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Cost-effective emission reductions to improve air quality in South Asia

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South Asia is a global hotspot of air pollution, harboring 37 of the world's 40 most polluted cities. Sixty percent of its residents inhabit areas characterized by high pollution levels, where concentrations of fine particulate matter ($PM_{2.5}$) - accountable for chronic respiratory diseases and over two million premature deaths annually in the region - surpass the least stringent air quality standard set by the World Health Organization (WHO). Addressing this problem with fragmented approaches is unlikely to yield significant results, as air pollution extends beyond geographical boundaries. Even if fully executed, existing policy measures will only offer partial relief in diminishing $PM_{2.5}$ concentrations in South Asia.

This study aims to identify and map air pollution hotspots in South Asia in terms of concentration and exposure, understand the various sources of pollution in hotspot areas, and help categorize policy actions and interventions based on a systematic analysis of costs and benefits using the GAINS modeling framework. A large variety of emission sources contribute to $PM_{2.5}$ pollution in ambient air therefore, effective air quality management needs to balance measures across these sources. Our results reveal that the current environmental policies will decouple emissions from economic growth, however, will not be sufficient to deliver large reductions in ambient $PM_{2.5}$ in the South Asia region. There is scope for further measures beyond current policies that could approach the WHO Interim Targets (35 $\mu g/m^3$) for $PM_{2.5}$. Finally, cost-optimal strategies for air quality management can achieve significant cost savings compared to conventional approaches; however, they require cooperation within states, regions and countries in South Asia.

Monitoring of the chemical composition of $PM_{2.5}$ reveals that a significant share of total fine particulate matter in ambient air in South Asia is composed of secondary particles, i.e., particles that are formed in the atmosphere through chemical reactions from gaseous precursor emissions (i.e., SO_2, NO_x, NH_3 and VOC). This is relevant for air quality management, as measures that only address sources of primary particles often will not affect these secondary particles and thus have only a limited impact on total $PM_{2.5}$ concentrations in the atmosphere. Cost- effective air quality management must also include measures for the precursor emissions of secondary particles.

Some legislation exists for SO^2 and NO_x emissions, but its effectiveness can be enhanced by also including ammonia emissions (mainly from agricultural sources) in the portfolio as in many situations they are critically determining the generation of secondary particles.

This study examines four scenarios aimed at mitigating air pollution, varying in terms of policy implementation and international collaboration. The most economically efficient scenario, characterized by full coordination among states/provinces, regions, and countries within South Asia, would lead to a reduction in the average $PM_{2.5}$ exposure in the region to 30 μg/m³ by 2030. Implementation of this cost-effective scenario is projected to annually prevent 750,000 premature deaths by 2030. The developed scenarios are integrated into the World Bank's support for crafting regional air quality management plans at both state/province and regional (i.e., Indo-Gangetic Plain) levels in South Asia.