ENVIRONMENTAL AND MEDICAL CHALLENGES OF SMOG: A GLOBAL PERSPECTIVE WITH FOCUS ON PAKISTAN'S ESL EDUCATION SYSTEM

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Abstract
Smog, a harmful mixture of smoke and fog, poses significant environmental and health challenges worldwide. Root causes include vehicular emissions, industrial pollution, and agricultural stubble burning, exacerbated by poor regulatory enforcement and climatic conditions. Its origins lie in the industrial revolution when massive coal burning and urbanization intensified air pollution. Pakistan faces a dire smog crisis, particularly during winter in urban areas like Lahore and Multan. Smog in Pakistan severely affects public health, causing respiratory illnesses, cardiovascular diseases, and reduced life expectancy. Beyond health, it disrupts the education sector as schools, colleges and universities frequently close during peak smog seasons to protect children. Prolonged closures hinder academic progress and disproportionately affect underprivileged students who lack access to remote learning facilities, deepening educational inequities. This study underscores the urgent need for comprehensive air quality management in Pakistan to mitigate smog's adverse effects. Effective solutions include transitioning to cleaner energy, enhancing public transportation, and strict enforcement of environmental regulations. Addressing smog is vital not only for public health but also for safeguarding Pakistan's education system and its future generations. Pakistan, as a developing country, faced numerous challenges in online education. Key issues included the lack of a robust Learning Management System (LMS) and the complexities arising from being a multilingual nation. Students encountered significant difficulties in adapting to online learning environments, particularly in foreign language acquisition and maintaining educational continuity.

Keywords: Smog, Urbanization, Online Education, Learning Management System, Pakistan, Lahore, Multan, Environment, Health, Economic, etc.

Introduction
Smog is a type of air pollution that forms when pollutants in the atmosphere interact, often under the influence of sunlight. The word "smog" is a combination of "smoke" and "fog," reflecting its origins and appearance. Smog typically looks like a hazy, dense layer in the air, often visible in urban or industrial areas. There are many types of smog that is needed to

understand to cope up with this upcoming disaster effectively. Types include following; Photochemical Smog is the smog that is formed when sunlight have interaction with nitrogen oxides (NOx) and volatile organic compounds (VOCs) released from vehicles, industrial facilities, and other sources. Its composition consists of Ozone (O_3), Nitrogen dioxide (NO_2), and other chemicals. This type of smog is very common in sunny, warm climates; it causes a brownish haze and can irritate the respiratory system. Malik et al, (2024)

Industrial Smog is the result of burning of coal and fossil fuels, releasing sulfur dioxide (SO_2) and particulate matter. Its composition includes sulfurous compounds, soot, and smoke particles. It is more common in cooler, damp climates; it appears grayish due to soot and particulate content.

Smog leaves worst effects on health as it exacerbates respiratory issues such as asthma, bronchitis, and other lung conditions. It can irritate the eyes, throat, and skin. In the environment it reduces visibility, damages crops, and contributes to acid rain. Its prevention and reduction is possible by taking certain preventive measures including reduction in emissions from vehicles by using cleaner fuels or public transportation, ensuring the implementation on stricter industrial regulations to limit pollutants, Promotion of renewable energy sources like solar and wind power and planting trees to naturally absorb pollutants.

Industries and transport are significant contributors to smog in Pakistan due to the release of harmful chemicals and particulate matter into the atmosphere. Industrial processes, particularly in brick kilns, steel mills, and factories, emit large quantities of sulfur dioxide (SO_2), nitrogen oxides (NO_x), and volatile organic compounds (VOCs). Similarly, the widespread use of outdated vehicles and poor fuel quality leads to high emissions of carbon monoxide (CO) and fine particulate matter (PM2.5). These pollutants combine with atmospheric moisture and sunlight to form dense smog, particularly during winter, severely impacting air quality, visibility, and public health in urban centers like Lahore and Karachi. Addressing this issue requires stricter emissions standards, cleaner technologies, and effective policy enforcement. Geddes & Murphy (2012)

As per Stephens (1987) history of smog is closely tied to the Industrial Revolution and the increased use of fossil fuels. Here's an overview of its evolution and impact over time. In the early history, during medieval times, reports of air pollution date back to the 13th century in England, when coal use began to increase. In 1272, King Edward I banned the burning of sea coal in London due to its noxious smoke. During 17th–19th Century, as cities grew and industrialization expanded, coal became the dominant energy source, leading to significant air pollution in urban centers. The term "smog" wasn't yet used, but thick, smoky fogs were common in cities like London.

Bharadwaj et al. (2016), the Term "Smog" was coined in 1905 introduced by Dr. Henry Antoine Des Voeux in a paper for the Public Health Congress in London. It described the mixture of smoke and fog prevalent in industrial cities.

