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# TRANSBOUNDARY AIR POLLUTION IN THE INDO-GANGETIC REGION: LESSONS FROM GLOBAL FRAMEWORKS AND OPPORTUNITIES FOR INDIA-PAKISTAN COLLABORATION

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## ABSTRACT

*Across many of the major cities in South Asia, over 50 per cent of air pollution is not local but transboundary in nature, travelling from neighbouring cities, states, or even countries. In the Indo-Gangetic Plain and Himalayan Foothills (IGP-HF) region, pollution arises predominantly from household cooking, transportation, crop residue burning, inefficient fertilizer usage, industries, and power plants. The governance of these sectors is often fragmented, with responsibilities spreading across multiple ministries and departments, creating challenges for effective regulation. In light of this, the present article examines the pressing issue of transboundary air pollution in the IGP-HF region, analysing its sources, effects, and the legal frameworks addressing it. It further deals with the case study of the Indo-Gangetic Plain region, drawing lessons from transboundary pollution management models in the United States and other parts of the world. It highlights successful airshed management practices, such as the Cross-State Air Pollution Rule (CSAPR) in the U.S. and regional cooperation frameworks in Europe, emphasising the importance of a unified regulatory approach. The study lastly underscores the need for India and Pakistan to revive mechanisms like the Malé Declaration and explore bilateral collaboration for tackling air pollution through knowledge exchange, coordinated policy-making, and public engagement. The authors argue that fostering regional cooperation in air quality management is not merely an environmental necessity but also a diplomatic opportunity. Enhanced India-Pakistan ties, supported by shared environmental goals, could transform air pollution from a source of dissonance into a platform for collaboration. By way of aligning regional policies, promoting data sharing, and adopting sustainable practices, the Indo-Gangetic Plain region can address the transboundary pollution crisis while advancing broader climate resilience and public health objectives.*

## INTRODUCTION

Transboundary Pollution refers to the shifting of pollutants from one nation or region to another either by means of water, air, or soil. It is also known as Cross-border Pollution or Transnational Pollution. Air pollution knows no boundaries. Hazardous emissions travel from one region to another by means of wind currents. This includes particulate matter (PM), toxic chemicals, and pollutants from power plants, factories, or automobiles in one area that can travel great distances through wind. The air quality in nearby regions and across international borders is

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hence impacted. According to studies, both human respiratory systems and the ecology at large may suffer from poor air quality if this phenomenon persists over a long period of time.

As a transcontinental challenge, transboundary air pollution solicits coordinated approaches. The key causes involve emissions of sulphur dioxide ($SO_2$), nitrogen oxides ($NO_x$), volatile organic compounds (VOCs), and other toxic substances like heavy metals and persistent organic pollutants (POPs) from transportation and energy use. Pollutants like Carbon monoxide (CO) and methane ($CH_4$) are devoid of geographical borders since they can linger in the atmosphere for thousands of kilometres. These toxins lead to the primary consequences being the eutrophication of lands and rivers, dispersion of noxious chemicals in the atmosphere, acidification of both soil and water and summer smog (smoky fog) brought on by tropospheric ozone. In addition to harming the aquatic ecosystem and acidifying lakes and streams, it has a detrimental impact on vegetation and buildings. Moreover, it not only jeopardises human health but also harms crops and plants, upsetting the species diversity and nutritional balance in vulnerable habitats. [2]

## GLOBAL CONCERN RAISED BY TRANSBOUNDARY AIR POLLUTION

Transboundary air pollution is a significant global issue that transcends national borders and impacts countries, irrespective of their individual domestic environmental policies. While nations strive to improve air quality within their own territories, the atmosphere is a shared resource that crosses political boundaries. Pollutants released in one country have the potential to affect the health, environment, and economies of neighbouring or even distant countries, sometimes travelling hundreds or even thousands of kilometres. The Environmental Protection Agency (EPA) is working diligently in order to understand and mitigate the impacts of foreign air pollution to improve environmental quality and public health.

A study on cross-border air pollution in Ho Chi Minh City, Vietnam, illustrates the issue further. It found that PM2.5 levels were consistently high, comprising over 60% of the Air Quality Index (AQI). During this period, the overall PM2.5 levels were 100% to 115% higher than local pollution benchmarks. Reports state that this rise in PM2.5 levels was mainly caused by biomass burning in Indonesia, which was exacerbated by a specific weather pattern linked to the El Niño phenomenon. This underscores the severe consequences of pollutants originating from outside the city.[3]

A similar situation is also witnessed in Sri Lanka's air quality, which is suffering from transboundary air pollution brought in by contaminants from China and India. Acid rain and hazed air are two problems that might result from this pollution. The air-borne pollution from other regions makes the pollution in some cities progressively worse.

Perhaps another excellent illustration of how transboundary air pollution is a major problem which negatively affects a population across an extensive territory is the Indo-Gangetic Plains, which span Pakistan, India, Nepal, and Bangladesh. The World Health Organization (WHO)

[2] Gregory Wetstone and Armin Rosencranz, "*Transboundary Air Pollution: The Search for an International esponse.*" 8 HARV. ENVTL. L. REV. 89 (1984).
[3] To Thi Hien et. al., *Current Status of Fine Particulate Matter (PM2.5) in Vietnam's Most Populous City, Ho Chi Minh City* AEROSOL AND AIR QUALITY RESEARCH (Nov. 15, 2024, 7:20 PM) https://aaqr.org/articles/aaqr-18-12-oa-0471.

reports that 99 per cent[4] of people on the planet breathe air with high levels of pollutants that exceed WHO guideline limits (15 micrograms per m3 per day and 5 micrograms per m3 per year). While it is well-established and evidently supported by science that even annual outdoor PM2.5 levels below 5 microgram/m3 (µg/m3) are detrimental to human health, different nations set their own ambient air quality standards, which are typically less stringent than WHO recommendations. For instance, in contrast to the neighbouring countries of Pakistan and Bangladesh defining their yearly PM2.5 levels at 15 µg/m3, India and Bhutan have established their national ambient air quality standards at 40 µg/m3. [5]

## TRAIL SMELTER CASE AND THE DEVELOPMENT OF POLLUTER PAYS PRINCIPLE

The Trail Smelter Case is a landmark precedent in international environmental law, establishing the state's liability and responsibility for transboundary pollution.[6] The conflict started when a byproduct of the smelting process at the Consolidated Mining and Smelting Company of Canada Ltd., operating close to the U.S.-Canada border, discharged sulphur dioxide ($SO_2$). As a result, Washington, USA, suffered significant loss, especially to vegetation and agricultural land. Although early claims were settled privately, subsisting harm led the US government to step in and institute arbitration under the 1935 Convention.

A number of critical issues were investigated by the tribunal. In lieu of the harm caused between 1932 and 1937, the tribunal granted $78,000 plus interest to settle claims made during that time. Based on the notion that no state has the authority to exploit its own territory in a manner that adversely impacts another state, it held that Canada must refrain from continuing such detrimental acts to avoid future culpability. The tribunal balanced the interests of the economy and the environment by requiring an emissions control regulatory regime in order to address persistent complaints. A $7,500 yearly payout was also established for any further substantiated and documented damages.[7]

The case reinforced the obligation of states to ensure activities within their own jurisdiction do not harm the environment or people of any other neighbouring state, emphasising on state's liability towards transboundary harm. It underscored the 'Polluter Pays Principle' by mandating that the polluter state be held accountable for damages and be required to implement technical and operational framework changes. It also reflected early concepts of sustainable development by balancing economic interests such as maintaining smelter operations with environmental protection. The principles established in the Trail Smelter Case have influenced succeeding frameworks, such as the Stockholm Declaration (Principle 22), and the UN Framework Convention on Climate Change, and influenced the International Court of Justice's rulings on environmental disputes.

