

# Unveiling the Smog Crisis

## SOLUTIONS AHEAD

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# Unveiling the **Smog Crisis**: Solutions Ahead



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## ***Executive Summary***

As air quality temporarily improves outside of the smog season, many in the public and policy circles mistakenly believe that environmental concerns have been resolved. However, as soon as smog returns, both mainstream and social media are flooded with trends and outcries about the failure of the health system to respond effectively. To prevent these recurring inefficiencies in the subsequent smog seasons, it is crucial to take action now.

Smog's impact on Pakistan is severe and persistent throughout the year, except for the brief monsoon respite in July and August. Major urban centers like Lahore, Karachi, Peshawar, and Faisalabad are particularly affected, with these cities ranking among the top 20 most polluted globally in 2022. The smog problem has escalated intensely, with PM2.5 levels exceeding WHO guidelines by seven times for nearly 60 percent of the population. This has led to a significant reduction in the average lifespan, with recent findings from the Air Quality Life Index by the University of Chicago revealing a loss of 3.9 years in Pakistan and a staggering 7.5 years for residents of Lahore. Despite this, there has been a lack of serious and timely action to mitigate the hazardous impact of smog on citizens' health.

This document explored the science behind smog, including its definition, composition, causes, and consequences. It also examined the role of various sectors in smog formation, reviewed policy development and implementation challenges, and proposed a future framework with key priorities for combating the smog crisis in Pakistan.

## ***Conclusion***

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- Smog is a critical issue that imposes significant health, social, and economic costs on society.
- The transport sector is the leading contributor to smog in Punjab and Lahore, with the industrial and agricultural sectors also playing major roles.
- Despite the development of legal frameworks, plans, and policies, effective implementation remains a significant challenge.
- Inefficiency in addressing environmental degradation is further exacerbated by a lack of coordination among key stakeholders.
- Despite efforts, Pakistan has yet to fully transition to Euro-5 fuel standards. However, even a complete shift to Euro-5 is unlikely to bring significant improvements in emission reduction. A more impactful solution would be transitioning to Euro-6 standards. Euro-6 fuel significantly lowers harmful emissions from vehicles, making it a crucial step in addressing urban air pollution. Adopting Euro-6, alongside complementary measures like vehicle maintenance and emission testing, could lead to far greater improvements in air quality.
- Pakistan should reassess the roles of federal and provincial governments in addressing smog, particularly regarding fuel standardization. The government must either allow provinces to set fuel prices and standards according to their specific needs or ensure strict adherence to Euro-6 fuel quality nationwide.
- Punjab could benefit from adopting stringent enforcement rules and effective implementation strategies, as seen in other countries.

- The agriculture sector, frequently blamed for contributing to smog, requires a more nuanced understanding of its underlying challenges. While technological solutions are available to reduce crop residue burning, they have not been prioritized.
- The impact of transboundary smog calls for a cooperative regional response, though achieving such collaboration is challenging.
- Punitive measures like fines for emitters or farmers have often been ineffective, highlighting the need for comprehensive and coordinated strategies.
- Global experience shows that combining regulations with a behavioral approach is more effective. Raising public awareness through educational programs and media campaigns is crucial for driving meaningful change.

## *Way Forward*

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Combating smog requires a blend of immediate interventions and long-term strategies to reduce pollution, enhance public awareness, and promote sustainable practices. The approach is divided into two pathways: quick actions and long-term priorities.

## *Quick Actions*

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- Evidence is essential for efficient and effective planning, making it imperative to rapidly install additional air quality monitoring systems. This will provide precise data on pollution levels, aiding in spatial planning and identifying congestion hotspots, which will enhance transport planning initiatives.
- Complete conversion to Euro 6 standards is urgently needed. Further, the government should either empower provinces to set fuel prices and standards based on their specific needs or ensure that the federal government strictly enforces Euro 6 fuel quality nationwide. A digital monitoring mechanism at the local level can be implemented to ensure thorough examination, regulation, and delivery of quality fuel at petrol pumps.
- Promote a cycling culture in the cities. An effective starting point could be to focus on university students, as they can play a pivotal role in embracing and promoting cycling culture within the community.
- Encourage and advocate the use of ride-sharing services like carpooling instead of solo driving and raise awareness about how driving habits can lower vehicle emissions. Further, expand public transportation networks for convenient access to grocery stores and malls.
- The implementation of Miyawaki forests to enhance urban green cover should be expedited. Since forest departments typically do not operate within city limits, this initiative must be prioritized by the provincial government in collaboration with district administrations. Accelerating the adoption of Miyawaki techniques will help improve urban air quality.
- Revising the vacation calendar by extending winter breaks and reducing summer vacations while keeping the total number of school days unchanged. With changing weather patterns, winter vacations should shift to January instead of the end of December. Schools should start earlier and end before the hottest hours during summer. Adjusting vacation schedules can help mitigate the reduction in school days caused by smog, particularly in affected areas like Lahore.

- The government should lead the implementation of school transportation buses, similar to university transportation models. This initiative would significantly reduce the number of vehicles on the roads, easing congestion and lowering emissions and energy demands. Public-private partnerships could accelerate this transition, and an incentive structure should be developed to encourage students at the school and college levels to use school transport.
- Encouraging and prioritizing sustainable agricultural practices by allocating funds toward technological solutions is essential. Investing in machines like the Happy Seeder to manage rice stubble and promoting improved livestock management techniques can significantly reduce environmental impacts. These innovations offer practical alternatives to harmful practices like crop residue burning, while also enhancing productivity and sustainability in agriculture.
- Achieving short-term priorities requires a well-coordinated network of all stakeholders, along with sufficient and timely availability of funds. This can be quickly implemented by redirecting more funds toward tackling smog, as public health is a top priority for enhancing the nation's overall productivity.

## *Long-Term Priorities*

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- Cities have turned into gas chambers due to vehicular emissions. To combat this, a robust and sustainable public transport system is essential. While public transport options do exist, they are currently inadequate to meet the needs of large urban centers. Expanding the system and implementing planned transportation schemes is crucial. However, this must be done within a well-structured and comprehensive framework. Public transportation should also be integrated with city and town planning or master planning to ensure long-term effectiveness and sustainability, without compromising urban development.
- Further, Urban areas like DHA should permit and invest in public transport. The metro bus and Orange Line train networks should be expedited following international models, and feeder bus networks should be expanded.
- Traffic distribution should be planned by considering air quality or implementing taxes, particularly congestion taxes, which can be an effective measure to curb smog in major urban centers. By imposing higher taxes on vehicles entering densely populated areas, especially during peak hours, authorities can discourage excessive vehicle use, reducing traffic and emissions. Revenue generated from these taxes can be reinvested in public transport and green infrastructure.
- The Punjab government should phase out rickshaws due to their high emissions. Although Govt. announced the plan to phase out rickshaws but it should happen practically. Strengthening and digitizing vehicle inspection systems, retiring old vehicles, installing catalytic converters, and adopting the latest Euro Standards for emissions and manufacturing are essential for improving air quality.
- In urban planning, establishing clear boundaries within cities and adhering strictly to master plans is crucial. Categorizing the development of urban areas is essential and should be unwavering without compromise. Emphasizing walkability within cities, which has notably declined, particularly in places like Lahore, is paramount. Prioritizing only essential developments can reduce pollution stemming from multiple construction activities, highlighting the need for a long-term development strategy.
- Shifting towards electric vehicles (EVs) offers a promising long-term solution to combat smog at both urban and national levels. Replacing conventional urban transport with EV buses and encouraging the integration of EV cars for personal use can significantly reduce emissions. However, the successful implementation of EVs requires meticulous planning. While



- importing EVs or bringing in foreign companies for EV production is a quick step, creating a widespread network of charging stations across the country requires careful estimation and strategic planning. Additionally, assessing the overall energy costs is vital, especially given the rising energy expenses due to the gradual removal of subsidies. Balancing energy demand and affordability will be key to ensuring the viability of this transition.
- Ensuring a regional dialogue takes precedence in all endeavors aimed at addressing transboundary smog concerns. The severity of the smog issue could serve as an opportunity for India and Pakistan to break the deadlock and collaborate on mutual environmental challenges. But the reality is bitter. Politics often strays from justice, swayed by power dynamics. The current right-wing leadership, makes hopes for cooperation, fairness, and justice make it like an unfulfilled dream. However, interference from international environmental organizations and regional economic powers can make this happen.
- Engaging with international support and funding is crucial in addressing the smog problem, particularly in leveraging the potential of carbon credits. Reducing smog in Pakistan offers a valuable opportunity to access carbon credits, which can yield both environmental and economic benefits. By taking significant actions to cut emissions in key sectors like agriculture, industry, and transportation such as curbing crop residue burning, adopting cleaner technologies, and promoting electric vehicles. Pakistan can strategically position itself to earn these credits and attract global support. This could help finance further green initiatives, contribute to improved public health, and foster a sustainable economy.

