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Cost-benefit analysis of alternatives to mitigate the air quality and health impacts from agricultural residue burning in India

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Poor air quality in India affects the health of millions living in one of the most populated regions in the world. Agricultural residue burning as a common way to remove crop waste and make fields for the next planting season contributes to this problem and, despite attempts to reduce agricultural fires, remains a recurring issue due to a lack of viable alternatives. As India population grows, more food production will be needed, with yet more crop residue to burn. Sustainable and economically feasible interventions are therefore needed to mitigate the impact of agricultural residue burning. To support policy-making, an adjoint modeling approach has been applied to estimate how air quality and health impacts respond to changes in specific time and location of burning, and how effective potential mitigation options might be in reducing them.

This work extends based upon these initial findings and seeks to provide a cost-benefit analysis of alternatives to agricultural residue burning using the GEOS-Chem adjoint model. With a multi-year assessment that accounts for the impact of inter-annual variability of meteorology, the public cost presented in terms of the monetary valuation of air quality damages resulting from population exposure and health impacts due to emissions of agricultural burning, and the private returns presented in terms of the individual profit from crop cultivation for farmers in India, are quantified in order to better understand the potential trade-offs between air quality improvement and economic benefit.

The end results focusing on northwestern India during the post-monsoon rice residue burning season, where the majority of agricultural fires in India come from, show that appropriate measures, including crop diversification, agricultural mechanization and shifting the time of burning, may help avoid air quality damages from agricultural residue burning without risking the income of farmers. Proper incentive mechanisms such as subsidies for investment cost and compensation for human effort may further facilitate the best possible outcomes. These findings help inform better decision-making to mitigate the impacts of agricultural fires and reduce the uncertainties regarding sustainable agricultural practices not just for India but also for regions and countries facing similar issues.