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[4] World Health Organisation https://www.who.int/health-topics/air-pollution#tab=tab_1 (last visited Dec. 12, 2024).

[5] WHO global air quality guidelines: particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide, WORLD HEALTH ORGANISATION, (Sept. 22, 2021), https://www.who.int/publications/i/item/9789240034228

[6] Rishika Rishabh, *Responsibility V. Sovereignty: Transboundary Environmental Harm* 4 (2) IJLMH Page 598 - 606 (2021).

[7] John D. Wirth, *The Trail Smelter Dispute: Canadians and Americans Confront Transboundary Pollution*, Vol. 1, ASEH 34, 34-51 (1996)

## LEGAL FRAMEWORKS GOVERNING TRANSBOUNDARY AIR POLLUTION

### Geneva Convention on Long-Range Transboundary Air Pollution, 1979

In November 1979, the "Geneva Convention on Long-Range Transboundary Air Pollution" (CLRTAP) was signed under the auspices of the United Nations Economic Commission for Europe (UNECE), resulting in one of the major initiatives to administer and supervise the global transboundary impacts of air pollution, especially in Europe. It took effect in 1983. CLRTAP was the first legally binding international instrument to address the issue of air pollution. CLRTAP has been successfully fostering cooperation among its 51 parties, including countries from Europe, North America, Russia, and former East Bloc nations, to lower transboundary air pollution and advance the understanding of air pollution science. The CLRTAP calls for joint, shared and coordinated efforts to inhibit its impacts on the environment and human life.[8]

It is the closest “framework instrument” we have in the domain of combating air pollution, which is analogous to say the United Nations Framework Convention on Climate Change (UNFCCC) or the UN Convention on Biological Diversity (CBD). Akin to these framework instruments, the Convention on Long-range Transboundary Air Pollution establishes a procedural framework for collaborative efforts that have been advanced upon by subsequent protocols, instead of setting concrete commitments towards air pollution reduction. The Convention has 8 such subsequent protocols that target desks with specific pollutants and minimise the effects of those. The eight aforementioned protocols under the CLRTAP are[9]:

1. *1984 EMEP Protocol:* This protocol sets up a collaborative framework for sharing the data and pinpointing the main sources of air pollution in Europe, which is cost-effective and includes a basic data repository to perform the emission reductions and the verifying of the data. The participant member states involved in the CLRTAP undertake to participate in the Cooperative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP). This program gives scientific tools such as projection development, emission assessments, and atmospheric monitoring. Originally aimed at $SO_2$ and related aftereffects, EMEP has broadened its activities in this respect to study other pollutants and their influence on water, soil, vegetation, health, and the environment. Moreover, it is responsible for the production of full, linked, and final pollution assessment reports. Along with standard monitoring methods, EMEP has incorporated national and international programs at the same time and obtained meteorological data for studying transmission processes for data exchange with the aim of more effective collaborative pollution management.

2. *1985 Helsinki Protocol on Sulphur Emissions*: As an innovative step, this protocol mandates a 30% sulphur emissions reduction from 1980 levels, setting the foundation for worldwide efforts to address acid rain and the ecological impacts that come with it.

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[8] CCAC Secretariat, In a World Full of Dirty Air, Regional Agreements on Air Pollution Offer a Glimmer of Hope Climate and Clean Air Coalition, COALITION FOR SUSTAINABLE CLIMATE ACTION (Sept. 6, 2023) https://www.ccacoalition.org/news/world-full-dirty-air-regional-agreements-air-pollution-offer-glimmer-hope.

[9] Updated Handbook for the 1979 Convention on Long-range Transboundary Air Pollution and its Protocols UNECE.

3. *1988 Sofia Protocol on Nitrogen Oxides ($NO_x$)*: This protocol, which takes a phased strategy, targets ammonia and VOCs because of their roles in photochemical pollution, acidification, and eutrophication. It focuses on the necessity of stopping $NO_x$ emissions at 1987 levels and works its way down to further reductions.

4. *1991 VOC Protocol*: With three emission-reduction targets, the VOC Protocol which focuses on the precursors to ground-level ozone, provides flexibility by allowing parties to choose pathways that are appropriate for their respective environmental and economic circumstances.

5. *1994 Oslo Protocol on Sulphur Emissions*: While the Helsinki Protocol concentrates on using traditional technologies, the provisions of the Oslo Protocol lay stress on contemporary methods such as energy conservation, renewable energy application, and the use of best available technologies (BATs) to attain sulphur emission reductions.

6. *1998 Aarhus Protocol on Heavy Metals*: It targets 3 metals: cadmium, lead, and Mercury. The parties of the convention had to reduce their emissions for these metals below the levels of the year 1990 (or any alternative year between 1985 and 1995). The Aarhus Protocol aims to cut emissions from industrial sources, combustion processes and waste incineration. The protocol encourages parties to gradually eliminate lead-filled petrol. Additionally, it initiates action to mitigate the heavy-metal emissions from other products as well as the management strategies for products that prominently contain mercury. An amendment was made in 2012 which set out strict Emission Limit Values (ELVs) for particulate matter and lead, mercury, and cadmium that may apply in some particular combustion and industrial emissions released into air. In an effort to widen the scope of industrial operations, the production of ferromanganese and silico alloys were included in the emission source's categories for the 3 heavy metals mentioned above.

7. *1998 Protocol on Persistent Organic Pollutants (POPs)*: This protocol aims to eliminate harmful pollutants by banning some substances outright, while other substances will be phased out over a specified period. The 2009 amendments broadened the list of the prohibited pollutants. it also made it possible for countries with transitioning economies to be more flexible in their policy related decisions.

8. *1999 Gothenburg Protocol*: It aims to mitigate the causes of acidification, eutrophication and ground-level ozone. It established National Emission Ceilings for 10 years (2010-2020) for nitrogen oxides ($NO_x$), Volatile Organic Compounds (VOCs), Sulphur Dioxide ($SO_2$), and ammonia ($NH_3$). It also mandates the use of the Best Available Technique (BAT) method to keep emissions in limit. Moreover, VOCs emissions from aerosols and paints are to be reduced as well as farmers are to take measures to inhibit $NH_3$ emissions. In 2012, this protocol too was amended to include the 2020 national emission-reduction commitment; this action was later ratified by the EU. The protocol's technical annexes now comprise emission limit values (ELVs) for key stationary sources and mobile sources. This amended protocol is the first legally binding instrument to establish commitments for emission-reduction of fine particulate matter. The 2012 protocol includes soot (also known as black carbon, which is a short-lived climate pollutant) as a component of fine particulate matter. Since black carbon is a significant contributor to global warming and air pollution, the amended protocol aims to reduce particulate matter through implementation.

Since its ratification, the UNECE Convention on Long-Range Transboundary Air Pollution has proven to be a trailblazing framework. Certain pollutants' emissions have been successfully decreased by convention-mandated protocols; for example, since the early 1990s, Europe's sulphur dioxide emissions have decreased by more than 90%. The Convention established the fundamental framework for regulating and minimising the harm that transboundary air pollution does to the environment and human health, and it has made a significant contribution to the development of international environmental law.

The UNECE Convention on Long-range Transboundary Air Pollution has shown that via collaborative efforts from other nations, amazing outcomes are indeed achievable, such as Europe's life expectancy has now been increased by one year as a result of the emission reductions made possible by the Convention, moreover, 600,000 premature deaths have been avoided annually.