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# 1 *The Cost of Neglecting the Environment*



## 1.1. *The extent of Problem*

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As air quality is a little better as compared to the smog season both public and people in policy circles think that there is nothing to fix related to environment. As soon as it hits again we will see both mainstream media and social media storming with the smog trends and screaming about the failure of the health system to respond the situation effectively. Taking action now is crucial to prevent a recurrence of these inefficiencies in the next smog season. The pervasive impact of smog continues to significantly affect Pakistan throughout the year, with the exception being the two months of July and August when the monsoon season improves environmental conditions. However, outside of this brief respite, the adverse effects of smog persist, particularly in major urban centers like Lahore, Karachi, Peshawar, and Faisalabad. In 2022, these four cities ranked among the top 20 most polluted cities in the world, underscoring the severity of the issue.

As we noticed in the last smog season that smog problem in Pakistan has escalated intensely, with PM2.5 levels surpassing WHO guidelines by seven times for nearly 60 percent of the population<sup>1</sup>. The gravity of the situation is starkly evident as it has significantly impacted the average lifespan of inhabitants. Initially reduced by 2.7 years, as reported by the National Commission for Human Rights a year ago<sup>2</sup>, the recent alarming findings of the Air Quality Life Index by the University of Chicago have revealed that this lost life span has gone up to 3.9 years in Pakistan. This index also revealed a staggering reduction of 7.5 years in the average lifespan of a Lahore resident<sup>3</sup>.

The right to a healthy environment, including access to clean and breathable air is a fundamental human right. But, it has been persistently violated in Pakistan and as a result we've been entrenched in deteriorating air quality, especially in Lahore, once known as the City of Gardens, now unfortunately labeled as the world's most polluted city. Even Pakistan's largest and most developed city has

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<sup>1</sup> <https://www.aljazeera.com/news/2023/3/14/lahore-most-polluted-city-pakistan-third-among-countries-survey>

<sup>2</sup> <https://www.nchr.gov.pk/wp-content/uploads/2023/06/Annual-Report-2022.pdf>

<sup>3</sup> [https://aqli.epic.uchicago.edu/wp-content/uploads/2023/08/AQLI\\_2023\\_Report-Global.pdf](https://aqli.epic.uchicago.edu/wp-content/uploads/2023/08/AQLI_2023_Report-Global.pdf)

lingered in the top three polluted cities for over several years. Despite this, serious and timely actions to control and alleviate the hazardous impact of smog on citizens' health have been lacking. The government's emphasis on the construction of roads, underpasses, bridges, and similar infrastructure begs the question: What purpose does this development serve if it doesn't contribute to creating cities that are truly livable for their inhabitants? Unfortunately, we've shaped environments that no one desires to inhabit. None of us dreamed of living within the world's most polluted atmospheres. No one wished for their children to be unable to enjoy parks, open fields, confined indoors due to the looming threats to life and health.

This document aims to explore the science behind smog, elucidating its definition, scientific composition, causes, and the severe consequences it poses. Additionally, it will highlight the specific contributions of various sectors to smog formation. Moreover, it will scrutinize the development of policies, legal advancements, and the implementation of these policy measures in detail. Finally, it will propose a future framework with key priority areas aimed at combatting the smog crisis in Pakistan.

## 1.2. The Science of Smog:

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The term "smog" made its debut in the early 20th century, precisely in 1905, coined by H.A. Des Voeux to depict atmospheric conditions prevalent across various British towns. Its usage gained traction in 1911 when Voeux presented a report to the Manchester Conference of the Smoke Abatement League of Great Britain. This report highlighted the tragic occurrence of over 1000 "smoke-fog" related fatalities in Glasgow and Edinburgh during the autumn of 1909<sup>4</sup>.

Smog, essentially an air pollutant, originates from the combination of "smoke" and "fog," often termed as smoky fog. This pollutant primarily comprises two gases: nitrogen oxide and sulfur oxide alongside some less visible pollutants such as carbon monoxide, CFCs, and radioactive sources are also the part of smog.

There exist two main types of smog: sulfurous smog and photochemical smog. Sulfurous smog arises from a notable concentration of sulfur oxides in the atmosphere, predominantly caused by the utilization of sulfur-containing fossil fuels, particularly coal. This variant of smog, also known as "London smog", exacerbated by moisture and a high presence of suspended particulate matter in the air. Smog, akin to air pollution trapped at higher atmospheric levels, can endure as atmospheric brown clouds.

Photochemical smog often labelled as "Los Angeles smog," in contrast, tends to occur conspicuously in urban centers with a significant concentration of automobiles. Unlike sulfurous smog, it doesn't necessitate the presence of smoke or fog. This variation of smog originates from nitrogen oxides and hydrocarbon vapors discharged by vehicles and various other sources. These emissions subsequently undergo photochemical reactions within the lower atmosphere, contributing to the formation of this type of smog. Ozone, a highly toxic gas, forms as a result of the interaction between nitrogen oxides and hydrocarbon vapors under sunlight exposure. Additionally, some nitrogen dioxide is produced through the reaction of nitrogen oxide with sunlight. This resultant smog leads to a light brownish discoloration of the atmosphere, decreased visibility, harm to plants, eye irritation, and respiratory difficulties. Concentrations of ozone at surface levels are deemed unhealthy when they surpass 70 parts per billion for durations of eight hours or more. Such circumstances are frequently observed in urban areas susceptible to the presence of photochemical smog.

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<sup>4</sup> <https://timesagriculture.com/what-is-smog-history-types-causes-impacts-and-measures-complete-overview/>

**Particulate Matter (PM)** basically signifies the size of pollutants present in the air. These pollutants encompass small and medium-sized solid or liquid particles composed of various elements like chemicals, metals, and dust. These particles originate from any burning or combustion, encompassing actions like construction, driving on unpaved roads, and agricultural activities, particles discharged from vehicles, industries, and tobacco smoke.

**PM<sub>2.5</sub>** pollutants consist of smaller particles with a diameter of less than 2.5 micrometers. These tinier particles pose a higher level of danger or hazard as they can penetrate deep into the lungs.

**PM<sub>10</sub>** pollutants range in size from 2.5 to 10 micrometers, making them larger than PM<sub>2.5</sub> particles. However, they're still significantly smaller—25 to 100 times thinner than a human hair. Despite their larger size compared to PM<sub>2.5</sub>, these particles are less hazardous because they typically remain in the nose and throat, unable to penetrate deeper into the lungs due to their size.

*(WHO: The Air Quality Guidelines 2021)*

Figure 1: PM<sub>2.5</sub> OR PM<sub>10</sub>: What does it indicate?

### 1.3. The Multidimensional Cost of Smog:

According to economic theory, there is a correlation between pollution and economic growth, particularly evident in developing countries. When striving for economic advancement, these nations often overlook the negative externality associated with growth, namely pollution, which significantly contributes to issues like smog. This outcome is the result of years of neglect during which economic initiatives prioritized progress without due consideration for the environment. Despite the passage of 75 years, little investment has been directed toward environmental improvement. Presently, the severe repercussions of smog have far-reaching and potentially lethal effects on both human health and the environment, highlighting the urgency of addressing these neglected environmental aspects.

The primary challenge in assessing the impact of smog and pollution on diverse sectors lies in the lack of data. Historically, this sector has faced insufficient funding, and when funds were allocated, they were not utilized to establish comprehensive data inventories for improved Research and Development and evidence-based policy formulation. Nevertheless, the magnitude of the impacts cannot be dismissed.

<sup>5</sup> <https://documents1.worldbank.org/curated/fr/701891468285328404/pdf/890650PUBOClea00Box385269B00PUBLIC0.pdf>

<sup>6</sup> <https://scholar.archive.org/work/gvdjakgarndvlepwyurnoukh5y/access/wayback/https://publie.frontierscienceassociates.com/index.php/pjsm/article/download/92/35>

### 1.3.1. The Impact of Smog on Health:

Pakistan's urban air pollution inflicts some of the most severe impacts in South Asia, surpassing several well-known causes of both mortality and morbidity within the country<sup>5</sup>. The health repercussions of smog stand out as the most significant and evident among these effects. Smog aggravates respiratory problems like asthma and bronchitis, causing wheezing breathing difficulties, chest pain, coughing, and irritation in eyes, the respiratory tract nose and throat infections and allergies. The impacts typically dwindle within a few days post-exposure, yet the particles present in smog can persistently harm the lungs even after the initial irritations fade away. The winter of 2019 has reported that only in Lahore there have been 11 million complaints of burning eyes and headaches, surpassing the usual limit by fivefold<sup>6</sup>. Prolonged exposure to smog has been linked to an increased risk of heart attacks, strokes, and other cardiovascular issues due to the pollutants' impact on the cardiovascular system.

