Particulate matter produced during commercial sugarcane harvesting and processing: A respiratory health hazard?

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Emissions from sugarcane burning are known to impact the respiratory health of exposed populations. However, there have been few previous studies on occupational exposures to smoke and re-suspended ash on commercial sugarcane estates.

From measurements taken whilst shadowing labourers during pre-harvest sugarcane burning in Brazil, airborne PM_{10} concentrations reached maximum levels of ~280 mg m^{-3}, much higher than during manual harvesting (~11 mg m^{-3}) and in the sugarcane processing factory (~29 mg m^{-3}). Guidelines for exposure to both ambient and occupational particulate matter (PM), issued by WHO for example, could easily be exceeded where labourers' shift lengths are greater than 8 h. Further modelling of this data is ongoing to estimate the potential exposure levels over time and space during the sugarcane burning. Size-selected airborne PM, collected during monitoring, was characterised using Scanning Electron Microscopy (SEM) with X-ray elemental analysis. The very fine (<0.5 μm) and fine (>0.5 to <2.5 μm) fractions of the PM were predominantly carbonaceous. Only a small proportion of the sugarcane ash (~0.8 vol. %) and bagasse ash (~1.9 vol. %) was <10 μm diameter, determined by laser diffractometry. However, grinding experiments, to simulate disaggregation as a result of disturbance during harvest or bagasse ash removal, showed that the ash was fragile and easily broken down into thoracic (<10 μm) and in some instances respirable (<4 μm) sized PM. Leaching tests using deionised water were carried out on the ash samples to determine the bioavailability of adsorbed species on the PM surfaces, which could impact on human health or the environment. Initial leachate extracts were generally low in terms of concentrations of F^-, Cl^-, SO_4^{2-}, Ba, Ca, Mg, Mn, Na, P, Si and Sr.

As the concentrations of PM_{10} are above recommended exposure limits, and re-suspended particles of ash in the fields and processing plant contain potentially toxic cristobalite (e.g., Le Blond et al. 2010). We recommend that workers are protected from extended periods of exposure to the smoke and re-suspended ash. Further work in Nicaragua and El Salvador (in summer 2015) will generate more data to compare to these preliminary results. However, this issue will become increasingly important due to the predicted rise in global sugarcane production for biofuels.