



Environmental Degradation and Smog: Assessing the Governance Mechanism in Lahore

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ABSTRACT

The study analyzes driving factors and the governance mechanisms in Lahore, Pakistan, in relation to the ongoing environmental challenge of smog. Smog formation in the city is primarily driven by factors such as vehicular emissions, industrial activities, agricultural practices especially crop residue burning, and meteorological conditions. Despite the existence of laws and regulations designed to address smog, their enforcement remains inconsistent. The main objective of this research paper is to identify the key contributors of smog and analyzes the effectiveness of the current governance frameworks in mitigating this issue. The study incorporates resilience policies and climate justice principal to evaluate governance mechanism of Punjab Government in Lahore. The research paper finds that Vehicle emissions are root factor of smog in Lahore contributing 83.15%. The study indicates that the government has implemented comprehensive regulations to control smog by sectoral emission reduction strategy, which includes interventions in agriculture, transportation, industry, municipal administration, energy, education, and health.



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Introduction

Environmental degradation is a matter of serious concern for the world, causing bad air quality, endangers plant life and respiratory system of humans. The deteriorate situation of environmental degradation cause rise in smog which has led to atmospheric pollution, disruption in ecosystem and socio-economic activities. In Pakistan smog has emerged serious environmental crisis, ranks 179th among 180 countries, an overall score of 25.5 overall and in stands 178 in air quality index with 6.3 score reported by Environmental Performance Index. (Environment, 2024) Environmental pollution has intensified due to high levels of vehicle emissions, rampant industrialization, the growing reliance on low-quality fossil fuels, Population growth, accelerated urban expansion and an increase in energy consumption. (Anjum, et al., 2021) The second largest metropolitan city of Pakistan, Lahore is currently confronting the issue of smog. Over the years, this city has observed an alarming Exacerbation in climate change. In the past decades severe atmospheric pollution in Lahore has escalated to Hazardous levels, putting it among the 17th most polluted cities globally. (IQAir) The city's IQAir exceeds at 300–400 level and drastically going beyond safety standards established by Punjab Environmental Quality Standards and the World Health Organization (WHO). (Saba & Hassan, 2024) Hence, the clear skies of Lahore has been engulfed by a dangerously heavy blanket of pollution, which has shrouded the entire city and taken a toll on the lives of its inhabitants and creating a significant problem that demands immediate attention Lahore's air quality has deteriorated to 97.4 micrograms of PM 2.5 particles per cubic meter. Over the last six years, Lahore has persistently been listed among the top 15 most polluted cities globally. (Saba & Hassan, 2024) The rise in smog not only deteriorates air quality but also perpetuates a detrimental cycle with significant implications for climate change. Given these challenges, it is clear that coordinated initiatives and thorough strategies are essential to restore Lahore's skies and safeguard the environment for its dynamic community. (Razzaq, 2024) This article aims to provide an in-depth analysis of the smog issue in Lahore by investigating its underlying causes and contributing elements. The research paper gives an analysis of governance frameworks in the context of resolving environmental concerns with the principles of climate justice and builds resilience in society.

The research study evaluates governance policies adopted by the government of Punjab, specifically, focuses on policy frameworks and actions plans to reduce the threat of smog. This study aims to provide an insight overview of different governmental sectors that take initiatives to combat the phenomena of smog.

Literature Review

A number of literatures have been studied deeply and broadly on the issue of smog. Lahore is the second largest metropolis of Pakistan and experience the frequent spell of smog which is harmful for human health and sustainable environment. (Safdar, Zeenat, & Nasir, 2023). A number of studies concluded that Lahore smog is exacerbated by the emissions of vehicles such as cars, rickshaws and trucks, wastes of agricultural leftovers such as burning of rice residue and emissions of industrial chemical and wastes are major source of smog. (Rashid, et al., 2020) (Kashif, Shah, & Arooj, 2019)