According to WHO's Global Health Observatory, around 200 deaths per 100,000 people in Pakistan are linked to environmental factors. The World Bank estimated that the nation faces a 22,000 premature adult deaths annually due to outdoor air pollution, causing 163,432 lost years of healthy life (Disability-Adjusted Life Years -DALYs). Additionally, indoor pollution results in 40 million cases of acute respiratory infections and 28,000 deaths yearly. The Global Health Observatory estimates show roughly 30 deaths per 100,000 due to indoor air pollution and about 25 deaths per 100,000 due to outdoor air pollution (WHO, 2021). Further, population-weighted exposure to harmful PM is estimate to grow by more than 50 percent by 2030.

The inhalation of smog particles is also associated with premature deaths. These particles contain chemicals like benzene, formaldehyde, and butadiene, all of which consist of cancer-causing carcinogens that contribute to the development of lung cancer. Each year, pollution contributes to approximately 9 million premature deaths worldwide, equating to one in every six deaths globally, comparable to the toll of smoking. Over 90 percent of these fatalities happen in low and middle-income nations. In 2019, the countries recording the highest number of pollution related deaths were India, China, Nigeria, Pakistan, and Indonesia<sup>7</sup>. In addition to this, exposure to smog is closely associated with birth defects and low birth weight in newborns. Pregnant women exposed to smog have experienced cases of birth defects in their babies, including conditions like spina bifida, indicating spinal column malformations, and anencephaly, a condition involving underdevelopment or absence of a part of the brain. Moreover, research indicates that even exposure to as little as 5 µg of smog particulate matter can elevate the risk of delivering babies with very low birth weights. Further, extended periods of heavy smog obstruct UV rays from reaching the Earth's surface. This impedes the production of Vitamin D, potentially leading to conditions like rickets due to compromised metabolism of calcium and phosphorus in the bone structure.

Smog reduces visibility, leading to hazardous driving conditions and an increased risk of accidents on roads. The higher frequency of winter smog events severely affects the everyday lives of millions of people in the form of traffic delays, poor visibility, and disturbed daily routines<sup>8</sup>.

### 1.3.2. The Impact of Smog on Agri-Food System:

Smog harms plants, crops, and ecosystems. It can stunt plant growth, reduce crop yields, and harm wildlife, disrupting ecological balance. The effects of smog on the agri-food system are most obvious in the form of reduced yields and a study has documented the staple crop losses of approximately

<sup>7</sup> [https://www.thelancet.com/journals/lanph/article/PIIS2542-5196\(22\)00090-0/fulltext](https://www.thelancet.com/journals/lanph/article/PIIS2542-5196(22)00090-0/fulltext)

<sup>8</sup> <https://www.mdpi.com/2073-4433/12/11/1532#B34-atmosphere-12-01532>

<sup>9</sup> <https://www.ccacoalition.org/content/air-pollution-measures-asia-and-pacific>

<sup>10</sup> [https://nbrienvi.nic.in/Database/1\\_2051.aspx](https://nbrienvi.nic.in/Database/1_2051.aspx)

5-20 percent in maize, rice, soy, and wheat in the region. Black carbon also has an intense localized negative impact on plant productivity by limiting photosynthesis and increasing plant surface temperatures<sup>9</sup>.

The exposure of crops and vegetables to smog compromises their natural defenses against infections, making them more susceptible to diseases. Consequently, this impedes the growth of plants, resulting in significant damage to crops, trees, and overall vegetation, leading to lower yields and less healthy, nutritious food. A research by the University of California has confirmed that the estimated loss to plant growth is about 10-40 percent due to smog<sup>10</sup>. Further Smog in the natural environment pose challenges for animals, impeding their ability to adapt or thrive in toxic conditions. This can result in the loss of numerous animal species or render them more susceptible to illnesses<sup>11&12</sup>.

### **1.3.3. The Economic Cost of Smog:**

As per the World Bank's research, the calculated impact of air quality issues amounts to 5.88 percent of the annual GDP, totaling 47.8 billion USD. It's further estimated that each unit of PM2.5 results in a loss of 18.9 US dollars in GDP per capita. Diminished productivity from sickness and missed work, rising healthcare expenses encompassing medication and check-up fees, reduced work output, lost workdays, and costs linked to preventive measures all pose enduring threats to economic growth and advancement.

### **1.3.4. The Social Costs of Smog:**

The extensive and diverse social costs underscore the multifaceted and far-reaching impacts of smog on communities and the overall well-being of society. Children, in particular, bear the brunt, experiencing disruptions in education and physical activities due to school closures and limited outdoor playtime. The smog's adverse effects have transformed social interactions and outdoor exposure into health hazards, particularly notable in Lahore. Additionally, engaging in physical exercises outdoors poses health risks due to the persistent smog.

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<sup>11</sup> <https://oizom.com/effect-of-air-pollution-on-plants-and-animals/>

<sup>12</sup> <https://www.pranaair.com/blog/effect-of-air-pollution-on-plants-and-animals/>

<sup>13</sup> <http://www.gcisc.org.pk/R-SMOG-Report.pdf>

## 2 Causes of Smog: Sectoral Contributions



There are several factors which contribute to the emergence of the fifth season (smog season) in Lahore and Punjab. These are vehicle emissions, industrial pollutants, emissions from brick kilns, burning of crop residue and waste, urban development affecting green spaces, pollutions from construction activities and factors transcending borders.

### 2.1. Sectoral Contributions in Punjab

The initial evidence on sectoral contribution to smog was presented by the FAO through the project "Remote Sensing for Spatio-Temporal Mapping of Smog"<sup>13</sup> commissioned by the Punjab Government. This report was unveiled in February 2019. Transport sector stands as the primary contributor to smog, accounting for approximately 43 percent of the pollution, followed by the industrial sector at 25 percent, agriculture contributing 20 percent and power sector contributing 12 percent to the smog crisis in Punjab province (Figure 3).

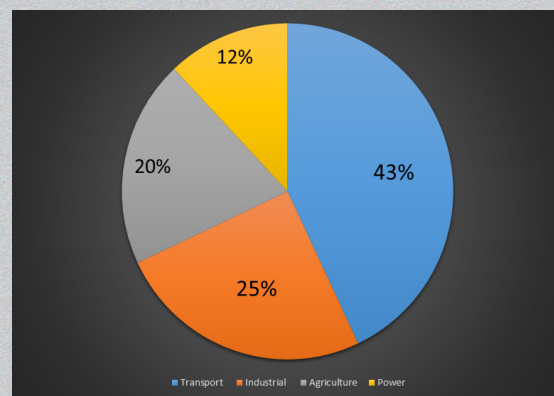


Figure 3: Smog: Sectoral Contribution in Punjab (FAO, 2019)

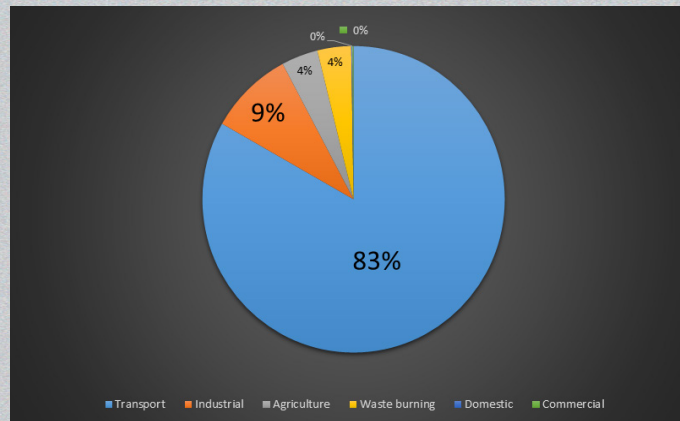
Data Source: FAO

<sup>14</sup> <https://www.urbanunit.gov.pk/Download/publications/Files/8/2023/Emission%20Inventory%20of%20Lahore%202023.pdf>

## 2.2. Sectoral Contributions in Lahore

Despite the pressing severity of the issue and the WHO's recommendations, Lahore lacks real-time air quality monitoring systems. Presently, only two such systems are operational; one at Al-Jazari Academy of Urban Unit in Township and another at the US Consulate office in Shimla Pahari. These systems monitor the average concentration of PM2.5. In 2022, the yearly average concentration of PM2.5 was recorded at 129.3 µg/m<sup>3</sup> at the US Consulate and 147.8 µg/m<sup>3</sup> at Al-Jazari Academy, signifying unhealthy to very unhealthy air quality. These concentrations exceed the annual average limits by 9-10 times, which stand at 15 µg/m<sup>3</sup>. Air quality data obtained from the Copernicus Atmospheric Monitoring Services (CAMS) Portal for 2011-2021 consistently categorizes Lahore's air quality as Unhealthy and Very Unhealthy based on the AQI categories defined by the Punjab EPA over the past decade<sup>14</sup>.

