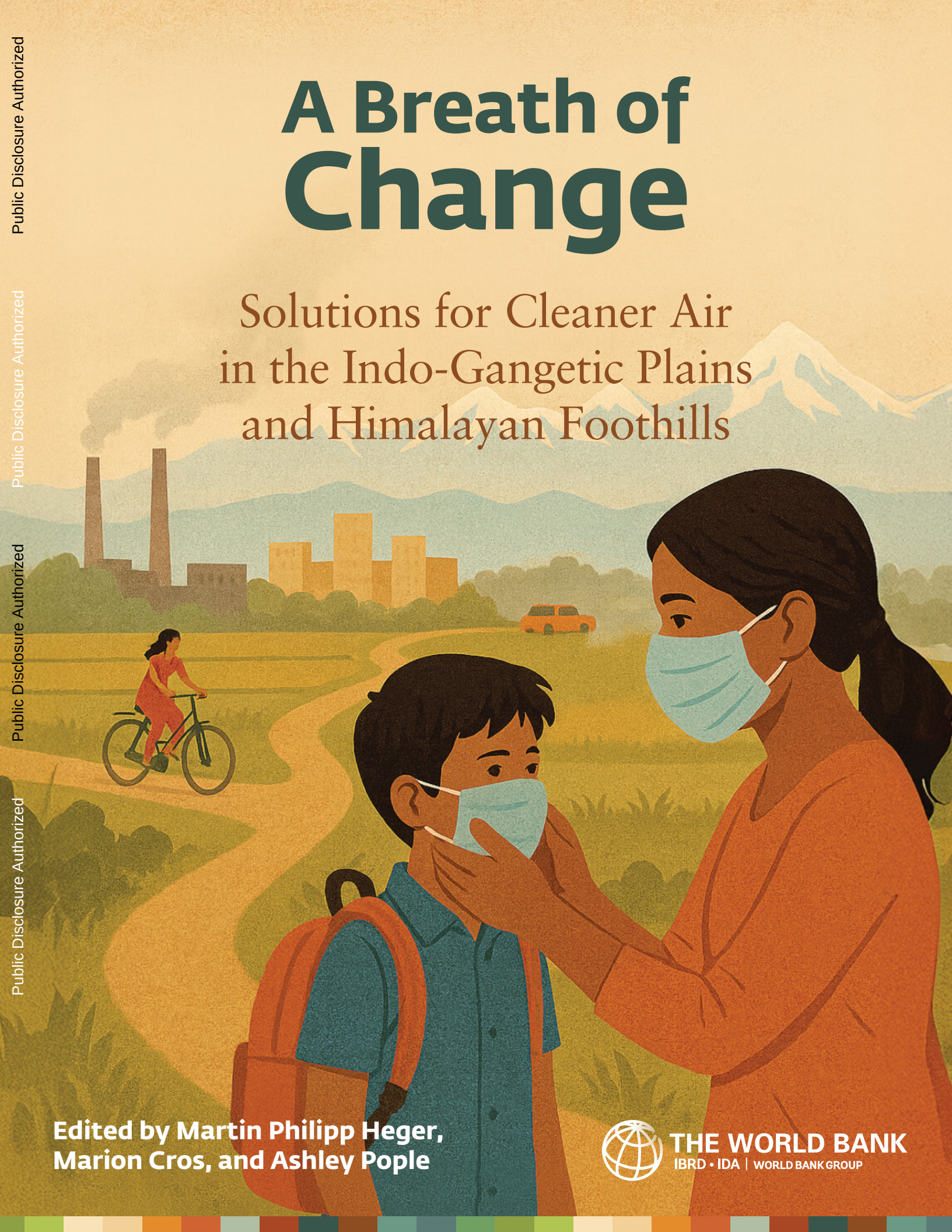
A Breath of Change

Solutions for Cleaner Air in the Indo-Gangetic Plains and Himalayan Foothills



Edited by Martin Philipp Heger, Marion Cros, and Ashley Pople

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1818 H Street NW, Washington, DC 20433
Telephone: 202-473-1000; Internet: www.worldbank.org