**ASEAN Agreement on Transboundary Haze Pollution (AATHP) 2002**

The ASEAN Agreement on Transboundary Haze Pollution (AATHP) is a legally binding treaty between ASEAN member countries to address and tackle haze pollution. It necessitates collaboration in combating and tracking haze pollution, sharing technology and information, offering mutually beneficial assistance, promptly responding to information requests about haze pollution coming from within their borders, and putting legal, administrative, and other measures in place to meet commitments. It was signed in June 2002 and ratified in January 2015. In an effort to foster cooperation, the agreement also created the ASEAN Coordinating Centre for Transboundary Haze Pollution Control. The Second ASEAN Haze-Free Roadmap (2023–2030), which was unveiled by ASEAN in 2023, aims to eradicate transboundary haze pollution by curbing open burning from land, forest, and agricultural fires.[10]

**The Stockholm Convention, 2004**

The Stockholm Convention is an international agreement designed to safeguard the well-being of human health and conserve the environment from persistent organic pollutants, or POPs. it identifies POPs in different Annexes following the result of extensive scientific studies, consultations, and negotiations among the participating nations. The primary goals of the convention incorporate the promotion of safe substitutions for those already being used, identifying more POPs for action, decontaminating and removing the old stockpiles and the machinery that uses POPs, and moving towards a cleaner environment with lesser POPs emissions. India concurred with the convention in 2006 by Article 25(4), by staking a stance on an "opt-out" provision which means that any amendments to the Annexes are not enforceable unless the country explicitly ratifies them. The convention also outlaws nine of the "dirty dozen" chemicals, restricts the use of DDT for malaria control, and aims to mitigate the unintended production of furans and dioxins. Article 22 puts specific emphasis on the cooperation of the states towards the detection of international legal issues related to the liability and reparation of the pollution and environmental damage caused by the spheres of domestic law application to beyond their control areas.[11]

[10] Supat Wangwongwatana, Tackling Transboundary Haze Pollution in Southeast Asia, SLOCAT (Dec 12 2024, 6:35 PM), https://slocat.net/tackling-transboundary-haze-pollution-in-southeast-asia/

[11] Peter Lallas, "*The Stockholm Convention on Persistent Organic Pollutants*." 95(3) AMERICAN JOURNAL OF INTERNATIONAL LAW 692–708 (2001).

### Malé Declaration on Control and Prevention of Air Pollution and Its Likely Transboundary Effects for South Asia, 1998

In 1998, the United Nations Environment Programme (UNEP) along with the Stockholm Environment Institute (SEI) brought an initiative to raise awareness about the likelihood of the transboundary air pollution impacts, particularly in South Asia and it led to the adoption of the 'Malé Declaration on Control and Prevention of Air Pollution and Its Likely Transboundary Effects for South Asia' (Malé Declaration). The Malé Declaration has eight member nations in South Asia, i.e., Bangladesh, Bhutan, India, Iran, Maldives, Nepal, Pakistan, and Sri Lanka. These countries are represented by the national ministries and national implementation agencies that have been designated as national focal points. According to the declaration, the participating countries are obliged to carry out studies and programmes dedicated to air pollution in order to determine the source and causes, nature, extent and effects of local and regional air pollution. These measures consist of monitoring and pollution reporting; testing and research on emission inventories, modelling, and human health; and the dissemination and utilisation of information on clean air technologies.

The Malé Declaration was the first regional agreement reached in South Asia in 1998 on the topic of pollution. This revolutionary directive has attracted India, Pakistan, as well as Nepal, among other countries, towards the development of emission inventories, pollution monitoring, and the identification of the impact on the various sectors. The declaration's continued operation in the last few years has shown the region's determination to curb and tackle air pollution as a shared regional problem.[12]

### Canada-United States Air Quality Agreement, 1991

The 1991 Canada-United States Air Quality Agreement was signed by both Canada and the United States. It was launched to address cross-border air pollution that results in acid rain. The Agreement also focuses on primary contributors of acid rain- emissions of sulphur dioxide ($SO_2$) and nitrogen oxides ($NO_x$)- and aims to facilitate joint scientific research and technical work related to acid rain. In December 2000, the Ozone Annex was added to the Canada-United States Air Quality Agreement to address transboundary air pollution that leads to elevated ambient levels of ground-level ozone, a primary component of smog in both countries. The Ozone Annex's primary and long-term objective is to achieve ozone pollution control in both of the countries involved. The Ozone Annex commits both nations to reduce their emissions of nitrogen oxides and volatile organic compounds—precursor pollutants to ground-level ozone—in areas where transboundary pollution contributes to ozone formation.[13]

### Asia Pacific Clean Air Partnership (APCAP), 2015

The United Nations Environment Assembly (UNEA) recognized the urgent need to address air pollution and its effects in the Asia Pacific region, as reflected in its 2014 resolution. Subsequently, the 2017 UNEA resolution also stressed the importance of preventing and reducing air pollution to improve global air quality. In response to the same, the Asia Pacific

[12] Malé Declaration on Control and Prevention of Air Pollution and Its Likely Transboundary Effects for South Asia https://unece.org/fileadmin/DAM/env/documents/2011/eb/eb/n_12.pdf (last visited Dec. 12, 2024).

[13] Canada-United States Air Quality Agreement: overview, Government of Canada https://www.canada.ca/en/environment-climate-change/services/air-pollution/issues/transboundary/canada-united-states-air-quality-agreement-overview.html (last visited Dec. 10, 2024).

Clean Air Partnership (APCAP) was established to foster regional cooperation and knowledge sharing. Since its inception in 2015, APCAP has brought together countries like Afghanistan, Cambodia, India, Iran, Japan, Malaysia, Maldives, Mongolia, Nepal, New Zealand, Pakistan, Philippines, Singapore, Sri Lanka, and Thailand to work towards a cleaner region. The partnership strives to support the development and implementation aspect of regional clean air programs, enhance capacity building, and promote innovative solutions for air pollution reduction. By fostering collaboration and knowledge exchange, APCAP seeks to address the multifaceted challenges posed by air pollution and contribute to sustainable development in the Asia-Pacific region.[14]

### United Nations Framework Convention on Climate Change (UNFCCC), 1992

The United Nations Framework Convention on Climate Change (UNFCCC) was signed in June, 1992 at the United Nations Conference on Environment and Development, also commonly referred to as the Earth Summit, or the Rio Summit. UNFCCC took effect in 1994 and it has been ratified by 197 countries. It is the parent treaty of both- the 2015 Paris Agreement and the 1997 Kyoto Protocol. The aim of this convention is to maintain atmospheric concentrations of greenhouse gases at levels that avoid harmful effects, allowing ecosystems to naturally adjust themselves and promote sustainable development. The Kyoto Protocol, established under the UNFCCC, is an international agreement adopted in Kyoto, Japan, in 1997 and came into effect in 2005, binding the parties to its emission reduction targets. Acknowledging the responsibility of developed countries for the current high GHG levels caused by over 150 years of industrial activity, Phase 1 (2005–12) targeted a 5% emissions reduction, while Phase 2 (2013–20) aimed for at least an 18% reduction by industrialized nations. The Paris Agreement, which was adopted in 2015 at COP 21, superseded the Kyoto Protocol as the momentous framework to tackle climate change. The Paris Agreement aspires to limit the global temperature increase to well below 2°C above pre-industrial levels, with a more ambitious goal of 1.5°C.[15] It also addresses the financial implications of climate change, particularly for vulnerable nations. The agreement outlines mechanisms to redress loss and damage, and mobilize climate finance to support developing countries in their adaptation efforts and transition to renewable energy sources. However, the financial support obligations for developed countries are not legally binding.

