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Policy and governance dynamics in the water-energy-food-land nexus of biofuels: Proposing a qualitative analysis model

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ABSTRACT

The production of biofuels is inextricably linked with the water-energy-food-land (WEFL) nexus. Understanding these linkages is necessary to formulate effective policies that can influence positive outcomes and contribute to the realization of long-term economic, environmental, and social goals. The use of biofuels can help achieve the United Nation's Sustainable Development Goals (SDGs) and implement the Paris Agreement on climate change. However, the biofuels sector must account for its interdependencies and trade-offs with other sectors. In this study, we formulate a qualitative analytical model that goes beyond the three water-energy-food nexus components by incorporating other elements, such as policy, innovation, governance, and labor to examine their effect as influencing factors and to understand how synergies, trade-offs, and long-overlooked interlinkages between sectors and among existing policies and institutions can become visible. This qualitative model was applied to the case of ethanol in Brazil, for which a large corpus was constructed from the scientific literature, documents and sustainability reports from sugarcane ethanol companies. We used a supervised latent Dirichlet allocation (sLDA) algorithm along with co-occurrence and network analyses. The results demonstrate this approach can be used to evaluate the interfaces between science, policy, and businesses within the WEFL-biofuels nexus. This is done by identifying how best to integrate the development of policies, governance, and stakeholder actions to support cost-effective decisions for optimal resource management and regulatory processes while enabling better integration of scientific insight and policy-making. We also identified how these four influencing factors are of vital importance within the nexus and, if properly addressed, can contribute to more holistic nexus thinking management.