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Contributors

Christer Aagren *(AQM expert, NGO observer to the Convention for the Long-range Transboundary Air Pollution, CLRTAP)*
Stefan Aastroem *(AQM expert, acting co-chair, Forum for International Cooperation on Air Pollution (FICAP), CLRTAP)*
Saher Asad *(Education Economist, World Bank)*
Silvia Calderon *(Environmental Governance Consultant)*
Sharlene Chichgar *(Senior Environmental Specialist, World Bank)*
Andrew Goodland *(Lead Agriculture Specialist)*
Michelle Hallak *(Senior Energy Specialist, World Bank)*
Yasmeen Hopkins *(Transport Specialist, World Bank)*
Vahid Hosseini *(Professor Simon Fraser University, Expert in Sustainable Urban Transport)*
Ivan Jaques *(Senior Energy Specialist, World Bank)*
Gary Kleiman *(Atmospheric Scientist)*
Hagen Kruse *(Economist, World Bank)*
Yeshika Malik *(Climate Change Specialist, World Bank)*
Thierry Michel Rene Martin *(Senior Urban Specialist, World Bank)*
Monica Yanez-Pagans *(Senior Education Economist, World Bank)*
Neha Sharma *(Environment Consultant, World Bank)*
Yun Shu *(Senior Scientist, Chinese Research Academy of Environmental Sciences, CRAES)*
Megha Sood *(Transport Consultant)*
Iffat Mahmud *(Senior Operations Officer, World Bank)*
Wameq Azfar Raza *(Senior Health Specialist, World Bank)*
Mamata Ghimire *(Health Economist, World Bank)*
Anna Koziel *(Senior Health Specialist, World Bank)*
Muneer Mammi Kutty *(Health Specialist, World Bank)*
Rajesh Sahu *(Researcher, Indian Institute of Technology Kanpur)*
Prateek Saini *(Assistant Professor, Delhi Technological University)*
Jahanzaib Sohail *(Senior Economist, Health, World Bank)*
Mukesh Sharma *(Professor-Emeritus, Indian Institute of Technology Kanpur)*
Saumya Srivastava *(Agriculture Specialist, World Bank)*
Ishaa Srivastava *(Environmental Specialist, World Bank)*
Sayantan Sarkar *(Environment Specialist, World Bank)*
Shyam Srinivasan *(Transport Specialist, World Bank)*
Jostein Nygard *(Senior Environmental Specialist, World Bank)*
Pallavi Pant *(Head of Global Initiatives, Health Effects Institute)*
Nina Tsydenova *(Environmental Specialist, World Bank)*
Sachi Vohra *(Environment Consultant, World Bank)*
Stefan Veigl *(Junior Professional Associate, World Bank)*
Leo Watanabe *(Junior Professional Officer, World Bank)*
Christina Wong *(Environmental Consultant)*
Farah Zahir *(Senior Economist, World Bank)*

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- **Transport Chapter:** Ernesto Sanchez Triana (Lead Environment Specialist), Roger Gorham (Senior Transport Specialist), Cecilia M. Briceno-Garmendia (Lead Economist), Jessica Jolene Farmer (Principal Investment Officer, CNGTR), Gerald Ollivier (Lead Transport Specialist, ISAT2), and Sunil Kumar Poudyal (Transport Consultant).
- **Agriculture Chapter:** Ernesto Sanchez-Triana (Lead Environment Specialist), Madhur Gautam (Senior Research Fellow, IFPRI), and Tomas Ricardo Rosada Villamar (Practice Manager).
- **Waste Chapter:** Poonam Ahluwalia Khanijo (Senior Municipal Engineer), Jie Li (Senior Disaster Risk Management Specialist), Frank Van Woerden (Lead Environmental Engineer), and Jonah Matthew Rexer (Economist).
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Abbreviations