## PROBLEM OF TRANSBOUNDARY AIR POLLUTION ARISING IN THE INDO-GANGETIC PLAIN

One of the most polluted areas in the world is the Indo-Gangetic Plain, which includes Bangladesh, India, Nepal, and Pakistan. The health of millions of people, especially women, children, and the elderly, is being negatively impacted by the alarming levels of air pollution in many urban and rural areas of the region. Transboundary air pollution is turning into a significant problem in the Indo-Gangetic Plain. Major cities in the region, such as Multan, Lahore, New Delhi, Kolkata, and Dhaka, are experiencing increased levels of smoke, fog, particulate matter, and other air pollutants.[16]

[14] Ryan M. Colker, "The Asia-Pacific partnership." 49(10) ASHRAE JOURNAL 81-82 (2007).
[15] Special Report: Global Warming of 1.5 ºC IPCC https://www.ipcc.ch/sr15/chapter/chapter-2/ (last visited Dec. 12, 2024).
[16] Nandita Singh et. al., Organic aerosols over Indo-Gangetic Plain: Sources, distributions and climatic implications, 157 AE, 59-74 (2017)

The problems with air pollution in these nations are closely linked to climate change. Climate change is caused by the same sources of air pollution as previously mentioned. The Indo-Gangetic Plain region, which currently accounts for around 9% of global greenhouse gas emissions, also has significant externalities related to climate mitigation, much like the air pollution problem. Black carbon is one of the most powerful climate forcers, and policies that reduce air pollution also reduce short-lived climate pollutants like it. Particulate matter (PM2.5) concentrations in the area are significantly higher than WHO air quality standards. particularly within the Himalayan Foothills region.

Living in a polluted environment has major negative effects on one's health, according to a large body of worldwide evidence that keeps growing. According to estimates, air pollution causes 2 million premature deaths annually in South Asia, despite being the second most important risk factor for early death worldwide in 2021. In India, Bangladesh, Nepal, Pakistan, and Sri Lanka, the estimated costs of health care and lost productivity as a result of air pollution include 1.75 million premature deaths annually, welfare losses that range from 4.7% to 7.8% of GDP, depending on the country, and lost labour output that ranges from 0.47% to 0.8% of GDP. [17]

## SOUTH ASIA'S SMOG PROBLEM

One of the main causes of winter pollution in South Asia is the annual practice of stubble burning[18] in the Punjab districts of India and Pakistan. Every year before the winter season starts, the farmers of both countries burn agricultural stubble to prepare fields and fertilise them for the winter harvests[19]. This process is responsible for the release of dense clouds of particulate matter into the atmosphere, which degrades the air quality in nearby cities like New Delhi and Lahore.

Furthermore, another significant contributor to air pollution in densely populated South Asian cities is vehicle emissions. Most South Asian countries are still lagging behind much of the Western world in enforcing more stringent emissions laws, particularly when it comes to heavy-duty and two-wheeler vehicles. They are also plagued by the pervasiveness of outdated car fleets, the lack of better fuel substitutes, and the poor implementation of present environmental regulations. Additionally, the region has seen very delayed adoption of electric vehicles, which are increasingly acknowledged as an effective means of reducing vehicular pollution. Data from 2023 shows that about 17% of new automobile sales in Asia and roughly 25% of new car sales in Europe are electric. Nonetheless, electric cars accounted for little over 1% of all car sales in India in 2022. This notable disparity is caused by the relatively high cost of electric vehicles and the dearth of suitable charging sites in South Asia. Urbanization is only exacerbating these issues as more people buy automobiles and use fossil fuels.

The main causes of air pollution in the Indo-Gangetic Plain are similar for all four nations: solid waste burning, industrial sources (eg: brick kilns), transportation (eg: diesel engines),

[17] Air quality management in the Indo-Gangetic Plain and Himalayan foothills: ICIMOD and World Bank (Dec. 15, 2024, 7:00 PM), https://www.icimod.org/event/air-quality-management-in-the-indo-gangetic-plain-and-himalayan-foothills/

[18] Muhammad Isa Abdurrahman et. al., Stubble burning: Effects on health & environment, regulations and management practices, 2 EA, (2020)

[19] Stubble burning: Why it continues to smother north India, BBC news (Dec. 15, 2024, 7:00PM), https://www.bbc.com/news/world-asia-india-54930380.

open burning of agricultural residue, and household emissions from cookstoves. At a high-level World Bank Spring Meeting event in 2021 called "Solutions for Improved Air Quality and Green Recovery in South Asia," the four nations in the region outlined their goals for cleaner air in South Asia in Vision 2030.[20]

Hence, at this stage, fostering cross-country knowledge exchanges is highly necessary, with a special emphasis on success stories and best practices. Furthermore, considering the transboundary nature of the air pollution problem and the airflows across nations, pollution from one nation, or subnational area within a nation, may have a major environmental and human impact elsewhere. Coordination of the nations' planning, monitoring, and mitigation activities is therefore essential.

## *INITIATIVES TAKEN BY VARIOUS INSTITUTIONS*

South Asian countries are exploring various approaches to boost funding and investment opportunities, including innovative financing, collaborations between funding agencies and development partners, public-private partnerships, and fiscal policies and incentives that can promote the adoption of more environmentally friendly technologies or increase awareness of the pressing issue of climate change.[21]

### ICIMOD's Regional Programme on Atmosphere, 2013

From its headquarters in Kathmandu, Nepal, ICIMOD serves the eight Regional Member Countries of the Hindu Kush Himalayan (HKH) region: Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan. It is a regional intergovernmental learning and knowledge sharing centre. Their Regional Program on Atmosphere seeks to raise awareness, develop capacity, and foster cooperation in the HKH and upwind regions while advancing knowledge of air pollutant emissions, atmospheric processes and change, and impacts. Through increased knowledge and capacity of our regional partners, the program seeks to encourage the implementation of effective policies and measures to curb air pollution and its effects within the Hindu Kush Himalayan region. ICIMOD produce data and evidence, find, test, and pilot mitigation solutions, build outreach and capacity, encourage regional cooperation and cross-border network development, and influence local, national, regional, and international policy. Researchers at the International Centre for Integrated Mountain Development (ICIMOD), a regional intergovernmental knowledge centre, are creating a set of visualisation tools that will allow users to view past and projected trends in local, sub-regional, and regional air pollution levels.[22]

### The World Bank's Regional Programme on Air Pollution in the Indo-Gangetic Plain and Himalayan Foothills, 2022

In every nation that forms a part of the Indo-Gangetic Plain and the Himalayan Foothills region, the World Bank has been working on air quality management or AQM. On the one hand, the World Bank has created a number of air quality investment projects in various nations, including the Bangladesh Environmental Sustainability and Transformation (BEST) project

[20] *Id*. at 16.
[21] Air quality management in the Indo-Gangetic Plain and Himalayan foothills, INTERNATIONAL CENTRE FOR INTEGRATED MOUNTAIN DEVELOPMENT (Dec. 14, 2022), https://www.icimod.org/event/air-quality-management-in-the-indo-gangetic-plain-and-himalayan-foothills/
[22] Archana Karkl, International Center for Integrated Mountain Development, 20 MRD 90, 90-91 (2000)

and the Punjab Green Development Project (PGDP) in Pakistan's Punjab province. Currently, the World Bank is also developing air quality projects in Uttar Pradesh, Bihar, and Haryana, among other Indian states. By providing incentives for cleaner alternatives, it has backed policy reforms that are essential for lowering air pollution. One example is Nepal's Green, Resilient, and Inclusive Development (GRID) Policy Credit, which supported lowering the import prices of electric vehicles.

