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CHOKING CITY: LAHORE'S BATTLE WITH SMOG

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Abstract *Lahore, one of the most industrialized and concreted cities of Pakistan with the highest population density is experiencing severe smog, which has created environmental problems. Scattered smoke is a result of vehicular exhaust, industrial discharges, and farming biomass burning, whereby meteorological and geographical conditions, especially from October to December make the situation worse. Air pollution in Lahore results in large health risks, including respiratory and cardiovascular ailments, foremost mental health disorders, and potential learning gaps with higher consequences on sensitive groups. The socio-economic impacts are also worst which include productivity loss, pressure on the health facilities, interruption of school sessions, and a drop in tourism. The poor are most heavily impacted, particularly those living close to industrial zones. There is also action taken to stop smog such as the Punjab Clean Air Action Plan and Lahore Smog Control Ordinance but the enforcement has been poor because of financial and infrastructural constraints. Awareness programmes and technology applications including those for air quality demonstrate a potential but challenges include, expensive and scarce resources. Strategies and tactics can consist of sharper regulation of emissions, the extension of the monitoring networks, the introduction of financial enticements and incentives for sustainable farming, and more extensive overall public awareness programs. The other important thing, which should be the activities of concern to help solve the problem, is cooperation with other countries and using their experience of how they manage to control air pollution successfully in other cities.*

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Abbreviations: NGOs (Non-government organizations, WHO (world Health Organization), Particulate Matter (PM2.5, PM10), Carbon Monoxide (CO), Nitrogen Oxides (NO_x), Sulfur Dioxide (SO_2)

Introduction

Lahore city, one of the cultural and economic hubs of Pakistan, is suffering worst through smog calamity due to the increased rate of urbanization, industrialization, and population. The main sources are vehicles that are at least ten years old, industries such as brick kilns and textile mills, and crop residue burning. (Tsai et al., 2013) Pollutants stagnate in phases when there are low wind speeds when autumn is characterized by temperature inversions, and when Lahore is located between two rivers, the Sutlej and the Ravi, the city is known to suffer from fog, which in this circumstance means smog. Climate change is also expected to increase these conditions. They affect people's health in that exposure influences chronic diseases such as respiratory and cardiovascular diseases, lung cancer, and premature mortality depending on the length of exposure and pre-existing conditions of the vulnerable persons (Liu et al., 2021). The problem exists due to poor enforcement, including even the Lahore Smog Ordinance, and pollution persists nevertheless. In this case, there is a need to follow one more step to get deeper insight into the smog and this will be to understand the composition of the smog (Malik et al., 2024ab; Ahmad et al., 2014).

Understanding the Composition of the Smog

Lahore's smog experience involves various types of pollutants such as Particulate matter PM2.5 and PM10, Carbon monoxide (CO), Nitrogen oxides (NO_x), Sulfur dioxide (SO_2), Volatile organic

compounds (VOCs) (Vega et al., 2010). While PM10 is a somewhat larger particle, and PM2.5 is the most dangerous one, including severe respiratory and cardiovascular impact, which can even get into the lungs and bloodstream. Sources include vehicles, industries, brick kilns, and crop residue burning. PM10 also poses some risks to respiratory disease, most especially in sensitive groups (Perez-Diaz et al., 2017). Vehicle and industry emissions of nitrogen oxides result in the formation of ground-level ozone and chemicals that form acid rain and air pollution, sulfur dioxide from the burning of coal in industries also leads to air pollution (Figure 1). NO_x from vehicle emissions and industries, react with VOCs to form ozone that compounds respiratory diseases (Ali et al., 2019).

Figure 1. View of Lahore city

The Human Cost: Health Impacts of Smog

Lahore's smog is not only dangerous for public health but also for respiratory and cardiovascular diseases (Zeng et al., 2019). The core major components include particulate matter (PM), nitrogen oxides (NO_x), sulfur dioxide (SO_2), and carcinogens which cause illnesses ranging from asthma to chronic obstructive pulmonary disease (COPD) and long-term lung impairment (Pope et al., 2004). PM2.5, especially, gets into the lungs and bloodstream channels, thus irritating the lungs. Cutting across the gross domain of this strain of coronavirus are several categories of people which comprises children, the elderly, pregnant women and a host of others having pre-existing conditions such as diabetes, heart disease, and hypertension are more susceptible to coming down with respiratory tract infections, heart attacks, strokes and hypertension respectively (Arbex et al., 2012).