The Sectoral Emissions Inventory of Lahore is the first district-scale attempt to measure atmospheric pollutants from human activities across six developmental sectors. Each sector's emissions are intricately examined: the transport sector's emissions are calculated based on the count of registered vehicles in Lahore, industrial emissions stem from fuel consumption, crop residue burning is assessed according to the area under rice cultivation, waste burning emissions are determined by the proportion of waste burnt, and fuel consumption in commercial and domestic sectors is considered as well. In the breakdown of sectoral contributions to Lahore's smog crisis, the transport sector emerges as the dominant contributor, holding an 83 percent share in the issue (Figure 4). Following closely is industrial emissions, making up 9 percent of the problem, trailed by agriculture through crop residue burning and open waste burning, each contributing 4 percent to the overall situation.



**Figure 4 Smog: Sectoral Contribution in Lahore (Urban Unit, 2011-21)**

Data Source: Urban Unit, 2011-21



## 2.3. The Detailed Sectoral Inquiry

A thorough sectoral investigation focuses on the two primary contributors to smog: the transportation sector and the agricultural sector. So, here we dive into specifics for these sectors only. We focus on these sectors because the transport sector is clearly the top contributor, while the agriculture sector is believed to contribute significantly, particularly through stubble burning on a large scale under rice crops and emissions from rice burning beyond the borders.

### 2.3.1. Transport Sector:

Higher emissions stem primarily from three factors: the sheer volume of vehicles on the roads, followed by congestion, and lastly, poorly maintained engines.

Looking at the total count of registered vehicles in Lahore, they are skyrocketed by 204 percent between 2011 and 2021. The total number surged from 2.39 million in 2011 to 7.3 million in 2024 (GoP, 2024)<sup>15</sup>, marking an exceptionally rapid rate of increase. Consequently, emissions have escalated at a similar pace. However, these figures might not be entirely precise since a significant number of vehicles used in Punjab are registered in Lahore usually. Despite this, the increase remains notably high. The substantial rise in the total number of vehicles primarily consists of bikes, scooters, and auto-rickshaws, which are predominantly two-stroke vehicles.

The significant influx of cars, notably second-hand imported vehicles, often unsuitable for local conditions, amplifies emissions. Moreover, the proliferation of online taxi services like Uber, Careem, In-Drive, Yango, Bykea etc. since their introduction in 2017 has swelled the number of vehicles on roads. This not only increased the number of vehicles on roads

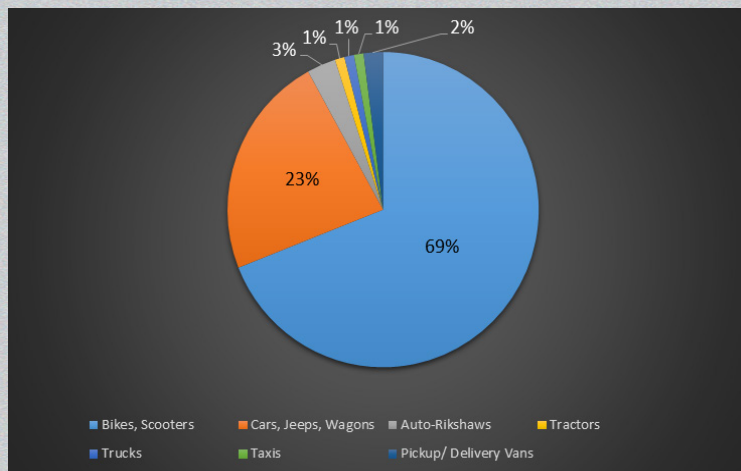
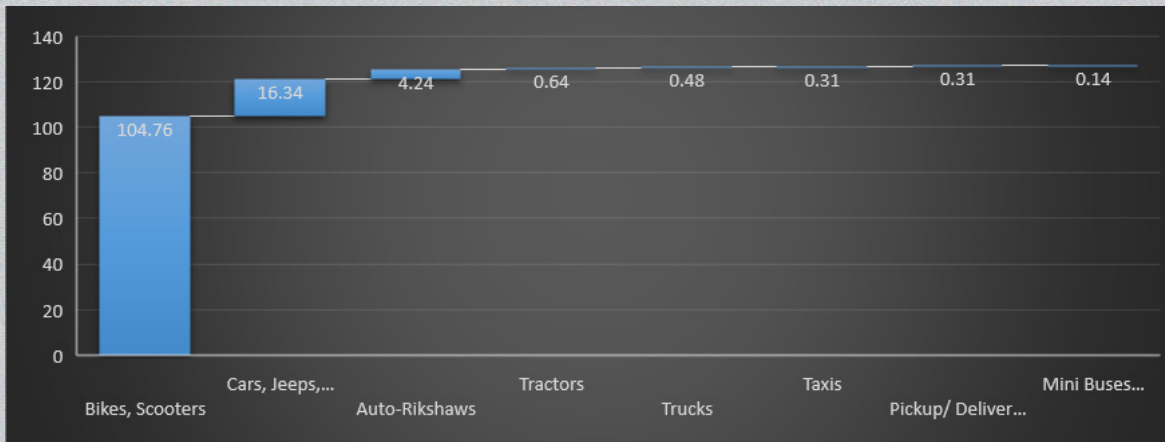


Figure 5 Category Share in total Vehicales

<sup>15</sup> <https://excise.punjab.gov.pk/system/files/TOTAL.pdf>

but the cumulative time on roads too due to nature of business. Online delivery services also expanded very briskly in the urban centers. This also results in increased congestion on roads. Hence, this surge heightened fuel consumption and consequently, increased emissions. Additionally, the prevalence of poor-quality fuel alongside the prevalence of older vehicles, two-stroke motorcycles, and auto-rickshaws significantly contributes to the substantial vehicular emissions.



**Figure 6 Emissions w.r.t Vehicular Category in Lahore**

Here are the consequences of the overlooked vehicle emissions standards, neglected within policy documents aimed at discouraging polluting vehicles on the roads. Vehicles with two-stroke engines like motorbikes and auto-rickshaws significantly contribute (69 percent) to PM<sub>2.5</sub>, especially in Lahore due to large in number (Figure 5). Although the PM<sub>2.5</sub> emission from trucks are large but due to smaller in number it don't appear as big contributor. Trucks represent less than 1 percent in numbers, their contribution to PM<sub>2.5</sub> is as high as 30 percent.

The fuel quality standard was also one of leading contributing factor in smog as Euro-2 standard fuel was in use since 1992, which was upgraded to Euro 5 in 2019. It was reported that the market share of Euro 5 is almost 70 percent. The fuel refined in Pakistan was also upgraded to Euro-5 by NRL which have almost 10 percent share in market. Switching from Euro-2 to Euro-5 fuel quality reduces emissions by nearly 60 percent. Nevertheless, a pivotal question arises regarding the efficacy of this transition in alleviating smog effects in Pakistan. Despite a decline in smog levels post-2017 and 2018 peaks, this reduction may have been influenced by the lockdowns during the COVID-19 pandemic in 2019 and 2020. The resurgence in smog concentration since 2021 and 2022 raises uncertainty about the true impact of enhancing fuel quality. Therefore, for more informed and evidence-based planning, there is an urgent need to reevaluate and quantify the contribution of each aspect within the overall transport sector to smog. However, the effectiveness of improving refining standards may be limited without simultaneously prioritizing vehicle emission standards

<sup>16</sup> <https://epd.punjab.gov.pk/system/files/Report%202022-hi-res%20%284%29.pdf>

<sup>17</sup> [https://epd.punjab.gov.pk/system/files/Policy%20on%20Controlling%20Smog%20%28Final%29\\_0.pdf](https://epd.punjab.gov.pk/system/files/Policy%20on%20Controlling%20Smog%20%28Final%29_0.pdf)

<sup>18</sup> [https://epd.punjab.gov.pk/index.php/system/files/SMOG-Regulation\\_compressed\\_0.pdf](https://epd.punjab.gov.pk/index.php/system/files/SMOG-Regulation_compressed_0.pdf)

## 2.3.2. Agriculture Sector:

There's a continuous debate that burning rice crop residue in Punjab is the primary contributor to smog. Every year, policymakers shift all the responsibility to farmers. In addition to policymakers, urban residents also attribute the emergence of smog to the burning of rice stubbles in Punjab. But, evidence have confirm that rice stubble burning in the rice-wheat belt of the Punjab is the third main contributor to the Smog.

Here, a question arises: why do farmers continue to burn this biomass? Apparently, they burn rice stubble due to its perceived cost-effectiveness and quick land clearance for the next crop. It's a well-known fact that farmers face multiple issues due to price distortions in both input and output markets. In the output market, they are forced to sell their crop even at a lower price than the government-announced price. At this time, when they are dealing with the output market distortions, they have to prepare land for the next crop.