Additionally, the World Bank has started working on the IGP-HF Air Quality Policy Planning tool, which is presently being piloted in a number of nations and will soon be extended to more. The effectiveness and cost of engineering and technological solutions, as well as the sources of air pollution at various scales (local, national, and regional), will be critically understood by decision makers thanks to this tool. The World Bank's regional program aims to continue facilitating regional discussions, create a nested regional tool for IGP-HF AQM Policy Planning for each participating country, and work on practical air quality solutions.[23]

### Graded Response Action Plan, 2017

It is crucial to recognise that the December smog, which is brought on by pollution entering from other states, is posing a threat to public health and safety. Reports of people waiting in line for emergency care due to discomfort and an inability to live comfortably in smog-filled, opaque spaces are on the rise. The people who are most affected are those whose jobs require them to be outside, such as daily wage workers, construction workers, and migrants. To control the smog, Delhi authorities have implemented the Graded Response Action Plan (GRAP-4).[24] As short-term steps to mitigate the pollution's negative effects, the plan calls for closing schools, restricting traffic, and outlawing diesel generators.[25]

### Commission for Air Quality Management (CAQM), 2021

The CAQM was given the authority to "take all such measures, issue directions, and entertain complaints, as it deems necessary or expedient, for the purpose of protecting and improving the quality of the air in the National Capital Region and adjoining areas" by the Commission for Air Quality Management in NCR & Adjoining Areas Act, 2021.[26] The Act gave CAQM cross-sectoral and cross-jurisdictional authority and acknowledged the transboundary nature of air pollution.

With the exception of Article 19 of the Air Act, 1981, which grants a state government the authority to designate, modify, or combine the "Air Pollution Control Area" wherein the Act's provisions will be applicable within its borders after consulting with the State Pollution Control

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[23] Air Pollution Knows No Borders in South Asia, Neither Do Solutions, WORLD BANK GROUP (Sept. 5, 2024), https://www.worldbank.org/en/news/feature/2024/09/05/air-pollution-knows-no-borders-in-south-asia-neither-do-solutions

[24] *Grap 4 restrictions in Delhi due to 'severe' air pollution; Check what's allowed and what's not*, The Economic Times (Dec. 12, 2020, 7:05 PM), https://economictimes.indiatimes.com/news/india/grap-4-restrictions-in-delhi-due-to-severe-air-pollution-check-whats-allowed-and-whats-not/articleshow/115389241.cms?from=mdr

[25] CAQM invokes Stage-IV of the GRAP in the entire Delhi-NCR w.e.f. 08:00 AM of 18.11.2024 (tomorrow) in addition to all actions under Stage I, II and III to prevent further deterioration of air quality in the region, PRESS RELEASE: PRESS INFORMATION BUREAU (Nov. 17, 2024, 8:58 PM) https://pib.gov.in/PressReleasePage.aspx?PRID=2074114

[26] The Commission for Air Quality Management in National Capital Region and Adjoining Areas Ordinance, 2021, PRS LEGISLATIVE RESEARCH https://prsindia.org/billtrack/the-commission-for-air-quality-management-in-national-capital-region-and-adjoining-areas-ordinance-2021

Board, there isn't a strict law in place that implements a regional air quality management framework.

Currently, India's air quality management is primarily city-centric, with the exception of the Commission for Air Quality Management (CAQM) in New Delhi and Adjoining Areas.[27] Furthermore, the CAQM has been implemented unevenly even though it has a regional plan. Although all strategies must be implemented uniformly throughout the region, there is a notable asymmetry in the scope of action because there is no institutional or legal framework for managing regional air quality.

**National Clean Air Programme (NCAP), 2019**

The Ministry of Environment, Forests, and Climate Change (MoEFCC) introduced the National Clean Air Programme (NCAP) in January 2019 as India's first national framework for managing air quality with a time-bound reduction target. Using 2017 as the base year, it sought to lower the concentrations of fine particulate matter (PM2.5) and coarse particulate matter (PM10) by at least 20% over the course of five years. The Central Pollution Control Board (CPCB) identified 132 non-attainment cities that had continuously failed to meet the National Ambient Air Quality Standards (NAAQS) for more than five years. The Air (Prevention and Control of Pollution) Act of 1981 established these standards, which set acceptable limits for pollutants like PM10, PM2.5, SO2, NO2, CO, NH3, ozone, lead, benzene, benzo(a)pyrene, arsenic, and nickel. Although a 20–30% decrease in PM10 and PM2.5 levels by 2024 was the original goal of the NCAP, the goal was changed in September 2022 to a more ambitious 40% reduction in particulate matter concentration by 2026.[28] Cities were expected to measure progress under this program beginning in 2020–21, which called for a rise in clean air quality days to at least 200 and a decrease of 15% or more in the annual average PM10 concentration. Lower amounts will be regarded as low, and funding will be cut accordingly. [29]

a) *How effective was the programme?*

The effectiveness of the National Clean Air Programme (NCAP), which was introduced in January 2019, is seriously questioned in the recent report National Clean Air Programme: An Agenda for Reform by the Centre for Science and Environment (CSE). Even though the NCAP established challenging goals, like cutting particulate pollution in 131 polluted cities by 40% by 2025–2026[30], the report points out significant implementation and focus area gaps. The following are the main conclusions drawn from the evaluation:

Unbalanced Fund Allocation: Sixty-four percent of the funds intended to improve air quality have gone toward reducing road dust, with very little left over to address major polluters like industries (0.61%), automobiles (12.63%), and biomass burning (14.51%). This excessive

[27] Nikhil M Babu, *What can Commission for Air Quality Management do to improve Delhi air?,* THE HINDU (November 24, 2024), https://www.thehindu.com/sci-tech/energy-and-environment/what-can-caqm-do-to-improve-delhi-air/article68903280.ece .

[28] Goals set under NCAP , PRESS RELEASE: PRESS INFORMATION BUREAU (Aug 08, 2024, 1:21PM), https://pib.gov.in/PressReleasePage.aspx?PRID=2043004

[29] Simrin Sirur, Missing the mark: India's National Clean Air Programme, IDR (Dec. 12, 2024, 7.05PM), https://idronline.org/article/environment/indias-national-clean-air-programme-continues-to-miss-the-mark/

[30] Parliament Question: - National Clean Air Programme, Ministry of Environment, Forest and Climate Change, Press Information Bureau https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2078363 (28 Nov. 2024 2:03PM)

emphasis jeopardises attempts to address the main causes of air pollution. Additionally, only 51% of the ₹10,566 crore that was made available was used in smaller NCAP cities, while 67% was used in cities that were part of the 15th Finance Commission. This unequal allocation of resources results in gaps in the comprehensive regional management of air quality.[31]

Defective Metrics for Evaluation: It is problematic that PM10 concentration is used as the main standard for evaluating improvements in air quality under NCAP, as it ignores PM2.5, a more dangerous pollutant linked to combustion sources such as automobiles and factories. This emphasis causes a gap between actual pollution levels and policy actions. Cities like Delhi, for example, perform well in the policy-driven Swachh Vayu Sarvekshan (SVS) but poorly in the PM10-focused NCAP evaluation. The need for a more comprehensive and health-relevant evaluation system is highlighted by the inconsistent performance of smaller cities like Angul and Kala Amb across these rankings.

Neglect of Key Combustion Sources: There is still insufficient effort being made to reduce emissions from major combustion sources, like automobiles and industries. There has been little reported progress in putting policies like modernising public transportation, retiring outdated cars, or switching to clean fuels into action. Plans to reform the vehicle and transportation systems are still in the early stages of development, and industrial areas located outside of city limits are frequently unregulated. Further impeding progress is the inability to analyse and replicate effective strategies due to the lack of publicly available data on air quality interventions.

*b) Need for a Regional and Multi-Sectoral Approach*

Due to the interconnectedness of pollution, cities cannot accomplish air quality goals on their own. Although they need better coordination and execution, regional strategies that focus on issues like transboundary pollution and the Indo-Gangetic Plains are essential. Achieving long-term improvement also requires sectoral targets in areas like waste management, energy transitions, and lowering dependency on polluting vehicles. For such extensive reforms to be possible, state and federal policies must be in harmony.

