HIMAP

CHAPTER 10 BRIEF

AIR POLLUTION IN THE HINDU KUSH HIMALAYA

Air pollution has large impacts on the Hindu Kush Himalaya (HKH), affecting not just the health of people and ecosystems, but also climate, the cryosphere, monsoon patterns, water availability, agriculture, and incomes. The HKH region is fragile and rapidly changing. While the outcome of the interplay of complex drivers is difficult to predict, it will have major consequences. That holds true for air pollution as well.

The HKH receives significant amounts of air pollution from within and outside of the region, and transboundary pollution from other parts of Asia. This chapter surveys the evidence on regional air pollution and considers options for reducing it, while underlining the need for regional collaboration in mitigation efforts.

KEY FINDINGS

- Air pollution in the Hindu Kush Himalaya (HKH) is on the rise and regional air quality has worsened in the past two decades, with the adjacent Indo-Gangetic Plains now one of the most polluted regions in the world.
- Persistent winter fog and haze have increased across the Indo-Gangetic Plains, leading to reduced visibility and elevated air pollution just south of the HKH and affecting air quality in the HKH as well as in the Indo-Gangetic Plains.
- The HKH is sensitive to climate change — air pollutants originating within and near the HKH amplify the effects of greenhouse gases and accelerate melting of the cryosphere through the deposition of black carbon and dust, and changing monsoon circulation and rainfall distribution over Asia.

POLICY MESSAGES

- To mitigate air pollution and its severe socio-economic effects, investment in clean technologies and infrastructure is essential.
- Dedicated national institutions are required to address air pollution across multiple sectors and scales and implement air pollution mitigation policies.
- Education is essential — the HKH needs more mechanisms to enhance knowledge sharing, to increase responsiveness to scientific evidence, and to promote awareness and behavioural change.