The emission of PM_{2.5} in climate is higher than other cities in Lahore which is threat for the residents of Lahore city reported by World Health Organization (WHO) (Majeed et al, 2024) Globally, it is noted that solid wastes that come from industries, vehicular emissions that share two-third of pollution in air, turbulent weather conditions and agricultural methods of burning crops are the primary source of air pollution in urban residential areas (Kashif, Shah, & Arooj, 2019) Excessive use of motor vehicles in urban residential areas was among the major

contributors toward unhealthy air pollutants and has become one of the most severe challenges for human sustainable development. (Manzueta, Kumar, Ariño, & Martín-Gómez, 2024)

Lahore is experiencing a major environmental crisis of smog, as a result of the increasing intensity of pollution, which has developed as a chronic and pressing issue. The ongoing presence of toxic pollution in the metropolis presents significant concerns to human health, ecological stability, and overall urban sustainability. The absence of an active action plan from the government and the inability of responsible authorities to take note of the seriousness of the situation, it is anticipated that the current scenario will become even direr. (Riaz & Hamid, 2018) Smog is formed and persists due to a variety of causes such as weather, industry operations, vehicle emissions, and crop burning. Chronic smog exposure raises the risk of heart disease, respiratory disorders, increased medical expenses, and environmental harm.(Khan Z. M., 2024)

Even though a lot of research has shown how serious Lahore's air pollution problem is and the present literature discusses the general causes and impacts of smog on human health which the city still has dangerously high smog levels, especially in the winter when temperature inversions make the buildup of pollutants worse. The present study will find out the root causes along contributing factors of smog in Lahore and analyze governance policies.

Research Objectives

1. To identify the root and contributing factors of smog in Lahore.
2. To analyze the present policies formulated and implemented by the government of Punjab to address smog.

Research Questions

1. How different driving factors contributing in Smog?
2. How has the government formulated and implemented policies to address the issue of smog?

These research questions aim to elucidate multifaceted factors of smog in Lahore, evaluate the existing governance policy frameworks and assess the effectiveness of government policies.

Research Methodology

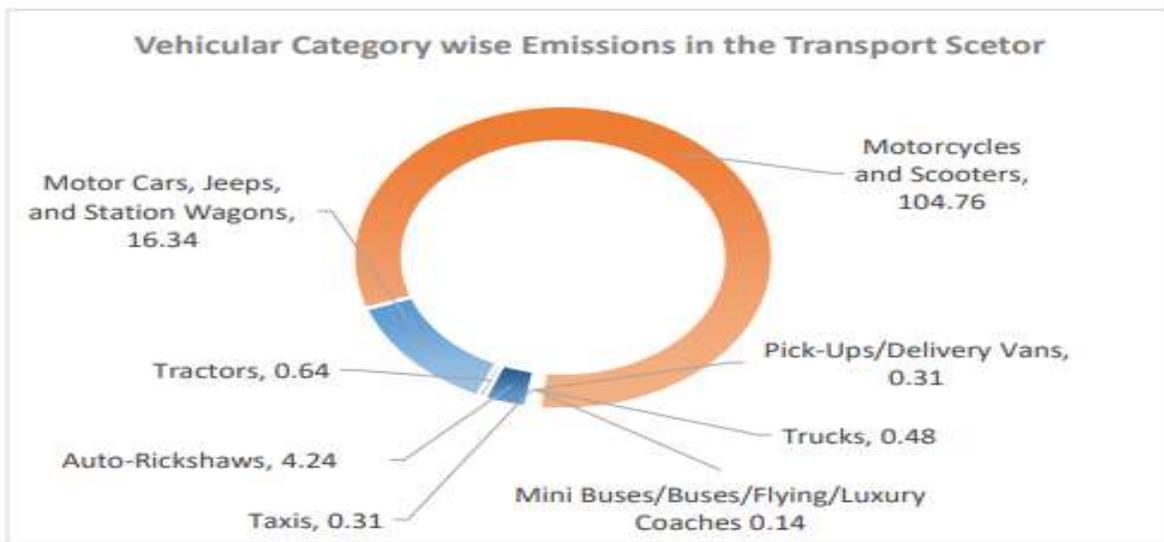
This study used a qualitative research technique to investigate the causes of smog in Lahore and assess the governance mechanism. Secondary data will be obtained from governmental reports, policy documents, and environmental evaluations, Air Quality Index which will be examined to evaluate the current strategies and their execution. This study involved a thorough review of Roadmap for Smog Mitigation in Lahore, laws, and regulations. In order to answer the research objectives, a comprehensive evaluation of several papers and associated materials served as the foundation for this exploratory study. The References section contains a comprehensive list of sources. In addition to assessing the policy landscape surrounding pollution mitigation in Lahore, this methodology guarantees a thorough examination of the issue. The analysis of data is an essential element of this investigation. Data was systematically analysed to derive meaningful insights after the relevant literature was reviewed. This process entailed the verification of data veracity, the removal of irrelevant information, and the performance of logical analysis.