*c) Strategic approaches recommended for better implementation*

In order to effectively address these issues, PM2.5 should take the place of PM10 as the main standard for evaluating air quality, guaranteeing that the sources of pollution that are relevant to human health are the focus. Funding systems need to establish sectoral objectives with clear due dates and offer rewards for concrete, measurable accomplishments. Transparency can be increased by creating robust data reporting and public accessibility systems, such as PRANA. Enhancing the capacity of Urban Local Bodies (ULBs) and State Pollution Control Boards (SPCBs) is also crucial for successful implementation. Innovative financing strategies including polluter-pays ideas, green municipal bonds, and environmental taxes should be employed to provide sustainable funding. Finally, performance-linked evaluations that highlight successful models and practices can help underperforming cities lead and support their efforts. The CREA states that more than 300 manual air quality monitoring stations must

[31] Nikhil Ghanekar, 'Need more focus on PM2.5': Study says dust mitigation draining clean air scheme funds THE INDIAN EXPRESS https://indianexpress.com/article/india/need-more-focus-on-pm2-5-study-says-dust-mitigation-draining-clean-air-scheme-funds-9466056/ (Dec. 12, 2024, 7:10PM).

be established each year if India is to reach the NCAP target of 1,500 monitoring stations by 2024.

## ROLE OF THE INDIAN JUDICIARY IN ADDRESSING AIR POLLUTION IN INDIA

With the use of *suo moto* jurisdiction, Public Interest Litigations (PILs), and historic precedents, the judiciary has been instrumental in addressing air pollution in India. In addition to interpreting current legislation, the courts have established new guidelines, guaranteeing the successful implementation of air pollution control measures.

The Supreme Court ordered the relocation of industries close to the Taj Mahal in order to prevent damage from air pollution in one of the most famous cases, M.C. Mehta v. Union of India.[32] According to the Court, businesses that engage in activities that are inherently dangerous have an "absolute and non-delegable" duty to the community, which means that they are responsible for any harm caused, regardless of the precautions taken. In order to safeguard the environment and public health, this established the "polluter pays" principle, made sure businesses absorb environmental costs and encouraged accountability and transparency by instituting the "strict liability" principle.

In order to safeguard the monument, the Court also ordered the creation of a green belt around the site. The Indian Supreme Court upheld strict liability for dangerous industries in the Union Carbide Corporation v. Union of India case.[33] According to this theory, businesses should be held fully accountable for any damages brought about by their operations, especially when handling hazardous materials or hazardous procedures. This is regardless of whether the business was careless or not.

The Court acknowledged stubble burning as a significant environmental hazard and health risk in Vikrant Kumar Tongad v. Environment Pollution (Prevention & Control) Authority.[34] It underlined that there are alternatives and that, for the sake of environmental and public health, stubble burning should be reduced.

In another case, Vardhaman Kaushik v. Union of India[35], the court ordered actions to improve air quality, including a ban on outdated diesel cars and restrictions on construction. These court rulings emphasised the significance of clean air for public health and demonstrated the necessity of judicial supervision in environmental protection, which cannot be left to the government or private sector alone.

A specialised forum for handling environmental cases, including those involving air pollution, was also made available by the creation of the National Green Tribunals (NGT) in 2010. The NGT has further strengthened the judiciary's role in preserving public health and air quality by facilitating the speedy resolution of environmental disputes and imposing severe penalties on violators.

[32] M.C. Mehta And Anr vs Union of India & Ors, AIR 1987 SC 1086
[33] Union Carbide Corporation vs. Union of India (UOI) and Ors., MANU/SC/0616/1989
[34] Vikrant Kumar Tongad vs. Environment Pollution (Prevention and Control) Authority and Ors., MANU/GT/0209/2015
[35] Vardhaman Kaushik v. Union of India, 2016 SCC OnLine NGT 4176

## TACKLING AIR POLLUTION BY AIRSHED MANAGEMENT AND DRAWING LESSONS FROM GLOBAL EXPERIENCES

The Indo-Gangetic Plain (IGP), which includes parts of Bangladesh, Nepal, Pakistan, and India, is a crucial hotspot for air pollution where problems with air quality transcend national boundaries. The region urgently calls for an integrated strategy to manage pollution. Low wind speeds, winter inversions, stagnant weather patterns, and burning of agricultural residues all contribute to the region's air quality problems. Thus, recent global developments demonstrate that airshed management could prove advantageous in the long run. [36]

An airshed refers to a geographical area characterised by shared meteorological, topographical, and climatic conditions that influence the distribution of its unique air mass. In air quality management, airsheds can be defined and demarcated based on emissions sources, meteorology, topography, and jurisdictional boundaries. Airshed air quality management brings the entire airshed under a unified regulatory framework. Although not a novel concept, regional airshed-level air quality management has been successfully implemented in countries like the United States, China, and the European Union.

PM2.5 emissions are the main source of pollution, mostly from home cooking and automobile use. The stakes are high for efficient airshed management because this very region is responsible for 46% of India's premature fatalities from air pollution. To ensure a permanent and longstanding improvement in air quality, it’s high time for not only localised actions but also a coordinated framework comprising infrastructure development, governance, and policy alignment throughout all Indo-Gangetic Plain states and neighbouring nations.

Airshed management is a well-established strategy that emphasises on regional coordination and tailored interventions. The World Bank and the GAINS (Greenhouse gas and Air pollution Interactions and Synergies) model are assisting Uttar Pradesh, India in spearheading the region's growing airshed action plans. The state places a high priority on cost-effective measures, like using clean cooking alternatives, to reduce household emissions.

It is pertinent to acknowledge other parts of the world that have implemented frameworks for airshed-level air quality management. Two such effective frameworks are the Great Lakes Basin Airshed Management Framework and the US's Cross-State Air Pollution Rule (CSAPR, also referred to as the Good Neighbour Policy).

The United States and Canada have collaborated previously in lieu of management of transboundary air pollution through initiatives such as the Great Lakes Basin Airshed Management Framework and the Georgia Basin-Puget Sound transboundary airshed strategy. These initiatives seek to enhance public health and air quality by promoting regional airshed management, increasing information exchange, and involving stakeholders through workshops and open discussions. Few off its achievements are that pollution from marine vessels is being addressed, diesel emissions are being reduced, and cleaner fuels are being introduced. Both countries also examined sulphur dioxide (SO2) and nitrogen oxides (NOx) emissions trading

[36] Kalyani Tembhe, India’s air quality management needs transboundary accountability to be effective, DOWN TO EARTH https://www.downtoearth.org.in/pollution/india-s-air-quality-management-needs-transboundary-accountability-to-be-effective-92706 (Dec. 12, 2024, 7:10PM).

under the Ozone Annex of the Canada-U.S. Air Quality Agreement, examining legal frameworks, compliance processes, and public reporting systems to reduce smog and acid rain.

Following numerous court cases and legislative efforts, the US enacted the CSAPR in 2016 to address the effect of interstate pollution on downwind air quality. The responsibility is enforceable by law. Despite the legal support of the Clean Air Act and the CSAPR, the US implementation and actions rely largely on the bureaucratic presidential cycles and the cooperation of the emitting states. Only recently, on March 15, 2023, the EPA enforce the Good Neighbour Rule's nitrogen oxide limits at power plants and industrial sources.

It is possible to either integrate an airshed-level air quality management framework into the existing Air Act 1981 framework or to promulgate a new framework by using these provisions as a basis and learning from experiences around the world. In India, the nation has already established the policy levers for managing regional air quality.

## RECENT DEVELOPMENTS

In the recent times, there has been notable research to find possible solutions to air pollution by utilising technology to the fullest indicating that there is a lot of efforts being taken to combat this problem and that, this process is ever-evolving. One of the newer techniques to reduce air pollution is by altering the weather and inducing rain, also known as Cloud seeding.