At the land preparation stage, they deal with the input market issues. For instance, fertilizer prices always shoot up when they are needed the most. The practice of black marketing takes input prices at alarmingly high levels. This increases the cost of production of the next crop, while they earn less profit on the previous crop.

In this scenario, they opt for this quick and cost-effective land clearance mechanism. The social cost of this crop residue burning includes environmental and health impacts, as well as a reduction in soil nutrients for subsequent crops, which offsets the momentary benefits to the farmers.

The government targeted the stubble burning problem by providing 500 machines to farmers at an 80 percent subsidy in 2021. There were plans to expand this initiative to 5000 machines the following year, but unfortunately, no progress has been observed. Interestingly, the cost of implementing or expanding this scheme would be less than constructing a flyover or underpass. However, it seems this initiative lacks priority once more.

Addressing smog necessitates<sup>19</sup> distinct priorities and frameworks for both Lahore district and the broader rice-wheat belt of Punjab province. The expansion of rice cultivation and the consequent rise in stubble burning in India also severely impact our environment, contributing to the smog, calling a comprehensive strategic regional efforts to combat the consequences of smog.

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<sup>19</sup> <https://epi.yale.edu/>

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### 3 ***Threats across the Borders: Tackling Transboundary Environmental Injustice***



Transboundary concerns are critical as smog doesn't adhere to passports, visas, or permissions to infiltrate the air. The expansion of rice cultivation and the consequent rise in stubble burning in India severely impacts Pakistan by contributing worryingly to smog, making our environment less livable. This is calling a comprehensive strategic regional efforts to combat the consequences of transboundary smog.

The evidence supporting Pakistan as a victim of environmental injustice in the context of smog is really convincing and robust. India holds the highest count of polluted cities globally. Between 2017 and 2021, thirty-five out of the fifty most polluted cities worldwide were from India. A report published by NASA underscored 80 percent of crop burning hotspots in Indian Punjab, notably in Haryana contributed to the smog in Lahore due to the shifting effluence. Further, the Borlaug Institute for South Asia (BISA) has disclosed that approximately 23 million tonnes of rice residue are burned annually in Haryana, Punjab, and Western Uttar Pradesh. This practice significantly contributes to air pollution. Hence, Pakistan is presenting the true example of "tragedy of global common". Consequently, the efforts to curb emissions in Pakistan have shown limited impact, highlighting that addressing the smog issue requires a collaborative approach rather than isolated solutions or conventional unilateral approaches.

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<sup>1</sup> <https://www.aljazeera.com/news/2023/3/14/lahore-most-polluted-city-pakistan-third-among-countries-survey>

<sup>2</sup> <https://www.nchr.gov.pk/wp-content/uploads/2023/06/Annual-Report-2022.pdf>

<sup>3</sup> [https://aqli.epic.uchicago.edu/wp-content/uploads/2023/08/AQLI\\_2023\\_Report-Global.pdf](https://aqli.epic.uchicago.edu/wp-content/uploads/2023/08/AQLI_2023_Report-Global.pdf)

Without any doubt, collaborative efforts among Pakistan and India are vital to tackle the transboundary issues of smog as it is driving a heavy load on the public health and on the economy of both of the countries. As per a World Bank report, air pollution costs Pakistan roughly 5.88% of its GDP annually, while in India, it accounts for approximately 8.5% of its GDP. It necessitates the formation of agreements for collective efforts, implementing a shared system to track air quality across borders which aids in understanding sources of smog and their relative impacts and harmonizing the environmental regulations for emission standards and practices. The investment in shared advanced pollution control technology and public engagement in emission reduction initiatives is the need of the hour.

International environmental norms, established notably during the 1992 Rio Earth Summit, emphasize the principle of common responsibility with differentiated roles. This means all states share the duty to protect the environment and curb carbon emissions, with those who contribute more should shoulder a greater responsibility. International Law also prohibits activities causing harm to other countries hence, building a strong case to apply this principle to transboundary air pollution in the subcontinent. Besides sub-continent, the Trail Smelter Case (USA versus Canada) underlines that a state cannot permit activities on its land that jeopardize life or property in another state according to International Environmental Law. Instances like the Singapore-Malaysia haze issue, where Indonesia's burning of palm trees affected neighboring countries, illustrates the importance of collective actions all around the world at least, when it comes to environment related issues.

To tackle the issue of air pollution in South Asia a joint regional framework is an urgent requirement. If applied with full might and main does such a regional framework will reduce the emission in affected countries, the answer is yes certainly. Pakistan already emphasized the necessity for bilateral discussions on air pollution and smog during the COP-26 platform in 2021 and still wants the issue to be resolved for the sake of our next generations. Pakistan also proposed hosting a regional conference focused on transboundary air pollution and smog in accordance with The Male Declaration, 1998. However, when considering Indo-Pak relations, it becomes a unique case, demanding a thorough examination of practical opportunities for a collaborative framework.

Before proceeding further, let's assess the effectiveness and drawbacks of the Male Declaration. This declaration emphasized the necessity for regional collaboration in managing transboundary air pollution. But the country's thirst for economic growth without considering the environment never let it implement earnestly and consequently, its goals remained unfulfilled. Regrettably, the recurring smog incidents in South Asia vividly illustrate the limitations of this agreement. The current air quality crisis emphasizes the urgent need to overhaul this framework, potentially under the guidance and support of organizations like ICIMOD and SAARC. The shared limitations among South Asian nations, specially the lack of monitoring facility and resources, still persist. Unlike China, that can independently address its issues without extensive cooperation with neighbors, South Asian countries face challenges in doing so. Therefore, the revitalization of this declaration considering new requirements should serve as a bridge, aiming to alleviate any geopolitical tensions and foster cooperation.

The severity of the smog issue could serve as an opportunity for India and Pakistan to break the deadlock and collaborate on mutual environmental challenges. But the reality is bitter. Politics often strays from justice, swayed by power dynamics. The current right-wing leadership, makes hopes for cooperation, fairness, and justice make it like an unfulfilled dream. Further, Economic disparities between Pakistan and India further diminish prospects for collaboration. The sabotage of the Indus Water Treaty and recent violations of International Law regarding Kashmir restrict the options to see a regional cooperation in the prospects. However, interference from international environment organizations and regional economic powers can make this happen.

## 4 **Legislation and Implementation: Regulatory Setup**



The efforts for air quality management in Pakistan were transformed into a proper framework in 1993 with the formulation of the National Environmental Quality Standards (NEQS) under the 1983 Environmental Protection Ordinance. By December 1999, the Pakistan Environmental Protection Council (PEPC) endorsed a revised version of the NEQS, which became effective in August 2000. However, the foundational legislation for environmental matters in Pakistan is the Pakistan Environmental Protection Act (PEPA), passed on December 6, 1997. It offers a wide-ranging framework for the supervision and regulation of environmental protection. The Pakistan Environmental Protection Agency (EPA) established ambient air quality standards nationwide, initially planned to take effect on January 1, 2012. These standards were later adopted by the Environment Protection Department, Punjab, in 2016<sup>16</sup>.

The Punjab government, through the Environmental Protection Agency (EPA), responded to the smog issue by introducing a smog policy in 2017<sup>17</sup>. This policy aimed to combat air pollution and smog through regulations focused on waste management and environment-friendly, low-sulfur fuels. The updated environmental policy of 2020 also underscores the significance of addressing polluted air concerns. The Smog Rules of 2023 introduce stringent penalties for activities that notably contribute to pollution, emphasizing the severity of consequences for such actions. However, the challenge lies in effectively enforcing these laws and regulations<sup>18</sup>.

The following figure provides details of all the policy initiatives implemented over the past three decades.

<sup>16</sup> <https://epd.punjab.gov.pk/system/files/Report%202022-hi-res%20%284%29.pdf>

<sup>17</sup> [https://epd.punjab.gov.pk/system/files/Policy%20on%20Controlling%20Smog%20%28Final%29\\_0.pdf](https://epd.punjab.gov.pk/system/files/Policy%20on%20Controlling%20Smog%20%28Final%29_0.pdf)

<sup>18</sup> [https://epd.punjab.gov.pk/index.php/system/files/SMOG-Regulation\\_compressed\\_0.pdf](https://epd.punjab.gov.pk/index.php/system/files/SMOG-Regulation_compressed_0.pdf)

**Figure 7: Policy Initiatives over the Past Three Decades**

Year	Policy/Initiative
1993	National Environmental Quality Standards (NEQS)
1997	Environmental Protection Act
1997	Punjab Environmental Protection Act
2000	National Environmental Quality Standards - Revised
2017	Punjab Smog Policy and Action Plan
2018	Punjab Clean Air Action Plan
2018	Punjab Green Development Program
2021	Punjab Smog Control Ordinance
2022	Punjab Environmental Protection Act (Amendment)
2023	National Clean Air Policy (NCAP)

### 4.1.1 The Role of Key Stakeholders:

The absence of a centralized coordinating body capable of overseeing these multifaceted responsibilities is a glaring gap in the current system. This deficiency becomes particularly evident during the peak of smog season, where emergency meetings and broad discussions yield little to no tangible results. The environment remains unchanged, primarily due to the lack of quantified, clear targets and indicators to guide actions.