LINKS TO

SUSTAINABLE DEVELOPMENT GOALS

3 GOOD HEALTH AND WELL-BEING

7 AFFORDABLE AND CLEAN ENERGY

13 CLIMATE ACTION

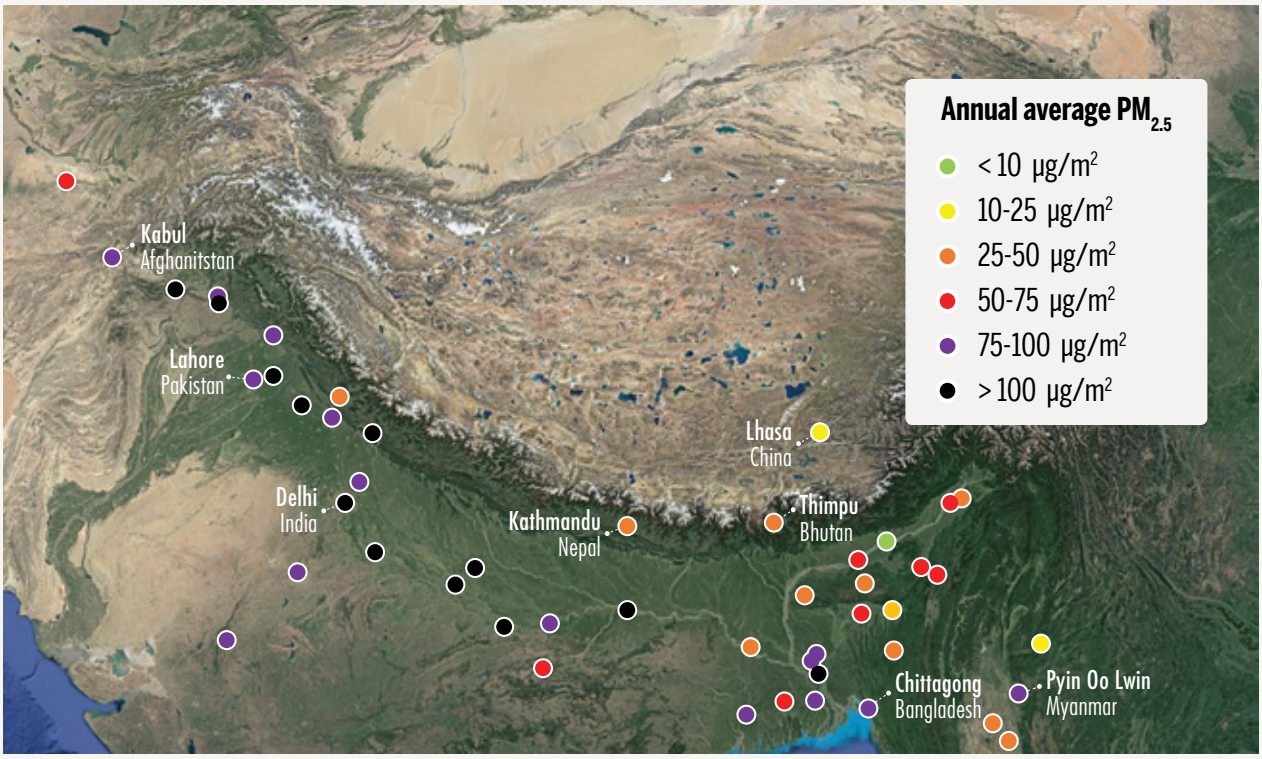
OBSERVATIONS AND TRENDS

MANY CITIES IN AND NEAR THE HKH HAVE ANNUAL AVERAGE $PM_{2.5}$ CONCENTRATIONS ALMOST 10 TIMES HIGHER THAN THE WORLD HEALTH ORGANIZATION GUIDELINE OF 10 $\mu g/m^3$

There has been a rapid rise in air pollution affecting the HKH in the past decade. Across the region, levels of particulate matter (PM) — both primary and secondary aerosols — as well as tropospheric ozone (O_3) — a secondary pollutant — have increased. Three urban cities in the HKH, including Peshawar (Pakistan), Mazar-e-Sharif (Afghanistan), and Kabul (Afghanistan), are on the list of the 20 most polluted cities in the world. Furthermore, in 12 cities – Agra, Allahabad, Amritsar, Jaipur, Patna, Dehradun, Delhi, Lucknow, Ludhiana in India; Peshawar, Rawalpindi in Pakistan; and Narayanganj in Bangladesh, the annual average concentrations are more than 10 times higher than the guideline value.

A large population in the HKH is exposed to pollution levels much higher than WHO recommendations. Air pollution mitigation is urgent given its severe impacts on health, climate, cryosphere, water resources, agriculture, and livelihoods.

ACROSS THE HINDU KUSH HIMALAYAN REGION, CITIES HAVE DANGEROUSLY HIGH CONCENTRATIONS OF AIR POLLUTION



SNOW AND GLACIER MELT ARE ACCELERATED BY ABSORBING AEROSOLS, AFFECTING SHIFTS IN RAINFALL DYNAMICS

The HKH is sensitive to global climate change through its impacts on atmospheric dynamics and thermal forcing. In addition snow and glacier melt are accelerated by absorbing aerosols including black carbon and dust. Several climate models have suggested the importance of aerosol solar absorption in modulating summer monsoon circulation and rainfall distribution over Asia. Water from seasonal snow and glacial melt provides significant resources for regional livelihoods. Monsoon rainfall — particularly over southern Asia — is a crucial freshwater resource for the region (constituting over 70% of annual rainfall). Thus, as aerosol radiative effects and regional warming perturb monsoon circulation and the Himalayan cryosphere, the resulting shifts in rainfall dynamics could have critical socio-economic as well as environmental implications.

HAZE AND WINTER FOG HAVE WORSENED IN AND NEAR THE HKH

The Indo-Gangetic Plains are a big source of pollution reaching the high mountains. Located just south of the HKH, this is an extensive stretch of highly fertile agricultural plains covering an area of 700,000 km^2. It is also among the world's most densely populated regions, inhabited by over 900 million people, roughly one seventh of the world's population.

A thick aerosol haze covers the heavily populated Indo-Gangetic Plains during the dry season, reducing visibility and obscuring sunlight. The haze often penetrates deep into Himalayan valleys, reaching the high mountains and at times even crossing the Himalaya to reach the Tibetan Plateau. The Indo-Gangetic Plains have seen an increase in persistent winter fog during the past two decades that is at least partly driven by increased air pollution, in addition to changes in moisture availability.

POOR VISIBILITY DAYS OVER THE INDO-GANGETIC PLAINS CAN BE AS HIGH AS 90% DURING WINTER

In winter months, temperatures over the Indo-Gangetic Plains are cold enough for frequent temperature inversion episodes— when a layer of cool air is trapped near the ground under a layer of warm air. This condition suppresses the normal tendency of pollutants to rise and disperse over a wide area, trapping them instead in a relatively shallow boundary layer and causing winter haze to be optically thick. Winter-time air pollution is also aggravated by increased biofuel burning for heating, combined with increased open biomass burning. Dense persistent haze and fog reduce the sun's ability to warm the land surface, further lowering the surface temperatures and perpetuating the inversion effect. Poor visibility days can be as high as 90% of the winter over the Indo-Gangetic Plains.