AEPC	Alternative Energy Promotion Centre (Nepal)
AI	Artificial Intelligence
AQI	Air Quality Index
AQM	Air Quality Management
ASHA	Accredited Social Health Activist (India)
B-NAQMP	Bangladesh National Air Quality Management Plan
BSP	Biogas Support Program (Nepal)
C&D	Construction and Demolition
CDM	Clean Development Mechanism
CEMS	Continuous Emission Monitoring System
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CRB	Crop Residue Burning
ELV	End-of-Life (Vehicle)
EPA	Environmental Protection Agency (United States)
EPR	Extended Producer Responsibility
ESP	Electrostatic Precipitators
ETS	Emission Trading Schemes
FCBTK	Fixed Chimney Bull's Trench Kiln
FGD	Flue Gas Desulfurization
FI	Financial Institution
GAINS	Greenhouse Gas and Air Pollution Interactions and Synergies (Model)
GDP	Gross Domestic Product
GHG	Greenhouse Gas
HHK	Hybrid Hoffmann Kiln
IDCOL	Infrastructure Development Company Limited (Bangladesh)
IDZZK	Induced Draft Zig-Zag Kiln
IEA	International Energy Agency
IGP-HF	Indo-Gangetic Plains & Himalayan Foothills
IIASA	International Institute for Applied Systems Analysis
IRENA	International Renewable Energy Agency
ISO	International Organization for Standardization
IoT	Internet of Things
KV-AQMAP	Kathmandu Valley Air Quality Management Plan (Nepal)
LEZ	Low Emission Zone
LPG	Liquefied Petroleum Gas
MBI	Market-Based Instrument
M&E	Monitoring and Evaluation
MRV	Measurement, Reporting, and Verification

MSME	Micro, Small, and Medium Enterprise
NAQMP	National Air Quality Management Plan
NCAP	Nepal Clean Air Program
NDC	Nationally Determined Contribution
NDZZK	Natural Draft Zig-Zag Kiln
NO_x	Nitrogen Oxides
NPK	Nitrogen, Phosphorous, and Potassium
OEM	Original Equipment Manufacturer
PM	Particulate Matter
$PM_{2.5}$	Particulate Matter with aerodynamic diameter of less than 2.5 micrometres
PMUY	Pradhan Mantri Ujjwala Yojana (India)
PNG	Piped Natural Gas
RBF	Results-Based Financing
RERED II	Renewable Energy for Rural Economic Development Phase II (Bangladesh)
SAR	South Asia Region
SCR	Selective Catalytic Reduction
SDG	Sustainable Development Goals
SNCR	Selective Noncatalytic Reduction
SO_2	Sulphur Dioxide
SO_x	Sulphur Oxides
SREDA	Sustainable and Renewable Energy Development Authority (Bangladesh)
TERI	The Energy and Resources Institute
UNEP	United Nations Environment Programme
US	United States
US$	United States Dollar
VCM	Voluntary Carbon Market
VOC	Volatile Organic Compound
VSBK	Vertical Shaft Brick Kiln
WHO	World Health Organization

Executive Summary

Air pollution across the Indo-Gangetic Plains and Himalayan Foothills (IGP-HF) has reached critical levels, threatening health and productivity for nearly one billion people. The impacts are severe: cardiovascular and respiratory diseases have become leading causes of illness and death, average life expectancy in the IGP-HF region is shortened by more than three years, and around one million people die prematurely each year from exposure to polluted air. The associated economic damage is estimated at about 10% of regional GDP annually, driven by lost labor productivity, higher healthcare costs, and reduced human capital.

By contrast, the costs of implementing clean air measures are far lower than the costs of continued pollution. Global experience shows that determined action can yield rapid gains. In China's Jing-Jin-Ji region and in Mexico City, sustained multi-sectoral action cut fine particulate matter ($PM_{2.5}$) concentrations by half within a decade. Similar progress is attainable in the IGP-HF region if actions are pursued coherently across sectors and borders.

This Solutions Book, *A Breath of Change,* sets out a practical roadmap for achieving the region's shared, intermediate target of reducing annual average $PM_{2.5}$ concentrations below 35 µg/m³ by 2035 ("35 by 35"), while laying the foundation for progressively cleaner air. Building on the diagnostics and country experiences synthesized in *Striving for Clean Air (2023)*, the solutions book moves from *why* clean air matters and *what* drives pollution to *how* to address air pollution. In other words, *how* coordinated, feasible, and evidence-based solutions can be implemented at scale.