**Cloud seeding** entails injecting substances like salt or silver iodide into clouds to create rain. Depending on the climate, different substances may be used, which may help remove pollutants from the atmosphere. It is a technique for creating artificial rainfall that is subsequently washed away. The ideal circumstances—certain humidity, precipitation, and cloud characteristics—determine this. Since cloud seeding is not a long-term solution, the process is costly, estimated to cost $1.5 million, and would only provide temporary relief if successful. Because of everyday traffic, industrial emissions, and weather patterns, pollution will soon return even if the rain temporarily clears the air. The issue is being addressed at the endpoint rather than the origin.[37]

Another possible solution is **drone-based mist spraying** which encompasses using drones to spray a fine mist of water to control air pollution. As part of the Winter Action Plan to address air quality, it was tested in Delhi by the Delhi Government. In order to suppress fine dust, which can be another type of PM2.5, these drones, each of which has 15 litres of water, are used to spray mist along roads. The usefulness of dust-suppression methods like water sprinkling is questioned. He asserts that although these actions might lessen the amount of dust in the air that is visible, they don't deal with its causes. However, mist-based dust suppression might be applied in mining regions with poorly surfaced roads and high vehicle traffic. It isn't a solution for controlling air pollution throughout the city; instead, the true issue is construction waste, industrial pollution, and vehicle emissions.[38]

[37] *What is cloud seeding? A proposed solution to Delhi's severe air pollution crisis*, TIMES OF INDIA, (Jan. 5, 2024, 5:10 PM), https://timesofindia.indiatimes.com/science/what-is-cloud-seeding-a-proposed-solution-to-delhis-severe-air-pollution-crisis/articleshow/115475761.cms.

[38] Press Trust of India, *Drone mist-spraying pilot project in hitch for high costs, limited results,* BUSINESS STANDARD, (Jan. 5, 2024, 5:12 PM), https://www.business-standard.com/india-news/drone-mist-spraying-pilot-project-in-hitch-for-high-costs-limited-results-124121200764_1.html.

Despite the results, these methods are considered as a temporary solution only as they would not suffice in the long run. Moreover, the machines and the equipment used are quite expensive and without proper maintenance and efficient usage protocols, these machines could lead to operational inefficiencies, wastage of resources further increasing costs and environmental risks such as abrupt changes in weather pattern. Even though technological interventions may offer a temporary respite from pollution, they fail to tackle the deep-rooted challenges which require long-term approach such as policy changes, stronger regional collaboration, and active participation of localites.

## INDIA AND PAKISTAN: ROADMAP TOWARDS A SOLUTION

Indo-Pak relations have been characterised by both cooperation and conflict since the partition of British India in 1947. The two neighbouring countries share a complex history marked by disputes and ideological differences. Despite attempts at peace-building, challenges such as the Kashmir conflict and political instability continue to strain bilateral ties. Moreover, both nations face internal challenges such as economic disparities, social unrest, and governance issues, which further complicate their relations. However, in a rapidly globalising world, the need for regional cooperation has never been more crucial. Strengthening Indo-Pak relations through dialogue, confidence-building measures, and mutual cooperation on economic, security, and environmental issues could not only benefit both countries but also contribute to regional stability in South Asia.

## CHALLENGES FACED IN THE GOVERNANCE OF AIR POLLUTION IN THE INDO-PAK CONTEXT

*Jurisdictional Fragmentation*: While governance structures are frequently limited to national or state borders, air pollution transcends political boundaries. Effective transboundary air pollution management is hampered by the disparity in policies and enforcement methods between the two countries caused by this jurisdictional fragmentation. The Malé Declaration, a deal to reduce transboundary air pollution in South Asia, is one tool currently in use for promoting environmental cooperation. However, the agreement has been essentially ineffective due to its lack of legally binding commitments and enforcement mechanisms. The declaration must be revived with improved funding and accountability measures in order to work as a guiding light for the India-Pakistan collaboration.

*Policy Coordination:* Diverse regulatory frameworks and environmental standards across countries complicate the development of unified strategies to address transboundary air pollution. There are regulatory gaps and difficulties with enforcement as a result of different countries' inconsistent policies. Despite the implementation of policy initiatives, the Indo-Gangetic belt's atmosphere has not significantly improved because of inadequate coordination. Pakistan's efforts to reduce vehicle pollution are exemplified by its adoption of Euro-V fuel standards and promotion of electric vehicles. Cleaner technologies have been adopted more quickly in India as a result of a more well-established environmental movement, investments in renewable energy, and electric vehicle purchases. Both nations, however, continue to rely

significantly on coal, which presents serious policy, economic, and infrastructure mismatches.[39]

*Absence of Joint Monitoring Mechanisms*: A "joint nation air pollution monitoring" is a collaborative effort between multiple countries to monitor air pollution levels across their borders, often coordinated through international organisations like the United Nations Economic Commission for Europe (UNECE) under their "Convention on Long-range Transboundary Air Pollution" (LRTAP), which includes a "Joint Task Force on the Health Aspects of Air Pollution" to assess the health impacts of transboundary air pollution; essentially, countries share air quality data to understand and address pollution issues that cross national boundaries. Effective management of transboundary pollution requires shared data and monitoring systems. Currently, there is no comprehensive bilateral framework for monitoring air quality across the India-Pakistan borders, leading to fragmented data collection and analysis. This issue could be overcome by setting up a cross border mechanism to monitor weather conditions and accordingly take effective measures to reduce the significant amount of pollutants in the Indo-Gangetic belt.

*Lack of Awareness and Politics upon pollution*: The practice of Politicising pollution simply deviates the people from the environmental crisis that is impending on us. Such acts, exemplified by public statements blaming each other nation for deteriorating air quality would be unfruitful in solving the underlying problem of both the societies. For instance, during the winter smog period in Lahore, Pakistani officials attributed the problem to crop burning in Indian Punjab, rather than addressing local sources of pollution. Such narratives not only undermine the possibility of genuine collaboration but also detract from addressing the root causes of pollution domestically. [40]

Instead, there is a significant need to sensitise the common masses about the environmental crisis that we are facing and the urgent need to protect the environment. Air pollution control requires integrating the issue into public discourse. Awareness camps, workshops and environment protection policies could help to sensitise the public and achieve this goal. For example, reducing vehicular emissions by urging a shift towards public transport systems in order to curb car dependence. Moreover we need to reach out to the grassroot levels and urge the people to try their best to save the environment and prevent cutting down of trees. Lastly the government needs to play an important role in controlling the pollution in both nations and reduce emissions from the industries. Effective measures need to be taken to enforce these policies and ensure proper adherence to them.

*Problems with Funding*: The Indian government has initiated several funding strategies to combat air pollution. Notably, the 15th Finance Commission recommended allocating approximately $1.7 billion over five years to support 42 cities with populations exceeding one million, contingent upon achieving annual pollution reductions of 15%. This performance-based fiscal transfer is an approach towards air quality management. Additionally, the environmental compensation is received as per the orders of the National Green Tribunals

[39] Arooj Fatima, Why India and Pakistan Should Work Toward a Joint Framework Against Smog, THE DIPLOMAT (Jan. 5, 2024, 5:00 PM), https://thediplomat.com/2023/03/why-india-and-pakistan-should-work-toward-a-joint-framework-against-smog/

[40] Pakistan blames India for worsening smog in Lahore as air quality index hits record high, THE HINDU, (Jan. 5, 2024, 5:05 PM), https://www.thehindu.com/news/national/pakistan-blames-india-for-worsening-smog-in-lahore-as-air-quality-index-hits-record-high/article68828728.ece

(NGT) is utilised to rejuvenate and protect the environment through strengthening of laboratories/monitoring network, projects and studies/monitoring in compliance of NGT orders, capacity building of pollution control boards, payment of travelling allowance/ dearness allowance/honorarium etc. to the chairman and members of NGT-constituted committees.