Causes of Smog in Lahore

Lahore district is situated on the alluvial plain of the River Ravi, at an altitude of 150 to 200 meters above sea level. The city is located in a semi-arid region with a tropical climate that features five different seasons. Winter (mid-November to mid-February) is characterized by heavy fog and smog, which degrades air quality. Spring (mid-February to mid-May) delivers pleasant weather, and summer (mid-May to June) is marked by high heat, dust storms, and rains.

The monsoon season (July to mid-September) momentarily improves air quality, followed by a dry autumn (mid-September to mid-November), which results in smog production. These seasonal variations have a substantial impact on Lahore's air quality, emphasizing the need for strong governance to address environmental issues, particularly smog-related pollution. (Hassan Ilyas, 2023) Lahore's air quality starts getting worse from the beginning of November as a result of atmospheric inversion layers that trap pollutants near the ground for many years.

There are several roots and contributing factors that has been gradually adulterated the clean skies of Lahore. According to report of Chief Minister Punjab Roadmap for Smog Mitigation in Lahore factors such as increased such as emissions of vehicles. A large number of automobiles roam on roads; particularly those are older and poorly maintained and release high volumes of harmful pollutants into the atmosphere. In transport sectors, vehicle emissions are major contributing source of smog. The pollutants such as SO_x, NO_x, NH₃ and VOCs generated from automobile exhaust can form secondary PM_{2.5} particles. Lahore's dependence on fossil fuels for energy production, transportation, and domestic consumption exacerbates pollution, as antiquated vehicles and inefficient fuel combustion methods emit substantial quantities of pollutants. The increase in diesel-powered vehicles, especially trucks and buses, contributes to the emission burden. Between 1998 and 2023 the number of vehicles registered in Punjab 21 Million vehicles reflecting an average annual growth of 60 % increase in vehicles over the last decade. Lahore accounts for 30% of overall registered vehicles in Punjab. (Saba & Hassan, 2024) It is indicated that 83.15% PM_{2.5} pollutions in Lahore is contributed from vehicle exhaust. (Hassan Ilyas, 2023)



Source: Sectoral Emission Inventory of Lahore: The Urban Unit report 2023

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

The Industry is second major contributor sector augmenting smog emitting 13.87 Gigagrams of emissions. The pollutants into the atmosphere caused by industrial wastes include SO₂, NO_x, NMVOC, NH₃, CO, CH₄, N₂O and CO₂. These industries release detrimental greenhouse gases throughout various stages of their production processes, encompassing raw material extraction, processing, refining, and final product manufacturing. The 2023 European Environmental Agency (EEA) emission inventory standards have carefully measured the magnitude of these

emissions, offering significant insights into their environmental effect. The phases of industrial activity emit substantial pollutants that significantly contribute to global warming and climate change. (EEA, 2023)

