

PAKISTAN'S AIR POLLUTION NEXUS: UNRAVELLING THE INTERPLAY WITH CLIMATE CHANGE

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(Views expressed in the brief are those of the author, and do not represent those of ISSI)



Introduction:

In 2023, Pakistan maintained its position as one of the world's top three countries with severe smog levels, alongside Bangladesh and India, according to the IQAir Report. Particulate matter (PM), exceeding the World Health Organization's (WHO) recommended levels by approximately 15 times, soared to an average concentration of 73.7 micrograms per cubic meter in Pakistan. The WHO guidelines suggest a maximum of 5 micrograms per cubic meter. The buildup of pollutants can also be ascribed to the unique topographical and climatic conditions of South Asia having limited dispersion mechanisms, which leads to an increase in PM2.5 concentrations.¹

¹ David Stanway, "Which countries had the worst air quality in 2023?" Reuters, March 19, 2024, <https://www.reuters.com/business/environment/bangladesh-pakistan-india-bottom-air-quality-rankings-2023-data-shows-2024-03-19/>

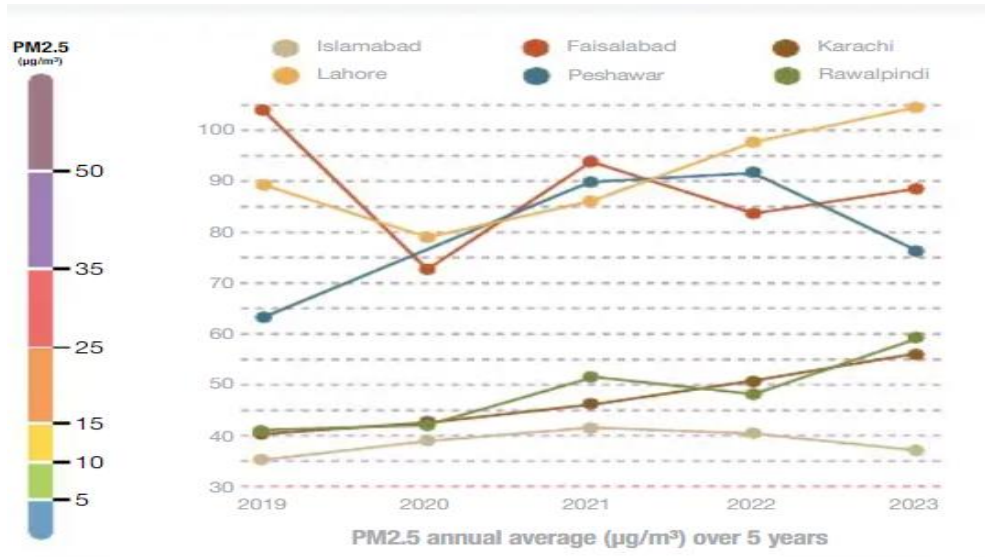


Figure: PM 2.5 Annual Average over five years in Pakistan²

Air pollution is a pressing environmental issue that transcends geographical boundaries, impacting nations worldwide. In Pakistan, air pollution and climate change are intricately linked through shared drivers, mutual impacts, and feedback loops. Understanding the interconnections between these phenomena is crucial for devising effective mitigation strategies and addressing environmental challenges comprehensively.³

Shared Drivers:

1. **Greenhouse Gas Emissions:** Both air pollution and climate change are fueled by the release of greenhouse gases (GHGs) into the atmosphere. In Pakistan, sources of air pollution comprise of industrial activities, vehicular emissions, and biomass burning that contribute to the emission of GHGs like carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O). These GHGs store heat in the Earth's atmosphere, leading to global warming and climate change.⁴
2. **Particulate Matter (PM) and Black Carbon:** Particulate matter, including black carbon, emitted from combustion processes contributes to both air pollution and climate change.

