An optimization model for design and analysis of land-water-energy-food nexus in a bioethanol supply chain

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This study presents an optimization-based framework to identify and evaluate the land-water-energy-food nexus interactions in a bioethanol supply chain. We first generate the system superstructure for nexus assessment, which includes four main parts: cultivation of biomass and grains, water supply, bioethanol production, and demand of water, bioethanol and food. We then develop a new optimization model using a mixed integer linear programming (MILP) to determine temporal and spatial integration of the nexus elements, to find out the optimal supply strategy of bioethanol. Through the proposed framework, we can determine the allocation of the underlying system, including i) types, quantities and location of utilized water, biomass, and grain sources, ii) types, number and location of technologies installed for bioethanol production, and iii) location and quantities of utilized lands. Based on the study, we can provide useful guidelines to policy-makers and stakeholders in the nexus business.