MAJOR GAPS IN HKH AIR QUALITY NETWORKS PERSIST DESPITE RECENT IMPROVEMENTS IN DATA COLLECTION

Despite recent improvements in data collection, major gaps in HKH air quality networks persist. Many large cities and even more rural areas within and surrounding the HKH (i.e., Indo-Gangetic Plains) still lack monitoring. These data gaps reflect several challenges. First, the topographical heterogeneity and resulting fine-scale atmospheric variations in the HKH mean that improved air quality monitoring would require a denser network of stations than is needed in the plains. Second, the current use of different instruments or protocols at different sites means that data from these sites urgently needs to be compared and validated to produce harmonized data bases. Third, in addition to the ground-based observation of air pollution, a full picture would also require measurement of the vertical variation of pollutants. In addition, more advanced instruments with higher sensitivity are essential for advancing our understanding of air pollution.

THERE IS AN URGENT NEED FOR AIR POLLUTANT MITIGATION

Air pollutant mitigation is urgently needed in the HKH, given the severe impacts of deteriorating air quality and increasing haze and winter fog across the region —on health, climate, the cryosphere, water resources, agriculture, ecosystems, and livelihoods. Such mitigation will require three elements:

Dedicated institutions and policies, both within countries and across national borders

Because air pollution in the HKH is regional, its mitigation is, critically, a regional responsibility. The region urgently requires institutional arrangements that will enable inter-agency coordination on air pollution, actively engaging multiple stakeholders. To begin with, two constraints need to be addressed: the lack of clarity in the division of labour among government institutions, and the lack of coordinating mechanisms to break down agency silos.

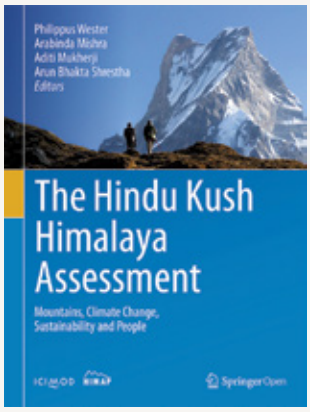
Public awareness and behavioural change

As an example, people who lack adequate solid waste collection services commonly burn their trash, generating emissions that can be linked to health problems. Raising awareness of these problems can help to build public support and pressure for improving services in urban areas — and for adopting alternative waste disposal methods, such as composting.

Mitigating air pollution in the HKH will not be possible without effective policies, public awareness, and greater investment in clean technologies.

Investment in clean technologies and green infrastructure

Promising clean technologies exist for mitigation in the household, industrial, transport, and energy sectors. At the household level, steps include chimney installation and the use of cleaner cook stoves that use liquefied petroleum gas (LPG), biogas, or electricity. At the industry level, brick producers can reduce fuel consumption and mitigate CO_2 and air pollutant emissions by shifting to more efficient zigzag or vertical shaft kilns. HKH countries can also adopt tighter vehicle emissions and fuel quality standards and design cities that promote public and non-motorized transport.



This chapter is a part of *The Hindu Kush Himalaya Assessment – Mountains, Climate Change, Sustainability and People.*

Download the full assessment at

https://doi.org/10.1007/978-3-319-92288-1

Suggested citation: Saikawa, Eri; Arnico Panday; Shichang Kang; Ritesh Gautam; Eric Zusman; Zhiyuan Cong; E. Somanathan; and Bhupesh Adhikary (2019) "Air Pollution in the Hindu Kush Himalaya", Chapter 10 in P. Wester, A. Mishra, A. Mukherji, A. B. Shrestha (eds) (2019) *The Hindu Kush Himalaya Assessment—Mountains, Climate Change, Sustainability and People.* Springer Nature Switzerland AG, Cham.

ICIMOD

The Hindu Kush Himalaya Assessment – Mountains, Climate Change, Sustainability and People is a product of the Hindu Kush Himalayan Monitoring and Assessment Programme (HIMAP) at ICIMOD.

Supported by

ICIMOD gratefully acknowledges the support of its core donors: the Governments of Afghanistan, Australia, Austria, Bangladesh, Bhutan, China, India, Myanmar, Nepal, Norway, Pakistan, Sweden, and Switzerland.

For further information:

Arnico Panday | arnico.panday@icimod.org

www.hi-map.org

International Centre for Integrated Mountain Development
GPO Box 3226, Kathmandu, Nepal
Tel +977-1-5275223
Fax +977-1-5275238