Nevertheless, problems still exist. A significant amount of the Environment Protection Charge (EPC) and Environmental Compensation (EC) collected goes unused, according to a report from the Central Pollution Control Board (CPCB) that was presented to the National Green Tribunal (NGT).[41] In order to improve the quality of the air in Delhi-NCR and Punjab, the EPC was created by a Supreme Court order in the M.C. Mehta vs. Union of India (1985) case. Its purpose is to finance scientific research, pollution control projects, and health impact studies. In addition to direct fines levied against polluters, the CPCB also receives a quarter of the environmental compensation that state pollution control boards collect. Despite these collections, the underutilisation of funds raises concerns about the effectiveness of pollution control measures. This highlights the importance of efficient funding mechanism and proper utilisation of the funds which could only be possible with the help of stringent enforcement and strict penalties.

*Underutilisation of Renewable energy and the Role of CSR*: Industrial activities are a significant source of air pollution in India, contributing over 50% of the nation's total air pollution levels. Key contributors include coal-fired thermal power plants, which are the largest industrial sources of air pollutants. An effective way to tackle industry-based air pollution would be transitioning to renewable energy sources. Unlike fossil fuels, renewable energy generation does not emit harmful pollutants like sulphur dioxide, nitrogen oxides, and particulate matter, which are major contributors to air quality degradation. By adopting renewable energy, we can significantly lower levels of fine particulate matter (PM2.5) and nitrogen dioxide ($NO_2$), leading to improved air quality and better public health outcomes. Herein, Corporate Social Responsibility (CSR) initiatives play a pivotal role in mitigating air pollution by enabling businesses to integrate environmental stewardship into their operations. Tata Motors is committed to achieving net-zero greenhouse gas emissions and to source 100% renewable electricity for its operations in the coming years.[42] B.L. Agro Industries in India has implemented 100% solar power in its manufacturing units and installed air purifiers to reduce carbon emissions, leading to an 88% improvement in air quality in the Parsakhera Industrial Area in Bareilly.[43] In Pakistan, companies have engaged in tree plantation drives and awareness campaigns to combat air pollution, contributing to environmental conservation and public health improvement. CSR efforts demonstrate how corporate engagement can effectively contribute to air pollution control in the region.

[41] CPCB report to NGT shows 80 pc environmental funds remain unutilized, THE ECONOMIC TIMES, (Jan. 5, 2024, 5:07 PM), https://economictimes.indiatimes.com/news/india/cpcb-report-to-ngt-shows-80-pc-environmental-funds-remain-unutilised/articleshow/108795532.cms

[42] Tata Motors says will become net zero in greenhouse emissions by 2045, THE HINDUSTAN TIMES, (Jan. 5, 2024, 5:17 PM), https://www.hindustantimes.com/car-bike/tata-motors-says-will-become-net-zero-in-greenhouse-emissions-by-2045-101693117214959.html.

[43] The News Desk, BL Agro helps improve air quality index by 88%, MEDIA BRIEF, (Jan. 5, 2024, 5:15 PM), https://mediabrief.com/bl-agro-helps-improve-air-quality-index-by-88/.

## NEED FOR REGIONAL COOPERATION BETWEEN INDIA AND PAKISTAN

The Indo-Pakistan Climate Collective (IPCC), a bilateral forum of scientists and civil society organizations, stressed the need for greater field engagement and information and data exchange to counter the problem of transboundary air pollution in its first-ever annual report. There are several ways that India and Pakistan might cooperate in their longstanding struggle against air pollution, including sharing technology advancements in pollution prevention and air quality monitoring. [44]

For instance, data sharing and coordinated regulations are necessary since emissions in one state often cause pollution in another. Seasonal changes complicate matters; in the summer, dust from alluvial soil significantly affects air quality, while in the winter, stubble burning is the primary source of pollution. It is thus recommended that the both nations create a unified air resources board throughout the Indo Gangetic-Plain in order to effectively handle these issues.

Furthermore, India and Pakistan can collaborate to adopt eco-friendly policies, especially in the fields of sustainable urban development and solar energy. This partnership can be used to leverage investments in sustainable technologies. The two countries can also work together to boost the adoption of electric vehicles by investing in the provision of charging stations and developing cleaner fuel substitutes. Similarly, cooperation on effective waste management strategies and updated public transit systems could also pay out in the long run.

India and Pakistan should promote the use of alternative farming methods to prevent stubble burning. These solutions include mulching, which adds crop remnants to the soil to improve moisture retention and soil vitality, composting, which breaks down crop residues to produce organic fertilizers that enrich the soil and cut waste, and zero-tillage farming, which plants crops without disturbing the soil and eliminates the need to burn crop residues. Crop debris can be utilized to make charcoal or biogas if stubble burning stops. By working together on research, training, and financial incentives, the two nations may apply all of these methods in their farming areas.

Highlighting the inadequacies of the Malé Declaration and reviving it for regional cooperation on air pollution would also encourage institutions to act in furtherance of intended objectives. Regional solutions to this problem need fostering consistent funding for the Declaration's projects, harmonizing international emissions legislation, and improving the implementation of long-term air quality standards and monitoring. To achieve these objectives, the two countries must re-engage in regional dialogue on the need for a framework of cooperation with mutual responsibilities and open oversight.[45]

Lastly, public awareness at the grassroots level is essential to prevent pollution. The state governments of Punjab's two provinces both in India and Pakistan ought to work together to develop coordinated education campaigns that highlight the detrimental impacts of pollution on human health and encourage individual-level efforts to cut hazardous emissions. They

[44] Neeraja Kulkarni, Clearing the Air: Next Steps for India-Pakistan Climate Diplomacy THE DIPLOMAT https://thediplomat.com/2024/12/clearing-the-air-next-steps-for-india-pakistan-climate-diplomacy/ (Dec. 12, 2024, 7:10PM).

[45] Abu Hurrairah Abbasi, Saher Liaqat India and Pakistan Must Collaborate to Combat Winter Smog https://southasianvoices.org/geo-c-pk-r-india-pak-smog-diplomacy-11-13-2024/ (Dec. 10, 2024, 9:15PM),

should encourage them to manage domestic garbage and increase the usage of public transportation.

To successfully execute these cooperative efforts, political challenges would undoubtedly need to be overcome. However, India and Pakistan must put aside their political differences when it comes to matters like public health and environmental preservation. Both governments would need to put long-term environmental goals ahead of short-term political benefits for climate diplomacy to be successful. Given their separate pollution challenges, India and Pakistan have a unique chance to work together to combat climate change.

Both countries can reduce the detrimental health effects of pollution and advance broader climate measures by collaborating on data-sharing, research, and planning. Such cooperation measures could possibly trigger a thaw between the two countries. By practicing smog diplomacy, Pakistan and India can shield millions of people from the potentially fatal effects of air pollution. They will also transform winter from a yearly health problem into a time of enjoyment by doing this.

## CONCLUSION

In conclusion, the challenge of transboundary air pollution in the Indo-Gangetic Plain and Himalayan Foothills region is a shared yet complex problem that transcends political and geographical boundaries. Addressing this issue demands a collaborative, region-wide approach rooted in robust governance, policy harmonization, and technological innovation. Lessons from international frameworks and regional airshed management strategies offer valuable insights for crafting effective solutions.

India and Pakistan, as key stakeholders in the region, have a unique opportunity to lead by example by prioritizing environmental diplomacy over political differences. Reviving mechanisms like the Malé Declaration, investing in joint research, and fostering public awareness can lay the foundation for long-term cooperation. Furthermore, adopting sustainable agricultural practices, promoting cleaner technologies, and implementing unified airshed management frameworks could mitigate the devastating impacts of air pollution on public health and the environment. Ultimately, tackling transboundary air pollution is not only an environmental imperative but also a pathway to fostering stronger regional ties. By transforming shared challenges into collaborative opportunities, the countries of the IGP-HF region can ensure cleaner air for millions of residents, safeguard public health, and contribute to global climate goals.