Addressing administrative delays and bureaucratic inefficiencies is critical to achieving effective planning and execution. The fragmented nature of departmental operations, where responsibilities are unclear and agencies often work in isolation, underscores the need for enhanced coordination among essential stakeholders. Furthermore, the lack of seamless collaboration between provincial and federal governments exacerbates these inefficiencies. For instance, while oil products fall under federal jurisdiction, vehicle emission standards are regulated by provincial bodies like the Engineering Development Board, etc. Another example is the forest department, which is not permitted to operate within urban boundaries.

Before proceeding, it is crucial to examine the stakeholders involved in managing the smog crisis in Punjab. These key players include the Environment Protection Department, Transport Department, Industrial Department, Agriculture Department, Meteorology Department, Disaster Management Authority, Forest Department, media, NGOs, and, importantly, the public. The roles and responsibilities of these stakeholders are detailed in figure 8.

**Figure 8: The Role and Responsibilities of Key Stakeholders**

Key Stakeholders	Responsibilities
<b>Environmental Protection and Climate Change Department</b>	<p>The primary responsibility of this department is to reduce or control the pollution by</p> <p>Maintaining and expanding the scale of environmental monitoring through environmental monitoring stations and laboratories and finally collecting and disseminating the information</p> <p>Issuing advisories and offering guidance to different sectors, departments and industries, and pertinent population segments to align the efforts for more effective planning</p> <p>Establishing, updating, and upholding environmental laws and benchmarks, monitoring pollutants, and implementing penalties for violations.</p> <p>Handling and resolving issues and feedback from the public</p>
<b>Transport Department</b>	Managing vehicle records, encouraging improved vehicle standards and cleaner fuel sources, enhancing vehicle fitness criteria and testing, and offering incentives to promote these advancements
<b>Industrial Department</b>	<p>Seeking eco-friendly methods and technologies for cleaner production to keep the environment clean and safeguard the health conditions of surroundings, Take it as corporate social responsibility</p> <p>Compliance with standards</p> <p>Collaborating with EP&amp;CCD, and engaging other stakeholders for coordinated efforts</p>
<b>Agriculture Department</b>	<p>Incentivize the provision of better technologies to avoid agricultural residue burning</p> <p>Promoting awareness about the advantageous utilization of crop residues, such as using them as mulch, and animal feed, and exploring their value-added products for bio-energy purposes. Encouraging incentives for these alternatives rather than relying solely on policies that involve bans and arrests related to crop residue burning</p>
<b>Health Department</b>	Issuing health advisories based on comprehensive data collected, encompassing spatial and temporal trends along with disease categorization. Training healthcare personnel and establishing emergency response protocols and facilities.
<b>Disaster Management Authority</b>	Its temporary role till smog declared as calamity, afterwards EP&CCD will take over the lead role
<b>Meteorology Department</b>	<p>Forecasting and early warning</p> <p>Disseminating information to relevant agencies and identifying hotspots</p>
<b>Academia</b>	Identifying policy success and failure, providing alternatives, and informing the public
<b>PHA and Forest Departments</b>	To enhance the green cover and plant trees
<b>NGO's</b>	Raising awareness and serving underprivileged communities by building resilience in a community
<b>Media</b>	Informing and guiding the public through the dissemination and publication of accurate information regarding health and administrative matters
<b>Public</b>	<p>Individual steps to keep the environment clean and green, especially household waste management</p> <p>Tree plantation and kitchen gardening</p>
<b>Education Department</b>	Raising awareness through engaging activities involving children for a better and greener environment.



Despite having numerous departments assigned various responsibilities, the collective impact remains significantly lacking. Pakistan ranks 179<sup>th</sup> out of 180 countries in the 2024 Environmental Performance Index, highlighting the severity of the situation<sup>19</sup>. The government's promise to support farmers by providing machinery at subsidized rates has not materialized, leading to continued crop burning and high emissions. The Punjab government's efforts to crack down on brick kilns, industries, and smoke-emitting vehicles through hefty fines are often ineffective, merely addressing symptoms without tackling the root cause. Many industry owners go undetected or continue to emit harmful smoke even after paying fines. Although zigzag technology for brick kilns was introduced for 10,000 units in 2021, proper monitoring has been lacking. Expedited implementation and monitoring of this technology could be achieved through digital systems under the District Coordination Office (DCO) and Environmental Protection Agency (EPA) for faster execution.

Further, the smog policy targeted adopting eco-friendly low-sulfur fuels, necessitating action on two fronts: establishing new contracts with international suppliers and prompting local refineries to adapt. Local refineries resist this shift due to the substantial investment needed to upgrade existing facilities. To facilitate this transition, implementing a more enticing incentive structure could be beneficial. Yet, successful implementation relies heavily on robust enforcement and monitoring, often overlooked or lacking on the regulatory side. Strengthening these aspects is critical for policy success. Conclusively, all the issues demand coordinated efforts from all stakeholders.

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## 5 Key Insights Learned Globally in Addressing Smog



The transport sector is the primary contributor, with the agriculture sector also playing a significant role, particularly due to large-scale stubble burning in rice fields and emissions from rice burning that extend beyond borders. Here, we summarize global approaches to addressing smog in these two sectors specifically.

### 5.1. European Union:

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The European Environment Agency records that roughly 75% of the EU's urban populace faces heightened PM<sub>2.5</sub> levels. In Poland, an estimated 47,500 premature deaths occur annually due to air quality concerns. Among different instances where environmental quality standards were surpassed, 64 percent are linked to road traffic emissions, the leading cause of NO<sub>2</sub> exceedances, while domestic heating contributes 14 percent to these emissions<sup>20</sup>.

Between 2014 and 2020, 944 air quality plans were developed (59% were reported to have been implemented), primarily aiming to protect health by reducing nitrogen dioxide (NO<sub>2</sub>) and larger particulate matter levels. These plans heavily prioritize measures in the transport sector, accounting for over two-thirds of the outlined actions, while only 12 percent are allocated to address concerns related to commercial and residential energy sectors, particularly linked to domestic heating.

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<sup>20</sup> <https://www.cleanairfund.org/geography/europe/>

## Transport Sector:

- Traffic planning and management was the top priority (39 percent of total measures), with a substantial focus on enhancing public transport to lower concentrations of pollutants.
- Frequently reported actions encompassed parking space management, speed limits, low-emission zones, and transport mode shifts.
- Around 19 percent of the measures prioritized public education through various media channels.
- 14 percent measures targeted the adoption of low-emission fuels for stationary and mobile sources across different scales.
- The implementation of all measures varied in administrative authority: 86 percent were managed locally, 11 percent regionally, and a mere 3 percent nationally<sup>21</sup>.

## Agriculture Sector:

Agriculture contributes to roughly 93 percent of total ammonia emissions in the EU, primarily associated with livestock farming and the use of synthetic nitrogen fertilizers, particularly urea. These emissions can lead to water eutrophication and soil acidification. Methane, produced during enteric fermentation in livestock, serves as a precursor to ground-level ozone formation, which can harm crops. Additionally, particulate matter like PM10 originates from burning biomass residues and forest fires. Hence, The EU utilizes the Common Agricultural Policy (CAP) to align agricultural practices with the EU's clean air policies, encompassing the objectives outlined in the Clean Air Programme for Europe and the commitments established in National Air Pollution Control Programmes (NAPCP).

- The support measures under the CAP encourage voluntary farming practices like incorporating inorganic nitrogen fertilizers directly into the soil and injecting liquid manure to minimize ammonia volatilization.
- Financial aid is directed towards installations such as manure storage, stables sealing, and air washers to reduce ammonia emissions.
- Investments in biogas installations aid in mitigating both ammonia and methane emissions.
- Knowledge transfer, advisory services, and training initiatives aim to raise awareness among farmers about emission issues and assist in developing practical solutions<sup>22</sup>.

## 5.2. United Kingdom:

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Despite various efforts to maintain clean and breathable air, the UK still surpasses WHO limits, primarily due to nitrogen dioxide (NO<sub>2</sub>) from vehicular emissions. Outdoor pollutants contribute to approximately 40,000 premature deaths annually, costing the UK economy around 25 billion USD each year. In 2019, the UK's average national exposure, weighted by population, exceeded the WHO's recommended limit, reaching an average of 10.5 µg/m<sup>3</sup>.