The IGP-HF airshed, an interconnected system spanning 13 jurisdictions across Bangladesh, Bhutan, India, Nepal, and Pakistan, demands solutions that are both multi-sectoral and multi-jurisdictional. Although national circumstances vary, the main causes of pollution are generally similar and can be ranked by their contribution, in descending order:

1. **Cooking & Heating:** Use of solid fuels in households
2. **Industry:** Reliance on fossil fuels and biomass in industrial production and power generation, without adequate pollution control technology
3. **Transport:** Use of highly polluting internal combustion engines, especially Heavy-Duty Vehicles
4. **Agriculture:** Crop residue burning, and inefficient management of fertilizer and manure
5. **Waste:** Open burning of municipal waste, inadequate management of construction and demolition debris, and road dust

As air flows freely across administrative and national borders, no jurisdiction can achieve clean air on its own. In many jurisdictions, more than half of ambient $PM_{2.5}$ concentrations originate outside local boundaries, carried by regional pollutants. This underscores the need for coordinated action across sectors and jurisdictions—linking national policies with subnational implementation and cross-border cooperation.

The Solutions Book highlights a portfolio of interventions in each of the five key pollution emitting sectors: scaling up access to **clean cooking** fuels and appliances (Chapter 3); electrifying and modernizing **industrial** boilers, furnaces, kilns and thermal power plants (Chapter 4); accelerating the transition to electric and efficient vehicles alongside improvements in fuel quality, and strengthening of non-motorized transport in the **transport** sector (Chapter 5); promoting sustainable **agricultural** crop residue, livestock manure and fertilizer management (Chapter 6); and improving **waste** collection, segregation, and recycling (Chapter 7).

In parallel, protective sectors, particularly **health** (Chapter 8) and **education** (Chapter 9), play a vital role in helping people cope while air quality remains poor. These sectors safeguard human capital through interventions such as public-health advisories, school-based awareness campaigns, improved classroom ventilation and filtration, provision of protective masks, and accessible health services for those affected by air pollution-related illnesses. Strengthening these systems ensures that populations, especially children and other vulnerable groups, are better protected from ongoing exposure, even as structural emission reductions take effect over time.

Together, these abatement and protection efforts form an integrated approach to cleaner, healthier, and more resilient development across the IGP-HF region. Realizing this vision requires four mutually reinforcing pillars, each critical to translating ambition into results: Information, Incentives, Institutions, and Infrastructure. These cross-cutting themes are woven throughout the sectoral chapters, with deeper exploration of governance frameworks, market-based instruments and regional cooperation provided in Chapters 10 to 12.

Information. Reliable, open, and actionable data are the foundation of effective air quality management. Expanding industrial emissions monitoring systems, harmonizing national and regional air quality standards, and improving public access to real-time data strengthen accountability. Satellite monitoring, AI-enabled source mapping, and transparent performance dashboards can guide enforcement and empower citizens to demand cleaner air.

Incentives. Well-designed fiscal and regulatory incentives shape how households, firms, and farms behave. Reforming fossil fuel subsidies, introducing feebate schemes and pollution fees, and establishing market-based instruments such as emissions trading systems can realign private decisions with public clean air goals. Clear and predictable pricing of pollution complements command-and-control approaches, while reward structures for compliance promote voluntary adoption of cleaner technologies.

Institutions. Strong, coordinated institutions and governance structures are essential for sustained progress at both national and regional levels. Inter-ministerial committees or environmental agencies play a key role in clarifying mandates and streamlining enforcement across sectors and jurisdictions. Decentralized air quality plans, anchored in national frameworks, enable provinces and municipalities to tailor actions to local conditions while maintaining accountability for outcomes. Institutionalizing a regional platform that is credible, coordinated and sustainably financed is essential for reaching the shared regional aspirational target of "35 by 35".

Infrastructure. Transforming the region's energy, transport, and industrial base requires financing and physical infrastructure. Dedicated credit lines, performance-based grants, and blended-finance instruments can de-risk private investment in clean technologies. Expanding reliable power grids, renewable energy systems, charging networks for electric vehicles, common industrial boiler facilities, and waste management systems will yield immediate emission reductions while catalyzing longer-term structural change.

Achieving "35 by 35" will protect lives, strengthen economies, and provide the foundations for resilient, inclusive, and low-carbon growth for South Asia. With political commitment, institutional clarity, and sustained cooperation, the Indo-Gangetic Plains and Himalayan Foothills can truly breathe a breath of change.