K4D Knowledge, evidence and learning for development

Monitoring Air Quality in Low-Income and Lower Middle-Income Countries - Summary[1]

This summary is based on a rapid review that surveyed academic and grey literature on air quality monitoring in low-income (LICs) and lower-middle-income countries (LMICs). Air pollution is a global environmental health threat, contributing to an estimated 3-7 million deaths per year (Lelieveld, Evans, Fnais, Giannadaki, & Pozzer, 2015; WHO, 2014). Whilst various types of air pollution exist, particulate matter air pollution contributes most to the global burden of disease. The effects of air pollution on health are documented in a range of epidemiological studies. The economic cost is also significant. The World Bank estimates that globally in 2013, air pollution led to USD 5.11 trillion in welfare losses, and USD 225 billion in lost labour income (World Bank & IHME, 2016).

Despite links between exposure to indoor and outdoor air pollution and negative health impacts, there is a paucity of long-term, appropriately calibrated data measuring air quality in LICs and LMICs. In particular, the apportionment of different pollution sources, e.g. vehicular emissions, industrial sources, and dust, to the overall pollution burden is often lacking. There is also a lack of evidence as to how these contributions vary between urban, peri-urban, and rural environments and, indeed, within these as well as over time.

In many countries, governments, multilateral organisations, and the private sector are increasingly motivated to take action on pollution. Unfortunately, there is a critical lack of air quality data. Whilst countries can take action without making substantial investments in measurements systems, any robust air quality management system should include a measurement component to address country-specific policy objectives and document trends over time. Capacity and capability across countries vary significantly.

A number of methods of air quality monitoring are utilised to assess levels of air pollution. This includes ground-level quality monitoring, which is well established in the global north, however, coverage in the global south is more variable. Other approaches are also available. A description of these is included below:

- **Ground-level monitoring**: Air pollution is traditionally monitored by reference or regulatory grade monitoring stations that are used to build a long term understanding of air quality. Given the size and cost of these devices, most cities can only afford limited numbers. Low-cost sensor-based technology offers a cost-effective, mobile, and flexible alternative for ground-level air quality monitoring – however, such devices are proliferating, and have varying quality and accuracy. There are also issues associated with durability, technical skills required to use and maintain, and the potential for erroneous monitoring.
- **Satellite remote sensing**: Satellite-based remote sensing offers the prospect of daily observational information. Satellite sensors measure interference in the light energy

[1] Avis, W. & Bartington, S. (2020). *Monitoring Air Quality in Low Income and Lower Middle-Income Countries*. K4D Helpdesk Report 776. Brighton, UK: Institute of Development Studies. Retrieved from https://opendocs.ids.ac.uk/opendocs/handle/20.500.12413/15694

reflected or emitted from the Earth, which is used to calculate concentrations of air pollutants. Challenges associated with this approach include lack of an accepted methodology, the effect of humidity, the coarse spatial resolution, the effect of clouds, deserts, snow, dust, and topographies. Measurements cannot be taken at night (a particular issue given that air quality, in many locations, declines during the evening).

- **Air pollution modelling**: Air pollution can be modelled over larger geographic domains via the combination of ground-level monitoring data and the application of modelling systems that simulate weather and pollutant dispersion patterns. The ASAP research team have utilised this modelling approach to reproduce real world air pollutant concentrations, with a degree of accuracy. The approach is nascent and requires further testing, uptake may be constrained by technical and infrastructure considerations, and is dependent on the quality of sources of data.
- **Visibility as a proxy for air pollution**: Visibility measurements collected at airports globally can be used as a proxy for air pollution. Visibility is inversely proportional to the amount of particulate matter present in the air i.e. declining visibility correlates closely with increasing levels of air pollution. This approach identifies trends in air quality over time but is unable to provide insight into current levels, or within area variations.

Air pollution affects all regions of the world, particularly those experiencing rapid urbanisation, the World Health Organization (WHO) estimated that between 2008 and 2013, urban air pollution levels increased by 8% and are expected to rise further given rapid urban development. Crop burning in Asia, agricultural production, and mining may also cause air pollution in peri-urban and rural areas. Populations in low-income cities are most impacted. According to the latest air quality database, 97% of cities in LICs and LMICs with over 100,000 inhabitants do not meet WHO air quality guidelines.

Whilst the majority of studies exploring air pollution monitor outdoor levels, indoor air quality is also a concern, particularly in households where vulnerable groups may be present. In many countries, people burn solid fuels (such as coal, wood, charcoal, dung, and other forms of biomass, like crop waste) to cook food and to heat and light homes. This practice generates high concentrations of pollutants in and around the home. In 2017, 3.6 billion people (47% of the global population) were exposed to household air pollution from the use of solid fuels for cooking. These exposures are most common in sub-Saharan Africa, South Asia, and East Asia (HEI, 2019, p. 8).

Studies of household air pollution also involve the deployment of low-cost sensors to measure PM and CO_2. Whilst an increasing number of studies explore this issue, more standardisation of data collection is required. The ASAP-East Africa team have monitored air quality indoors in a number of settings (see Avis et al, 2018; 2019). Such studies have allowed the exploration of air pollution in educational settings as well as comparison of households using different fuel types. Researchers in the ASAP project are also utilising low-cost monitors to explore the potential impact of household interventions on air quality.

Despite concerted efforts to manage air quality, air pollution remains one of the world's largest environmental health risks (Longhurst et al., 2016). A holistic approach is required for effective intervention that considers different sources of air pollution and addresses the related socio-economic and health problems. Air quality management policies are expected to protect public health and to remove many of the adverse socio-economic impacts that are associated with air pollution. However, evidence continues to show that air quality management policies are failing even in the global north, despite strong commitments at different scales of government. Awe et al. (2017, p. 19-23) outline a series of steps to enable the better use of air quality data: **integrating air quality measurement; quality assurance considerations; and data management, dissemination, and analysis.**

References

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