How to improve emission inventories related to cooking with solid fuels in the Indo-Gangetic Plain

Half of the world's population utilizes solid fuels such as wood, crop residue, and animal dung for cooking, most of which are in developing countries. Often times in these settings, women spend several hours a day cooking food on traditional, mud based stoves over an active fire in village huts. The resulting indoor pollution levels generated from the burning of these highly inefficient fuels is well over air quality guidelines set by the World Health Organization, which has been associated with nearly 4 million premature deaths annually worldwide. Furthermore, there are also a myriad of health effects associated with solid fuels used for cooking such as chronic obstructive pulmonary disease, pneumonia, cardiovascular disease, cancer, and low birth weight for newborns that can lead to serious health complications, to name a few. Besides the immediate health effects, the burning of these types of fuels also produces climate change agents such as greenhouse gases (e.g., Carbon Dioxide) that take decades to come out of the atmosphere, as well as short-lived climate pollutants (e.g., Black and Organic Carbon) that are removed from the atmosphere in a matter of weeks. In developing countries, understanding what emissions comprise the atmosphere is very important when developing climate change models and trying to understand the health burden associated with air quality as well as disease transmission models that rely on both of these factors.

A region of particular concern where many cook using these types of inefficient fuels is the densely populated Indo-Gangetic Plain, which is inhabited by nearly 600 million people. The Indo-Gangetic Plain region is an area that covers most of northern India, southern Pakistan, southern Nepal, and parts of Bangladesh, with its northern border made of the climate-sensitive Himalayan mountain range. In this region, short-lived climate pollutants (in addition to greenhouse gases) are a major contributor to changes in the precipitation cycle as well as impact annual glacial and snowpack melt, with nearly 1 billion people reliant on water from this region. Understanding the amount of Black and Organic Carbon in the atmosphere generated from the use of solid fuels in this region is critical to understanding the long-term climate and health impacts of the region as a whole. However, significant variability exists for estimates of Black and Organic Carbon regional concentration. Existing inventories within the Indo-Gangetic Plain suffer from limited representation of rural sources, reliance on idealized point source estimates (e.g., utilization of emission factors or fuel use estimates for cooking along with demographic information), and difficulty in distinguishing sources.

Outdoor air emission inventory development utilizes two approaches, termed top down and bottom up, which rely on various sources including transport models, emission factors, and remote sensing applications. Large discrepancies exist for Black and Organic Carbon source attribution throughout the Indo-Gangetic Plain depending on the approach utilized. Areas requiring attention tied to research of cookstove and solid fuel use that have been recognized to improve emission inventory estimates include emission factors, particulate matter speciation, and better quantification of

regional/economic sectors. However, limited attention has been given towards understanding ambient small-scale spatial variation of Black and Organic Carbon between cooking and non-cooking periods in low-resource environments. Understanding the indoor to outdoor relationship of Black and Organic Carbon emissions due to cooking at a local level is a top priority to improve emission inventories as many health and climate applications rely upon utilization of accurate emission inventories. Developing this understanding will contribute to an improved understanding of the impact that cooking with solid fuels has to localized air quality, particularly in rural areas, subsequently improving emission inventory profiles which are key aspects to climate change and epidemiological models in this region.

Sutyajeet Soneja
Department of Environmental Health Sciences, Bloomberg School of Public Health, Johns Hopkins University
Baltimore, USA

Publication

Highlighting Uncertainty and Recommendations for Improvement of Black Carbon Biomass Fuel-Based Emission Inventories in the Indo-Gangetic Plain Region.
Soneja SI, Tielsch JM, Khatry SK, Curriero FC, Breysse PN.
Curr Environ Health Rep. 2016 Mar