

## **Sugarcane contributed to removing carbon from the atmosphere in the last 20 years in Brazil**

*This innovative study showcases an example where energy production and land management net removals can be complementary, at scale when applied properly.*

A scientific study indicates that sugarcane cultivation over the last 20 years in Brazil, contrary to expectations, was responsible for removing (and not emitting) significant amounts of carbon from the atmosphere. The study is a combination of precise land use mapping and processing carbon accounting models at the Brazilian microregion scale. The study was conducted by three institutions, Agroicone, Unicamp (University of Campinas), and Embrapa (Brazilian Agricultural Research Corporation).

The land cultivated with sugarcane (a high carbon-high-yield crop adapted to Brazilian conditions) removed 9.8 MtCO<sub>2</sub>/year of CO<sub>2</sub> from the atmosphere, fixing it in soils and live and dead plant structures. Accumulated over the 20 years, it represents a total removal of 196 MtCO<sub>2</sub>, which would be equivalent to planting 1.4 billion trees, occupying an area larger than 1 million football fields or 80 times the city of Paris covered in forest.

The results get more impressive when looking at the land dynamics of the whole farms where sugarcane is produced and not just the sugarcane area itself. In this case, the carbon removal goes up to 17 million tons of CO<sub>2</sub> per year (344 million tons of CO<sub>2</sub> in 20 years). This is because although a reduced sugarcane expansion over natural vegetation (1.6%) (which includes all types of natural vegetation), the land transition maps also identified a maintenance and an increase in vegetation with higher carbon stocks, such as forests in the farms that produce sugarcane.

The results may have important repercussions on national and international bioenergy markets and certifications, as well as regulatory ones, in which land use impacts are always points of attention.

According to Professor Joaquim Seabra, from the School of Mechanical Engineering at Unicamp and one of the study's authors, the work highlighted the relevance of having a more refined parameterization to estimate the behavior of carbon stocks in Brazil in the sugarcane sector.

"It became very clear that the use of more precise parameters for the carbon stock can significantly change the conclusions about land use change, which have been disseminated by different international schemes, whether certification or regulatory schemes. Considering the production conditions in the national context, we have strong indications that we can have more carbon removals and at the same time limit the risk of the indirect effect (that is, expansion of areas over natural vegetation) here in Brazil", he says.

The research evaluated the dynamics of land occupation by the cultivation of sugarcane in the Center-South and North of Brazil, between the years 2000 and 2020. The result of this investigation showed that 25% of the existing sugarcane area was already sugarcane in 2000. The increase of 6.1 million hectares of sugarcane, identified in this period, came from the conversion of areas that were previously pastures (60%), annual crops (16%), and mosaics (22%) – or that is, areas that could combine agriculture and pasture. Only 1.6% of sugarcane expansion took place over areas of natural vegetation.

This land use conversion pattern, and the substitution of manual harvesting (where usually sugarcane leaves are burned before harvesting to protect manual workers from insects and the leaves themselves) to green-harvesting, based on mechanized harvesting (the leaves are not burned) and significant residues remaining in the field, contributed to the conclusion that areas cultivated with sugarcane were responsible for the net removal of approximately 9.8 million tons of CO<sub>2</sub> per year from the atmosphere.

In Brazil, the production of bioenergy from sugarcane is essential for the decarbonization of the energy and transport sector. As a result, it is an important ally in fulfilling the commitments established to reduce CO<sub>2</sub> emissions in its NDC (Nationally Determined Contribution to the Paris Agreement). The change in land use associated with the cultivation of sugarcane is a critical process for its sustainability and the estimates made so far indicated, predominantly, greenhouse gas emissions associated with the production of sugarcane. As Embrapa Environment researcher Nilza Ramos points out, "Based on a broad set of data and a series of methodological refinements, the study demonstrated a relevant contribution of sugarcane cultivation to carbon removals associated with the sugarcane land use in Brazil".

## **Methodology**

Researchers quantified the effects of sugarcane cultivation and expansion, and changes in management practices on soil and biomass carbon stocks over the past two decades. The analysis was carried out considering the sugarcane cultivation areas and the rural properties (Rural Environmental Registry - CAR) with the production of the raw material. In total, 90.7% of the sugarcane cultivated area in Brazil was analyzed, which corresponds to 93% of the national production of sugar and ethanol. Rural properties with sugarcane cultivation in the North of the country were also analyzed, which despite accounting for only 0.5% of national production, are a constant object of international attention.

The study was published in the international scientific journal *Land* and was based on publicly available and internationally recognized databases. Data on the conversion of sugarcane areas and pasture quality were obtained from the MapBiomass platform, data from rural properties (CAR) from Imaflores and the Brazilian Forestry Service, and carbon stock data from new estimates made by the team and from the BRLUC method from Embrapa. "We tried to use methodologies and data sources that had the support of the international scientific community", says Nilza Ramos.

"Results confirm a growing concept that we can have carbon storage in energy systems, notably when bioenergy is applied correctly. In this specific case, given the period under analysis, the results reflect the behavior of the sugarcane market, guided by the Forestry Code and commitments of the sugar-energy sector. The expectation is that RenovaBio's eligibility criteria can further reinforce these positive impacts, but this can only be verified over the years of this policy and new studies", according to the study leader, partner, and researcher at Agroicone, Marcelo Moreira.

Additionally, Seabra believes that the results of the paper may have a wider impact. "The results may be important both for the general assessment of the sustainability of production systems based on sugarcane production, and may also provide more suitable parameters for analysis within these regulatory or policy contexts, or international certification schemes turned to biofuels", he believes.

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