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## Transport Section:

To address traffic-related nitrogen emissions,

- UK has prioritized cycling and walking, outlined in a published investment strategy allocating an estimated £1.2 billion.
- A strong emphasis on Ultra-Low Emission Vehicles, with nearly £100 million invested in charging infrastructure and funding granted through programs like the Plug-in Car and Plug-In Van Grant Schemes.
- The Green Bus Fund was initiated, aiding bus companies and local authorities in introducing over 1,200 new low-carbon buses.
- The Clean Bus Technology Fund and Clean Vehicle Technology Fund were initiated aiming to retrofit nearly 3,000 older vehicles from 2016 to 2021.

## Agriculture Sector:

In mitigating emissions from the agricultural sector, the UK's approach involves

- Transitioning away from urea-based fertilizers toward ammonium nitrate.
- Concentrating on livestock management by employing qualified nutritionists to create tailored rations for cattle, considering factors such as breed, gender, production stage, and available feed quality on the farm. Recognizing the significance of dairy and beef sector management concerning NO<sub>2</sub> emissions, they prioritize this aspect as well.

## 5.3. Australia:

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Australia, witnessing nearly 5,000 annual deaths due to air pollution, faces widespread health issues like stroke, heart disease, and asthma. Additionally, coal ash disposal poses risks to local communities by potentially contaminating land and waterways. Toxic air pollution from New South Wales' five state-owned coal-fired power stations leads to approximately 279 premature deaths annually, alongside adverse health impacts including reduced birth weight in 233 babies, 361 cases of type 2 diabetes, and the loss of 2,614 years of life yearly. The Australian government revamped its approach to air quality data presentation, now reporting hourly averages of PM<sub>10</sub> and PM<sub>2.5</sub> instead of 24-hour averages.

## Transport Section:

To reduce the emissions from the transport sector, the key focus is as following:

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<sup>21</sup> <https://www.eea.europa.eu/publications/managing-air-quality-in-europe>

<sup>22</sup> [https://agriculture.ec.europa.eu/sustainability/environmental-sustainability/natural-resources/clean-air\\_en](https://agriculture.ec.europa.eu/sustainability/environmental-sustainability/natural-resources/clean-air_en)

- Implementing new policies aims at decreasing road traffic by enhancing pedestrian and cycle paths, expanding public transport, and introducing congestion taxes.
- Encouraging a swift transition to low-emission vehicles, particularly electric ones, is another focal point.
- Enhancing fuel efficiency, fuel quality, and emission standards, along with phasing out diesel vehicles, constitutes part of this strategy.
- Government and public transport vehicles will be restricted to non-fossil-fuel usage.
- Measures to avoid constructing educational and healthcare facilities near traffic-congested areas.
- Implementing stricter emission controls for local shipping and regulating off-road vehicle emissions.

## 5.4. India:

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Most Indian cities face poor air quality, notably high PM<sub>2.5</sub> levels, likewise Lahore. But the situation of smog is more severe in India as 39 of the world's 50 most polluted cities are in India<sup>23</sup>. Factors like rapid urbanization, surging vehicle numbers, inadequate waste management infrastructure, and agricultural/biomass burning exacerbate urban air quality issues. Currently, approximately 80 percent of the urban population is exposed to air quality below the standards set by India's Central Pollution Control Board and WHO.

### Transport Sector:

The Auto Fuel Policy of 2002 in India laid out the trajectory for advanced vehicular emissions and fuel quality norms, transitioning from BS-I to BS-IV by 2010. In 2016, the Government announced a leap to BS-VI vehicle emissions nationwide by 2020, skipping BS-V. The significant distinction between BS-IV and upcoming BS-VI norms lies in sulfur content in the fuel: while BS-IV fuels contain 50 ppm sulfur, BS-VI fuels only contain 10 ppm sulfur. Once BS-VI norms are implemented, cars are expected to show an 82 percent reduction in PM emissions and a 68 percent reduction in NO<sub>x</sub> emissions.

- Enforcing legislation favoring cleaner fuels in vehicles, industries, etc.
- Real-time monitoring of emissions, and mandating high-efficiency control devices.
- Enhancements in vehicular inspection using remote sensing technology
- Augmenting electric transportation and especially electric public transport, and installing charging infrastructure.
- A push for LPG usage, providing 2 free cylinders to the impoverished in winter. At the state level, incentives for fleet modernization and penalties for unregistered, polluting vehicles are proposed.
- An awareness campaign encourages non-motorized transport for short distances in the city and advocates for designated non-motorized lanes where feasible.

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<sup>23</sup> <https://indianexpress.com/article/india/iqair-report-indian-worlds-most-polluted-cities-39-8498146/#:~:text=Other%20cities%20that%20dominated%20the,Meerut%2C%20Hisar%20and%20Greater%20Noida.>

<sup>24</sup> <https://journals.sagepub.com/doi/10.1177/00195561221149934>

## Agriculture Sector:

The predominant policy approach in India toward stubble burning has been punitive, involving fines and imprisonment for farmers engaging in this practice. However, this approach has proven ineffective and even counterproductive. These measures, categorized under Section 188 of the Indian Penal Code and the Air Pollution Control Act of 1981, failed to address the issue and instead created animosity between farmers and the government. Farmers perceive these penalties as indications of an unsympathetic government that disregards their needs and fosters a sense of division between them and the state<sup>24</sup>.

- Punjab and Haryana attempted to discourage stubble burning by offering financial incentives of ₹100 per quintal, approximately ₹2,500 per acre, to cover machinery costs and prevent the practice. However, challenges arose due to funding disputes between the Central and State governments. The Centre rejected Punjab's request for additional funds due to resource constraints. A plan proposed to the Supreme Court suggests that if incentives are deemed necessary, states should independently finance them. There's also debate on whether these funds might be better allocated to subsidize machinery or support scientific research to address stubble burning, rather than short-term farmer incentives, given the limited availability of funds.
- Technological solutions to address stubble burning have been significantly advocated, with an emphasis on machinery. Machines like the Super Straw Management System (Super SMS), Rotavator, Happy Seeder, and Zero Till Seed Drill have been proposed for this purpose.
- The adoption of machines to tackle stubble burning faces several challenges. Despite a 50 percent government subsidy, these machines remain prohibitively expensive for most farmers. Even cooperative societies, which receive an 80 percent subsidy, struggle with the affordability of these machines. Additionally, it has been observed that subsidized machines available through government outlets or registered manufacturers are more expensive than

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## 6 Conclusions

*Smog is a critical issue that imposes significant health, social, and economic costs on society.*

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*The transport sector is leading contributor of smog in Punjab and Lahore while industrial, and agricultural sectors are other major contributors to this problem.*

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*Although legal frameworks, plans and policies have been developed over time, their effective implementation remains a major challenge.*

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*A lack of coordination among key stakeholders further exacerbates the inefficiency in addressing environmental degradation.*

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*Despite efforts, Pakistan has yet to fully transition to Euro-5 fuel standards. However, even a complete shift to Euro-5 is unlikely to bring significant improvements in emission reduction. A more impactful solution would be transitioning to Euro-6 standards, which offer stricter regulations on pollutants such as nitrogen oxides and particulate matter. Euro-6 fuel significantly lowers harmful emissions from vehicles, making it a crucial step in addressing urban air pollution. Adopting Euro-6, alongside complementary measures like vehicle maintenance and emission testing, could lead to far greater improvements in air quality.*

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*Pakistan should reassess the roles of federal and provincial governments in addressing smog, particularly concerning fuel standardization. Currently, decisions regarding fuel quality fall under federal jurisdiction, while other related decisions are handled at the provincial level. The government should either grant provinces the authority to set fuel prices and standards according to their specific needs or ensure that the federal government takes this issue seriously by strictly moving to Euro-6 fuel quality across the country.*

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*Several countries have made significant progress by enforcing stringent rules and ensuring their implementation, an approach that Punjab should consider adopting.*

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*When presenting the agriculture sector or farmers as major contributors to smog, the specific underlying reasons are often overlooked and not adequately addressed. Additionally, the impact of transboundary smog is significant, necessitating a regional or cooperative response. However, achieving such collaboration remains challenging.*

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*While punitive measures, such as fines, etc. for emitters or farmers, have been attempted, they have often proven ineffective and even counterproductive, highlighting the need for more comprehensive and coordinated strategies.*

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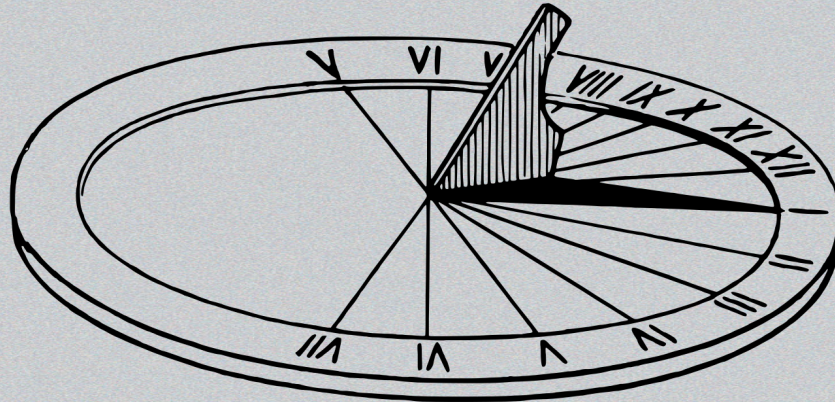
*Global experience shows that regulations combined with a behavioral approach are more effective in addressing these issues. Raising awareness and sensitizing the public through educational programs and media campaigns is crucial for driving meaningful change.*

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## 7 *Way Forward: Plummeting Smog Footprint*



Combating smog necessitates a blend of short-term, impactful interventions and sustained, long-term measures aimed at curbing pollution sources, enhancing public awareness, and fostering environmentally sustainable practices. Hence, a two-step future pathways are drafted. Firstly, short-term immediate actions focus on rapidly mitigating the negative impacts of smog, necessitating less time and financial resources are presented. Secondly, the long-term structural changes required are discussed which can pave the way toward a future characterized by improved air quality to safeguard public health.