There are 1023 industrial units and 156 brick kilns in Lahore. (Hashm & Sharoon, 2024) They release hazardous gases, smoke and pollutants in the absence of adequate mitigation measures. It is within a distance of twenty kilometers from residential areas that the various industries and brick kilns are situated in their respective spatial positions. Lahore’s pollution levels are increased by these releases, which are frequently unregulated or inadequately monitored. Hazardous gases build up as a result of enterprises using inferior fuels, including coal and furnace oil, which increase emissions. These pollutants create secondary pollutants like ground-level ozone, a significant component of smog, when they combine with sunshine and atmospheric moisture. Furthermore, businesses that use paints, solvents, and petroleum products release volatile organic compounds (VOCs), which worsen air pollution by combining with nitrogen oxides. (Arif & Hassan, 2023) Rapid industrial expansion frequently contributes to air quality, elevate health risks, global warming, and result in environmental degradation through the creation of acid rain and smog. (Awez, Khan, & Ali, 2024) In Lahore, industrial activity is said to be responsible for 9.07% of the problem. (Saba & Hassan, 2024)

Globally, burning crops remains the biggest contributor to black carbon – generated by the incomplete combustion of fossil fuels, wood and other fuels. Although it dissipates after a few weeks but its effect on global warming is several thousand times larger than carbon dioxide (found in vehicle emissions). (Shaikh, 2022) The practice of burning agricultural crops and thermal inversion, a meteorological phenomenon in which particulate matter and other pollutants that are confined in the air blend with condensed water vapour to produce smog contribute 3.09 % significantly to smog and worsens air pollution. (Saba & Hassan, 2024) The farmers in Punjab are unaware of alternate methods for crop wastes. Rice, an important crop during the Kharif season (June to October), produces a large amount of crop residue at the end of the harvesting period. The vast bulk of these wastes are either burned in open fields or used in domestic cooking. Farmers use residue burning for a variety of purposes, including weed management, land clearing for the following cultivation cycle, and nitrogen replenishment for future crops. (Azam & Shafique, 2017) A study conducted by The Food and Agriculture Organization (FAO) and reports that agricultural residue burning is responsible for around 121,000 tons of emissions. In Lahore, rice production data from the Agriculture Marketing Information System (AMIS) showed a total of 68,700 tons in 2021. In addition to residue burning, agricultural activities using fertilizers and pesticides contributes to air pollution. The extensive usage of these chemicals emits reactive nitrogen molecules. (FAO, 2020)

Sources of emissions in various sectors

Industry sector	Air pollutants
Steel furnaces / re-rolling mills, paper, and board mills	PM ₁₀ , PM _{2.5} , CO
Brick kilns, fertilizers and pharmaceutical industries	PM ₁₀ , PM _{2.5} , CO, SO ₂ , NO _x
Small resource recovery units, rice, and textile mills	PM ₁₀ , PM _{2.5}
Transport sector	
Motorcycle and motor car	PM _{2.5} , HC, CO
Pickup delivery van, auto rickshaw, bus, tractor, truck	PM _{2.5} , HC, CO, NO _x
Agriculture sector	
Rice straw burning	PM ₁₀ , PM _{2.5} , CO

Source: <https://epd.punjab.gov.pk/system/files/remote%20sensing%20analysis.pdf>

The formation of smog is notably affected by weather conditions, especially in the winter months. A significant factor leading to elevated smog levels during winter is the regular occurrence of temperature. A temperature inversion takes when a layer of warm air is positioned above cooler air close to the ground. This effectively inhibits pollutants, including emissions from vehicles and industries, from ascending and dispersing into the atmosphere. Consequently, these pollutants are confined near the surface resulting in elevated pollution levels and a rise in smog. (Bilal, Hassan, Tahir, Iqbal, & Shahid, 2022) In addition, smog is moved horizontally and vertically from one region to another which is facilitated by local wind region. The accumulation and persistence of pollution over time can be facilitated by the formation of natural atmospheric basins by topographical features, which impede pollutant dispersion. Airflow patterns can be further altered by geographic barriers, such as mountain ranges and coastal formations, which direct pollution along specific pathways and contribute to the degradation of localized air quality. It is imperative to comprehend these meteorological and geographical interactions in order to formulate effective strategies for mitigating air pollution.