² "The 2023 World Air Quality Report," IQAir, Accessed on March 25, 2024, https://www.scribd.com/document/714825689/2023-World-Air-Quality-Report#fullscreen&from_embed
³ Mian Ahmad Naeem Salik "Pakistan's struggles against Air Pollution," ISSI, April 19, 2021, <https://issi.org.pk/issue-brief-on-pakistans-struggle-against-air-pollution/>
⁴ "Air quality in Pakistan," IQAir, Accessed on March 25, 2024, <https://www.iqair.com/pakistan>

Black carbon absorbs sunlight and contributes to atmospheric warming, accelerating the melting of glaciers and altering regional climate patterns in countries like Pakistan.⁵

Mutual Impacts:

1. **Changes in Weather Patterns:** Air pollution can influence weather patterns and atmospheric conditions, exacerbating climate change impacts.⁶ For instance, elevated levels of PM can affect cloud formation and precipitation processes, altering rainfall patterns and exacerbating droughts or floods in Pakistan.
2. **Glacial Melting and Water Resources:** Air pollutants such as black carbon can settle on snow and ice surfaces, accelerating their melting rate. In Pakistan, where glacial melt contributes significantly to river flows and water resources, air pollution-induced glacial melting exacerbates water scarcity issues, affecting agricultural productivity, hydropower generation, and overall water security.⁷

Feedback Loops:

1. **Albedo Effect:** Air pollution, particularly black carbon, can reduce the albedo (reflectivity) of snow and ice surfaces, causing them to absorb more sunlight and accelerate melting. This leads to further warming and melting, creating a feedback loop that exacerbates climate change impacts such as rising temperatures and sea-level rise.⁸
2. **Agricultural Impacts:** Air pollution can adversely affect agricultural productivity and food security, impacting rural livelihoods and exacerbating poverty. Climate change-induced shifts in temperature and precipitation patterns further compound these challenges, creating a feedback loop of environmental degradation and socio-economic vulnerability.⁹

⁵ ibid

⁶ "Air Quality and Climate Change Research," USEPA, Accessed on March 25, 2024, <https://www.epa.gov/air-research/air-quality-and-climate-change-research#:~:text=Emissions%20of%20pollutants%20into%20the,cooling%20effects%20on%20the%20climate.>

⁷ Zainab Irfan, et al, "Air Contaminants and Atmospheric Black Carbon Association with White Sky Albedo at Hindukush Karakorum and Himalaya Glaciers," MDPI, January 18, 2022, <https://www.mdpi.com/2076-3417/12/3/962>

⁸ Kyle Powys Whyte, "How Does the Albedo Effect Influence Climate Change," The Tribal Climate Camp, November 24, 2023, <https://www.tribalclimatecamp.org/how-does-the-albedo-effect-influence-climate-change/>

⁹ "Air Pollution and Agriculture: How Pollution Affects Crops and Food Security?" Airly, Accessed on March 25, 2024, <https://airly.org/en/air-pollution-and-agriculture-how-pollution-affects-crops-and-food-security/#:~:text=The%20effects%20of%20air%20pollution,of%20air%20in%20agricultural%20regions.>

City Wise PM2.5 Levels in Pakistan:

PM2.5 levels continue to rise in various cities of Pakistan on an annual basis which is an alarming sign. Every city in Pakistan included in the 2023 report measured concentrations above 30 $\mu\text{g}/\text{m}^3$, at least six times the recommended WHO annual PM2.5 guideline. Increasing trends were seen in all major cities from 2022 except Peshawar which showed a decrease in PM2.5 levels in 2023. This can be seen in the figure below.¹⁰

| City | 2023 | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | 2022 |
|------------|------|-------|-------|------|------|------|------|---------|------|------|-------|-------|-------|------|
| Islamabad | 42.4 | 70.4 | 47.5 | 32.4 | 21.2 | 21.5 | 27.8 | 23.3 | 31.9 | 31.4 | 41.2 | 66.7 | 93.6 | 40.6 |
| Faisalabad | 88.2 | 92.0 | 106.5 | 66.5 | 44.5 | 42.9 | 43.8 | NO DATA | 38.9 | 46.0 | 70.4 | 196.8 | 204.2 | 84.5 |
| Karachi | 56.4 | 98.9 | 65.1 | 53.5 | 28.2 | 27.0 | 30.2 | 32.1 | 30.1 | 43.2 | 38.2 | 121.0 | 109.7 | 50.6 |
| Lahore | 99.5 | 143.2 | 117.3 | 73.8 | 52.9 | 52.4 | 46.4 | 39.8 | 42.2 | 53.8 | 125.9 | 251.0 | 197.5 | 97.4 |
| Peshawar | 76.5 | 135.9 | 78.7 | 53.3 | 34.2 | 39.0 | 42.9 | 35.5 | 44.0 | 52.8 | 83.1 | 155.8 | 166.3 | 91.8 |
| Rawalpindi | 59.5 | 87.8 | 72.7 | 43.5 | 26.2 | 26.8 | 30.5 | 29.8 | 41.7 | 48.1 | 61.6 | 106.7 | 139.7 | 48.5 |