### 7.1. *Quick Actions Required:*

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- Evidence is a prerequisite for efficient and effective planning. The need for the evidence necessitates the rapid installation of additional air quality measuring systems. Presently, there are only a few standardized systems in place (2 in Lahore and 7 in Punjab), so expanding this network is crucial. Doing so will significantly aid in spatial planning by providing precise data on pollution levels. This information will also identify congestion hotspots, facilitating more effective transport planning initiatives.
  - Complete conversion to Euro 6 standards, particularly focusing on fuels with significantly reduced sulfur content is an urgent need. The government should either grant provinces the authority to set fuel prices and standards according to their specific needs or ensure that the federal government takes this issue seriously by strictly moving to Euro-6 fuel quality across the country. A digital monitoring mechanism can be implemented at the local level to ensure
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the thorough examination, regulation, and delivery of quality fuel at petrol pumps.

- Promote a cycling culture in the cities. An effective starting point could be to focus on university students, as they can play a pivotal role in embracing and promoting cycling culture within the community.
- Encourage and advocate the use of ride-sharing services like carpooling instead of solo driving and raise awareness about how driving habits can lower vehicle emissions. Further, expand public transportation networks for convenient access to grocery stores and malls.
- Expedite Implementing Miawaki Forests or plantations (a Japanese approach) for enhancing green cover should be swiftly pursued. These forests grow rapidly, transforming into dense forests efficiently, thereby capturing higher carbon levels, a crucial tool in combating smog. Given that forest departments typically don't operate within cities, prioritizing this initiative should be a key focus for the provincial government with district administration.
- Revising the vacation calendar until the air quality index improves involves extending winter vacations while reducing summer break, ensuring that the total number of schooling days remains unaffected. Weather patterns are changing so the vacation schedules should also be revised. Educational institutes should no longer be closed at the end of December. Instead vacation schedule especially during winter should be shifted to January. Schools should be encouraged during summer months to start the day earlier and end it before extremely hot hours. Currently, smog-affected areas, notably Lahore and neighboring cities experience a drastic reduction in school days, which can be mitigated by adjusting the vacation schedule.
- The government should spearhead school transportation buses with enhanced safety, security, and comfort, following a model akin to university transportation systems. Implementing this initiative will notably decrease the number of vehicles on roads, subsequently alleviating congestion and reducing emissions and energy demands. The adoption of this kind of transition or mode of transportation can be accelerated through public-private partnerships, sharing costs and resources to expedite the process. An incentive structure should be developed at school and college level for the students who preferably use school transport.
- The burning of municipal solid waste, tires, plastic, rubber, and leather items should be banned completely.
- Rice stubble shredders and happy seeders offer engineering solutions to the critical issue of stubble burning. These machines operate by shredding stubbles, mulching them into the land, and seeding wheat through this mulch using a seed drill. This process not only reduces the cost of cultivating the next crop but also significantly cuts down GHG emissions. Minimizing rice stubble burning or effectively managing residue requires a two-pronged approach. First, launching educational and awareness campaigns via extension departments and media channels is crucial. Secondly, prioritizing the widespread provision of Happy Seeder machines at subsidized rates or **expanding their use through a facilitated service provider model by the government is essential**. Additionally, forging partnerships with agricultural and non-governmental organizations will strengthen dissemination efforts and enable the adoption of sustainable practices on a larger scale. Further, public-private partnerships should be leveraged to mobilize more resources, investment, and funding to broaden the scale of efforts.

- Switching from urea-based fertilizers to ammonium nitrate can also reduce emissions. Further, Farmers should be encouraged to adopt practices like applying nitrogen fertilizers directly into the soil and using liquid manure injection to reduce ammonia emissions.
- Improving livestock management by having qualified nutritionists design customized diets for cattle based on factors like breed, gender, production stage, and feed quality can further reduce emissions.
- Achieving short-term priorities requires a well-coordinated network of all stakeholders, along with sufficient and timely availability of funds. This can be quickly implemented by redirecting more funds toward tackling smog, as public health is a top priority for enhancing the nation's overall productivity.

## 7.2. Long Term Priorities:

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### **Public Transportation System:**

Cities have turned into gas chambers due to vehicular emissions. To combat this, a robust and sustainable public transport system is essential. While public transport options do exist, they are currently inadequate to meet the needs of large urban centers. Expanding the system and implementing planned transportation schemes is crucial. However, this must be done within a well-structured and comprehensive framework. Public transportation should also be integrated with city and town planning or master planning to ensure long-term effectiveness and sustainability, without compromising urban development.

Further, Urban areas like DHA should permit and invest in public transport. The metro bus and Orange Line train networks should be expedited following international models, and feeder bus networks should be expanded.

Traffic distribution should be planned by considering air quality or implementing taxes, particularly congestion taxes, which can be an effective measure to curb smog in major urban centers. By imposing higher taxes on vehicles entering densely populated areas, especially during peak hours, authorities can discourage excessive vehicle use, reducing traffic and emissions. Revenue generated from these taxes can be reinvested in public transport and green infrastructure.

The Punjab government should phase out rickshaws due to their high emissions. Although Govt. announced the plan to phase out rickshaws but it should happen practically. Strengthening and digitizing vehicle inspection systems, retiring old vehicles, installing catalytic converters, and adopting the latest Euro Standards for emissions and manufacturing are essential for improving air quality.

### **Urban Planning:**

In urban planning, establishing clear boundaries within cities and adhering strictly to master plans is crucial. Categorizing the development of urban areas is essential and should be unwavering without compromise. Emphasizing walkability within cities, which has notably declined, particularly in places like Lahore, is paramount. Prioritizing only essential developments can reduce pollution stemming from multiple construction activities, highlighting the need for a long-term development strategy.

## **Transition to EVs:**

Shifting towards electric vehicles (EVs) offers a promising long-term solution to combat smog at both urban and national levels. Replacing conventional urban transport with EV buses and encouraging the integration of EV cars for personal use can significantly reduce emissions. However, the successful implementation of EVs requires meticulous planning. While importing EVs or bringing foreign companies for EVs production is a quick step, creating a widespread network of charging stations across the country requires careful estimation and strategic planning. Additionally, assessing the overall energy costs is vital, especially given the rising energy expenses due to the gradual removal of subsidies. Balancing energy demand and affordability will be key to ensuring the viability of this transition.

## **Regional Dialogue:**

Ensuring a regional dialogue takes precedence in all endeavors aimed at addressing transboundary smog concerns. The severity of the smog issue could serve as an opportunity for India and Pakistan to break the deadlock and collaborate on mutual environmental challenges. But the reality is bitter. Politics often strays from justice, swayed by power dynamics. The current right-wing leadership, makes hopes for cooperation, fairness, and justice make it like an unfulfilled dream. However, interference from international environmental organizations and regional economic powers can make this happen.

## **Potential Carbon Credits:**

Engaging with international support and funding is crucial in addressing the smog problem, particularly in leveraging the potential of carbon credits. Reducing smog in Pakistan offers a valuable opportunity to access carbon credits, which can yield both environmental and economic benefits. Carbon credits operate as a market-based system, where companies or countries earn credits by lowering emissions below a specified threshold. By taking significant actions to cut emissions in key sectors like agriculture, industry, and transportation such as curbing crop residue burning, adopting cleaner technologies, and promoting electric vehicles. Pakistan can strategically position itself to earn these credits and attract global support.

The potential is substantial, especially in major urban centers like Lahore, where vehicular emissions and industrial activities contribute heavily to smog. By adopting cleaner technologies, improving public transportation, and encouraging sustainable practices, Pakistan can reduce its carbon footprint and sell these carbon credits on the international market, generating revenue. Moreover, international organizations and carbon markets are increasingly focused on air quality improvements, making smog reduction projects attractive for funding and partnerships. This could help finance further green initiatives, contribute to improved public health, and foster a sustainable economy.





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