Sectoral contribution of pollutant

Source: *Sectoral Emission Inventory of Lahore: The Urban Unit report 2023*

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

The study explores that vehicle an emission in Lahore is the root cause while generally assumes that industrial waste and agricultural burning in surroundings of Lahore, weather conditions, fossil fuel-fired power plants, the burning of waste materials, and coal being burned by thousands of brick kilns is just contributing factors.

Governance Mechanisms and Policy Interventions

The study finds that the transport sector contributes nearly 83% of total emissions, primarily from old, unregulated vehicles, diesel-powered trucks and rickshaws. The use of low-quality fuels and the absence of proper emission control mechanisms further aggravate air pollution. Traffic congestion lead to excessive idling, increasing emissions of nitrogen oxides (NO_x) and carbon monoxide (CO) is the key components of smog. The Punjab Environmental Protection (Smog Prevention and Control) Rules, 2023, were enacted by the Government of Punjab to address air pollution and smog issues in the region. The legislation targets transport sector, brick kilns, industrial facilities, resource recovery units and pyrolysis plants in Punjab. Lahore is the primary target of the Punjab Smog Mitigation Plan 2024 and the vision of Punjab Government is “Smog Less-Lahore”. (Saba & Hassan, 2024) The governance of smog mitigation in Lahore can be evaluated through resilience and climate justice, ensuring that policies effectively address immediate air quality issues while remaining adaptable to long-term environmental changes and providing equitable protection for vulnerable communities. Governance of Lahore's smog

management initiatives can be assessed based on policy efficacy, institutional coordination, enforcement, public engagement, transparency, and sustainability. A key approach adopted by Punjab Government is the sectoral emission reduction strategy introduced in agriculture, transportation, industry, municipal administration, energy, education, and health sectors. (Saba & Hassan, 2024).

The transportation sector has been a primary focus of resilience-building initiatives, as vehicles emissions constitute a substantial portion of air pollution. The Green Mass-transit Program, entailing the gradual deployment of 5,000 electric buses across Punjab signifies a fundamental transition towards sustainable urban mobility. Furthermore, the Vehicle Inspection and Certification System (VICS) have been enhanced to enforce emission requirements, and a zero-tolerance policy has been implemented for non-compliant cars, including the revocation of route permits for repeat offenders. Additionally, resilience-focused initiatives encompass the implementation of traffic congestion monitoring systems, the utilization of mobile air quality analyzers, and the solarisation of traffic signals to diminish dependence on fossil fuel-derived electricity. (Saba & Hassan, 2024) The industrial sector has also undergone significant reforms to enhance environmental resilience. The closure of highly polluting pyrolysis plants, which were found to emit hazardous toxins, represents a strict regulatory approach. (Khan, 2022) The introduction of live CCTV monitoring of industries coupled with drone surveillance of industrial clusters has ensured greater transparency and compliance with environmental regulations. The Punjab government introduced Zigzag technology for brick kilns which reduces the emission of smoke and a counter strategy for conventional making of bricks. (Bashir, et al., 2023) Furthermore, the installation of Emission Control Systems (ECS) for industries, guarantees monitoring and surveillance of harmful emission of gasses and beneficial for climate justice and resilience. The creation of a Smog Monitoring Unit (SMU) within the Planning and Development Board functions as a centralised authority for monitoring air quality trends, providing early warnings, and coordinating enforcement measures. The creation of digital tools like the Green Punjab App, Eco Watch App, and Smog Helpline (1373) has enabled residents to report infractions, fostering a participatory model of environmental governance. (Saba & Hassan, 2024) The implementation of mobile monitoring units with camera-mounted sensors has improved the capacity to identify and rectify air pollution infractions in real-time.