Figure: PM 2.5 Levels in Various Cities of Pakistan¹¹

Causes of Air Pollution in Pakistan:¹²

- Industrial Emissions:** Pakistan's burgeoning industrial sector, characterized by a lack of stringent regulations and outdated technologies, contributes significantly to air pollution. Factories emit harmful pollutants such as sulfur dioxide (SO₂), nitrogen oxides (NO_x), and PM.
- Vehicular Emissions:** The exponential growth in vehicular traffic, coupled with the prevalence of outdated vehicles and poor fuel quality standards, exacerbates air pollution in urban centers. Diesel-powered vehicles emit high levels of PM and NO_x.
- Biomass Burning:** The widespread use of biomass for cooking and heating purposes, especially in rural areas, releases pollutants such as carbon monoxide (CO), volatile organic compounds (VOCs), and PM, contributing to indoor and outdoor air pollution.

¹⁰ "The 2023 World Air Quality Report," IQAir, Accessed on March 25, 2024, https://www.scribd.com/document/714825689/2023-World-Air-Quality-Report#fullscreen&from_embed

¹¹ Ibid

¹² Mir Sher Baz Khetrn, "Health hazards caused by increasing air Pollution in Pakistan," ISSI, October 11, 2023, <https://issi.org.pk/issue-brief-on-health-hazards-caused-by-increasing-air-pollution-in-pakistan/>

4. **Crop Residue Burning:** Agricultural practices, including the burning of crop residues after harvest, significantly degrade air quality, especially during the post-harvest season. This practice releases large amounts of pollutants such as CO₂, carbon monoxide CO, and PM into the atmosphere.

Threats Posed by Air Pollution:

Air pollution causes considerable health risks, which includes respiratory diseases, cardiovascular ailments, and lung cancer. Susceptible populations such as children, the elderly, and individuals with pre-existing health conditions are vulnerable to the adverse effects of polluted air. Air pollution also adversely affects ecosystems, leading to biodiversity loss, acid rain, and soil and water contamination. Aquatic ecosystems can be disturbed by pollutants being deposited into the water bodies which can compromise the water quality and threaten aquatic life. Furthermore, air pollution can have various economic ramifications which includes increased expenditure on healthcare, loss of productivity due to illness, infrastructure damage, and diminished agricultural returns.¹³

Conclusion:

To mitigate air pollution in Pakistan, strong environmental regulations and enforcement of existing laws need to be undertaken to reduce emissions, by adopting green technologies and investing in research and development of clean technologies. Both the public and private sectors need to be encouraged to transition to renewable energy sources. The public needs to be made aware of the negative impacts of air pollution through advocacy campaigns. Furthermore, lessons and learnings should be implemented from international best practices and transboundary collaboration undertaken for air quality improvement in the country.¹⁴

Air pollution and climate change are interlinked challenges which can have long-lasting implications for public health, ecosystems, and socio-economic development in Pakistan. It is essential for the policymakers to come up with innovative strategies while dealing with the issue of air pollution. Therefore, the government and related stakeholders need to show urgency in addressing these issues. This calls for implementation of integrated policies which incorporate the interlinkages among these issues.

¹³ ibid

¹⁴ Mian Ahmad Naeem Salik "Pakistan's struggles against Air Pollution," ISSI, April 19, 2021, <https://issi.org.pk/issue-brief-on-pakistans-struggle-against-air-pollution/>