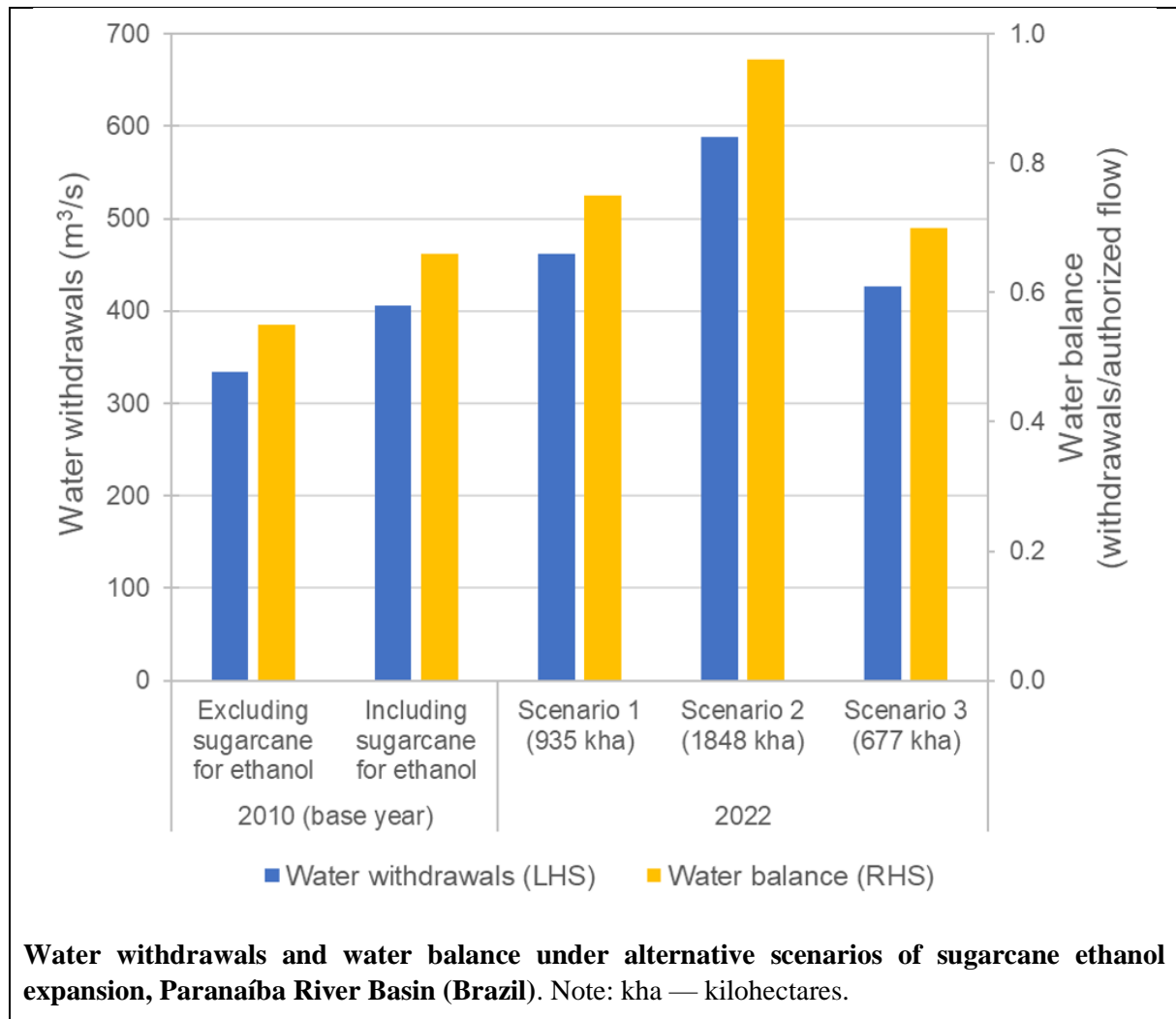


Photo (front page); Sao Simao Reservoir, near the confluence of the Rio Paranaíba and Rio Verde, "Brazil" by NASA Goddard Photo and Video is licensed with CC BY 2.0. To view a copy of this license, visit <https://creativecommons.org/licenses/by/2.0/>