In agriculture sector, the Punjab government has encouraged the adoption of Super Seeders and Rice Straw Shredders—modern farming equipment that enables for sustainable crop residue management without the need for open burning, which contributes significantly to seasonal smog. The Agriculture Department is providing 5,000 Super Seeder/Pak Seeder and 2,000 Rice Straw Shredder to farmers. This equipment has been made available to farmers with a 60% subsidy, encouraging wider use. Furthermore, the mapping of stubble-burning hotspots and the development of village management committees have been undertaken to improve local governance and prevent illicit agricultural burning. (Agriculture, 2024)

One of the key initiatives reflecting climate justice principle is the Punjab Solar Program, which provides free solar panels to low-income households consuming up to 200 units of electricity per month. This policy directly benefits economically disadvantaged communities by reducing their dependence on polluting energy sources while lowering their electricity costs. Additionally, the solarization of public hospitals, educational institutions, and municipal buildings ensures that essential public services remain functional even during energy shortages, reducing disparities in access to clean energy.

Summary of Punjab Government smog mitigation measures in various sectors

Sector	Key Actions & Policies	Statistical Data
Transport	Introduction of Electric Buses & E-Bikes for green mass transit	27 E-Buses deployed in Lahore, 8,200 E-Bikes in Phase-I
	Vehicle Inspection and Certification System (VICS)	3 VICS stations operational in Lahore
	Crackdown on smoke-emitting vehicles	75,881 vehicles checked, 18,069 fined, 13,678 impounded
	Traffic congestion management	Hotspot identification & signal optimization (Mall Road "Green Wave" project)
Industry	Crackdown on polluting industries & pyrolysis plants	12,540 industrial inspections, 4,403 notices, 594 industries sealed, Rs. 70M fines
	Conversion of brick kilns to Zig-Zag technology	95%+ brick kilns converted
	Monitoring of emissions through real-time CCTV	Live surveillance initiated in smog cell
Agriculture	provision of Super Seeders & Rice Straw Shredders to reduce stubble burning	5,000 Super Seeders & 2,000 Rice Straw Shredders distributed (60% subsidy)
	Patrolling squads with drones & village-level monitoring	PKR 4.87 billion allocated
	Anti-stubble burning enforcement	376 notices issued, 26 sites sealed (Mar-Sep 2024)
Environment	Deployment of Smog Monitoring Units (SMU) & real-time surveillance	60 Portable Gas Analyzers at traffic intersections
	Ban on single-use plastics	59,389 inspections, 34,251 kg confiscated, Rs. 1.9M fines imposed
	Tree plantation & fugitive dust control	36M trees in Punjab, 4.8M in Lahore
Energy	Solarization of public institutions	36 District Headquarters Hospitals (DHQs) solarized
	Punjab Solar Program (Roshan Gharana)	50,000 households to receive free solar panels

Compiled by Researcher

Source:

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

Discussion

The implementation of smog reduction regulations in Lahore demonstrates a robust dedication to climate justice, especially in safeguarding communities adversely affected by smog. The government has implemented stringent measures against wrongdoer, the inspection of 75,881 vehicles, the issuing of 18,069 fines, and the confiscation of 13,678 high-emission vehicles to mitigate traffic-related pollution in Lahore. The dismantling of non-compliant brick kilns and the closure of enterprises utilizing low quality fuel exemplify initiatives aimed at mitigating industrial emissions that disproportionately affect low-income populations living adjacent to industrial areas. Additionally, to safeguard roadside merchants, pedestrians, and informal workers from dust pollution, the government ordered to sprinkle water at building sites and prohibits open rubbish burning. Climate justice is bolstered by public health initiatives, such as complimentary influenza vaccinations for vulnerable people and the establishment of mobile health units in places impacted by smog. The government focuses to take strict actions against those who are major polluters of environment. Planning and Development Board established The Smog Monitoring Unit (SMU) to monitor the air quality index of Lahore and take effective measures for smog mitigation policies. The Standing Committee on Smog Mitigation (SCCSM) led by the Chief Minister Punjab Maryam Nawaz Sharif personally noticed and checked the mitigation plans. Environment Protection Agency (EPA) Punjab, the Lahore Development Authority (LDA), and the Lahore Traffic Police also collaborate with Punjab Government to implement regulations on industrial pollution management, vehicle emissions inspections, and dust mitigation from building sites. There is need to improve communication between provincial and municipal authorities for the implementation of smog reduction in all sectors.