Socioeconomic Burden and Public Discontent

For Lahore having smog constantly, drags the socioeconomic crisis as it worsens the conditions in healthcare through escalating the costs of treating respiratory and cardiovascular diseases (Razzaq et al., 2024). It has a reduced workforce output, leads to school closures, and disrupts school sessions however diminishing economic progress (Shrestha et al., 2021). Indigenous people, the elderly and low-income earners, with high-frequency exposure to the sun mostly in the agricultural, construction, and manufacturing industries and limited access to quality health care (Daniels et al., 2000). It is also affected since its image is spoiled by smog and thus the tourism department loses its revenue (Kim et al., 2015). Political instability and most importantly, poor implementation of the existing pollution standards have led to people taking to the streets to agitate for better measures to be taken (Bulbul et al., 2018).

Policies and Gaps: What Has Been Done?

Here are the measures that have been adopted by Lahore to control air pollution as follows, Punjab Clean Air Action Plan (2019), Smog Control Ordinance (2017), and Punjab crop residue burning control act (2020). These are: They cover objectives to lower transport, industrial, and farming emissions by using improved technologies and applying more stringent environmental requirements (Sui et al., 2021). However, such strategies' implementation has been limited by weak enforcement, economic challenges, inadequate monitoring, or low community awareness. Some steps such as the Green Bus Project and air quality sampling stations have been implemented but there exist some problems because of little compliance, irrelevant penalties as well as political barriers (Chauhan et al., 2020).

Community and Technological Interventions

This shows educational programs like the Lahore Clean-up Campaign though, problems persist still including the lack of funds, social opposition, and political constraints. Smart air quality monitors, AI apps, electric buses, and projects that involve renewable energy have potential but are hampered by challenges such as expensive costs, deficiency in infrastructure, and public awareness. Measures taken to address transportation including smart traffic systems, or electric cars are limited by initial costs and resist changes (Chen et al., 2021).

The Road Ahead: Recommendations for a Breathable Lahore

Policy Enforcement: Tighten legal standards on car exhaust emissions, industrial discharges, and the burning of crop residue, while increasing public surveillance of the quality of the air that they breathe.

Economic Measures: Implement poll taxes as a way of encouraging the use of clean technologies while at the same time supporting environment-related projects (Du et al., 2020).

Technological Advancements: Buy and invest in electricity from renewable energy sources, involve subsidies for renewable energy and waste to energy plants, and charging points for electric cars (Gauderman, 2002).

Agricultural Reforms

Ensure farmers get incentives for sustainable farming practices: Organic manure production, biogas production, and Climate-smart agriculture (Gurjar et al., 2016).

Public Awareness

Organize campaigns that aware the population regarding changes that they have to make to protect the environment such as using public transport and minimizing waste production (Hameed et al., 2000)

Urban Greening

Public areas such as parks and gardens increase greenery, minimize pollution or emissions, and improve against the heat island effect like in Singapore (Tao et al., 2014). The realization of the importance of a multi-sectorial approach linking and involving government, private, and civil society towards the sustainable achievement of a cleaner and respirable Lahore (Hopke et al., 2008).

Which Clay Is Right for a Collective Effort for a Clearer Future

Collective effort for a clearer future emphasis on sharing a common goal that will help address air pollution and smog problems in Lahore. Key points include:

Government Action

The Directives that need to be followed are improved legislation on the environment, increased usage of renewable sources of energy, no burning of agricultural residues, and improved air quality surveillance preferably on the sources and development of sustainable cities (Janssen et al., 2013).

Private Sector

Endorse pollution innovation, and process regulation in transport and production in addition to corporate social responsibility directed at the environment (Jung and Lin, 2013).

Educational Institutions

Investigate the identification of polluted sources and measure the effects of pollution on human health, offer information to decision-makers, and teach the public and students about the environment and correct behavior (Kampa et al., 2008).

Public Participation

Run information crusades to enlighten the populace on the impacts of smog as well as advocate for transformation to sustainable practices, development partners being Non-Governmental Organizations which can close the gap between government efforts and the people (Kioumourtzoglou et al., 2016)

International Collaboration

As the Beijing and Los Angeles relevant authorities did, and cooperate with UNEP and WHO for assistance and guidelines in pollution decrease. For Lahore, the central and provincial governments, private sectors, academia, and communities must work hand in hand towards a clean environment through promoting coherent policies, technological improvement, raising awareness, and active collaboration in the international regard (Kloog et al., 2013).

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