Trends in global warming and human health impacts related to Brazilian sugarcane ethanol production considering black carbon emissions

Abstract:
Sugarcane produced in Brazil has several environmental advantages. However, burning residues, which leads to GHG and black carbon (BC) emissions, has been used to facilitate manual harvest. BC emissions have a net warming effect and cause health problems. Mechanized harvest without burning is gradually replacing manually harvested burned sugarcane. Global warming potential (GWP) and human health indicators of sugarcane ethanol production in Brazil, in the pre-mechanization (100% burned), current (similar to 50% burned) and future (100% without burning) scenarios, were calculated. In the past, the GWP of ethanol production was 1.1 kg CO2 eq L-1 and BC emissions were 32.6 kg CO2 eq L-1. The human health impact in disability adjusted life years (DALY) was 3.16E-05 DALY L-1 ethanol. The current ethanol production process has a GWP 46% smaller, while BC emissions are seven times smaller than before mechanization started. The human health impact is currently 7.72E-06 DALY L-1. In the future, with complete mechanization and the integration of first and second generation ethanol, the expected GWP emissions will be 70% smaller, and BC emissions will be 216 times smaller than when all sugarcane was harvested with burning. These results show that ethanol production in Brazil is improving in terms of global warming and human health aspects. Other upstream aspects of ethanol production such as direct and indirect land use change, and downstream impacts such as the emissions of acetaldehydes were not considered in this study, which focused on a major technological shift in residue management in the agricultural phase of sugarcane ethanol production. A broader assessment of the sustainability of ethanol must account for those issues, as well as economic and social aspects. Sugarcane-derived ethanol produced in Brazil has been considered one of the most sustainable biofuels options, but it is essential to identify and promote practices and policies that further improve its production, such as the phase out of pre-harvest sugarcane burning and the increase in ethanol yield per unit of area.

Resource Description

Crosscutting Themes: Mitigation

Mitigation: Secondary Health Impacts of Mitigation

Exposure: Air Pollution

Air Pollution: Particulate Matter

Geographic Feature: Rural
Geographic Location: Non-United States

Non-United States: Central and South America

Health Impact: Cancer, Morbidity/Mortality, Respiratory Impact

Respiratory Impact: Other Respiratory Impact, Specify

Model/Methodology: Exposure Change Prediction, Outcome Change Prediction

Resource Type: Research Article

Climate Change and Socioeconomic Scenarios: Other Climate Change Scenario, Specify

Timescale: Long-Term (>10 years)