The Punjab government's smog control plans emphasize on sustainable environment and ensure air quality standards for urban Lahore. The shift to eco-friendly public transport via electric buses, the augmentation of solar energy in healthcare facilities and governmental structures, and the establishment of carbon sequestration zones in industrial regions all signify a dedication to enduring resilience. Lahore's revised urban master plan incorporates air quality techniques to mitigate urban congestion and regulate emissions from growing metropolitan regions.

Recommendation

To mitigate smog in Lahore a range of short-term, medium-term, and long-term planning must be executed. In the immediate future, it is essential to enhance low-cost air quality monitoring by the deployment of affordable sensors throughout Lahore and to improve gas pollutant monitoring for NO₂, SO₂, CO, and O₃ throughout all areas. Enforcement of sterner car emission regulations, including the adoption of Euro VI standards for new vehicles and the retrofitting of older vehicles to meet Euro IV norms, is necessary. The implementation of mandatory automobile emission testing under the Punjab VICS system is essential, and AI-driven traffic management should assist in alleviating congestion and pollution. Moreover, implementing pollution control regulations in coal and biomass businesses, along with requiring dust mitigation at construction sites by fence and water spraying, can substantially decrease smog levels.

In medium term, Lahore's public transport infrastructure has to be expanded. Providing financial incentives for electric vehicles (EVs) and constructing EV charging stations can assist reduce reliance on fossil fuels. Industries must comply with mandated pollution control devices, and the use of renewable energy in industrial processes should be encouraged, particularly through solar, wind, and biomass solutions.

In long term, farmers must be trained in crop residue management to prevent stubble burning,

and industries should be relocated away from metropolitan areas with tight zoning rules in place. Expanding urban forests and green belts will enhance air quality and provide a healthier environment for residents.

Education helps to raise awareness among masses, encourage eco-friendly behavior, and stimulating innovation. Schools and colleges educate their students about the causes and prevention on smog control. It is necessary to carry out public awareness campaigns in order to observe laws, the utilization of environment friendly modes of transportation, and the reduction of emissions to protect environment. Through the promotion of environmental responsibility, education enables individuals and communities to contribute to the cleaning up of Lahore. If these measures were implemented, they would give a strategy that is both comprehensive and successful for removing pollution from Lahore.

Conclusion

To sum up, the study investigated those factors that contribute to the formation of smog in Lahore and evaluated the governance policies that are currently in place to deal with environmental deterioration. According to the findings, the haze that is present in Lahore is caused by a number of different driving factors, such as smoke from vehicles, emissions from industrial processes, crop burning, and adverse weather conditions. A further escalation of the problem is brought about by the growing urbanization and the absence of effective regulatory enforcement.

Despite the fact that the government has developed a different rules and smog mitigation action plans, difficulties continue to arise in the process of putting them into effect. There is a lack of public awareness, poor monitoring, and weak enforcement, all of which contribute to the ineffectiveness of these measures. In spite of the fact that the implementation of programs such as automobile emission limits, industrial restrictions, and seasonal crop burning bans has taken place, the effectiveness of these initiatives in the long run is contingent on regular enforcement, technical developments, and coordination across different sectors.

In order to combat smog, it is necessary for all stake holders such as Government, industries, farmers, transporters and the general public to collaborate. It is possible for Pakistan to safeguard its agricultural output, as well as the health and welfare of its people, for future generations by taking preventative measures to reduce the formation of pollution and the conditions that it causes.

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