

Socioeconomic Impacts of integrated sugarcane bioenergy and livestock production in São Paulo state - Brazil

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Sugarcane bioenergy is a reality in Brazil, comprising the production of bioethanol (partially displacing fossil gasoline consumption) and bioelectricity (partially displacing fossil electricity generation). In 2021, sugarcane energy products were responsible for 16.4% of total primary energy supply in Brazil. As sugarcane bioethanol can reduce around 68% of greenhouse gas (GHG) emissions of displaced gasoline, there is an opportunity to increase almost double this reduction taking into account that around 80% of Brazilian light vehicles fleet are able to run with any blend of ethanol or gasoline (the so-called flex fuel cars).

On the other hand, there are concerns about the possible implications caused by the expansion of sugarcane production on indirect land use change, especially when this expansion takes place on pasture land for livestock activity. A promising strategy to enlarge sugarcane bioenergy in Brazil without compromising pasture industry is to integrate both activities, converting extensive livestock into intensive one. At Brazilian context, it is important to note that São Paulo state (one of the 27 Brazilian states) is responsible for (i) 31.2% of national gross domestic product (GDP), (ii) 45% of Brazilian ethanol production and (iii) 5% of livestock national production. In 2022, São Paulo state government launched its Climate Action Plan “Net Zero 2050”, joined the UNFCCC (United Nations Framework Convention on Climate Change) Race to Zero call. In this plan, among other actions, the state of São Paulo intends to reduce its GHG emissions in 2050, in relation to a business as usual (BAU) scenario, by (i) 83.3% on light vehicles and motorcycles and (ii) 183.3% on agriculture, forest, pasture and land use – i.e., in 2050 this activity will sequester GHG from the atmosphere.

The objective of this article is to compare and to evaluate all direct and indirect effects on socioeconomic aspects (such as activities output level, GDP and employment) in two scenarios: the first called BAU, which consists on sugarcane bioenergy and extensive livestock production without integration, and the second called integrated sugarcane bioenergy and livestock (ISBL) in the state of São Paulo, in which the same amount of sugarcane bioenergy and livestock production is obtained as in BAU scenario, but occupying directly just half of the land.

To achieve this goal, an interregional Brazilian input-output model was implemented, in which for the BAU scenario an optimized (in economic terms) extensive pasture activity and sugarcane bioenergy industry were introduced separately as singles sectors and (ii) for the ISBL scenario an optimized (in economic terms) integrated sugarcane bioenergy and livestock sector was inserted. For both scenarios in the model, based on the results obtained from an optimization model the respective direct technical coefficients were estimated taking in consideration a choice of intermediate consumption and use of primary factors of production that maximize their profitability. The Brazilian interregional input-output matrix was estimated for 2021, admitted as the first year where Brazilian economy was recovered, in general, from Covid-19 crisis in 2020.

Looking for keeping the comparison and analysis consistent between the two scenarios, a closure and a shock on exogenous variables were established on the interregional input-output model turning all values of final demand the same. Model's results show that the ISBL scenario is economic more efficient, as less jobs and output level activity are required to achieve the same consumption of all sectors by the whole final demand. Even considering the integration of sugarcane bioenergy and livestock production took place in São Paulo state, the model showed that increase in efficiency were observed as well at other states.