Rogaski (2019), smog has been appeared in history and there are major smog events around the world, some of those include London's Great Smog of 1952. It was caused as a combination of cold weather, stagnant air, and coal burning created a thick layer of toxic smog. It remained continued for almost five days, killing an estimated 10,000–12,000 people and causing respiratory problems for thousands more. As a result Clean Air Act of 1956was, which restricted coal burning in urban areas and encouraged the use of cleaner fuels.

Haagen-Smit (1970), Donora Smog (1948) is witnessed in history in Donora, Pennsylvania, USA. It was caused due to emissions from steel mills and a zinc plant trapped in a temperature inversion. It killed 20 people and sickened 6,000 people that was almost half of the town's population. As a result awareness was raised in the U.S. about air pollution's dangers and spurred future environmental legislation.

Gera & Bhasin, M. (2023), there was smog case in Los Angeles Smog (1940s–1950s) that was due to increased car use and industrial activities combined with sunny weather and geographic factors created photochemical smog. It caused persistent air quality problems led to public demand for action. This incident pioneered air pollution research and regulation in the U.S., including catalytic converters and emission standards.

Mosley (2014), in the modern developments smog is a global problem. It is no longer confined to industrial cities in the West. Rapid urbanization and industrialization in countries like China and India have led to severe smog issues in cities like Beijing and Delhi.

Mosley (2014) the history of smog in South Asia is deeply tied to rapid urbanization, industrialization, population growth, and the region's reliance on traditional energy sources like coal, wood, and crop residues. Here is a timeline and overview of how smog became a critical issue in South Asia.

Bilal et al (2022), Understanding the role of atmospheric circulations and dispersion of air pollution associated with extreme smog events over South Asian megacity. *Environmental monitoring and assessment*, *194*, 1-17. Traditional Pollution: In pre-industrial times, air pollution in South Asia was largely localized, caused by biomass burning for cooking and heating. Large-scale smog events were uncommon due to lower population density and lack of industrial emissions.

Pakistan, as a less developed country with weak healthcare infrastructure, faces significant challenges in addressing the impacts of smog. Unlike developed countries that have effectively tackled smog through advanced technologies and robust systems, Pakistan struggles due to limited resources and inadequate hospital facilities to manage the health crises caused by air pollution. Strengthening infrastructure and adopting proven strategies from developed nations are essential to effectively combat smog and its consequences. Nasar et al, (2024)

Sheeraz et al (2024), smog has once again become a critical issue in Pakistan, particularly in Punjab province, with Lahore being identified as the world's most polluted city multiple times this season. The severe air pollution is attributed to several factors, including seasonal crop burning in both Pakistan and neighboring India, industrial emissions, and low wind speeds coupled with dropping temperatures. The Air Quality Index (AQI) in Lahore has reached hazardous levels, with readings exceeding 1,100 on some days—far above safe limits BBC reported that Lahore, Pakistan's cultural capital, faces a recurring environmental crisis due to severe smog, particularly during the winter months. This hazardous smog results from a combination of vehicular emissions, industrial pollution, agricultural stubble burning, and unfavorable weather conditions. The dense smog reduces visibility, disrupts daily life, and poses significant health risks, including respiratory and cardiovascular problems. Citizens frequently report eye irritation, throat infections, and exacerbation of chronic conditions. Despite government initiatives, such as promoting cleaner fuel and imposing restrictions on crop burning, the measures remain insufficient to tackle the crisis effectively. Addressing Lahore's smog problem requires robust policies, public awareness campaigns, and regional cooperation to mitigate pollution sources and protect public health.

Source: https://www.bbc.com/news/articles/cm20k76d5xno.amp(Smog Capture in Lahore)

The Human Rights Watch (HRW) report highlights the alarming air pollution crisis in Pakistan, emphasizing its severe health, environmental, and socio-economic impacts. The report underscores that Lahore frequently rank among the world's most polluted, with air quality levels often exceeding hazardous thresholds. Factors such as industrial emissions, vehicular pollution, and crop residue burning contribute to this crisis, compounded by inadequate government regulation and enforcement. HRW calls for urgent action to address this public health emergency, advocating for stricter environmental policies, improved monitoring systems, and increased public awareness to safeguard the health and rights of Pakistan's population.

Source: https://www.hrw.org/news/2024/11/19/pakistans-deadly-air-pollution-crisis

November 15, 2024 Pakistan's Punjab province declared a health emergency due to worsening toxic smog, according to Reuters. Authorities implemented urgent measures, including banning construction activities, extending school closures for another week, and shifting university classes online. The smog, caused by industrial emissions, vehicular pollution, and crop burning, has severely impacted air quality, posing significant health risks to residents. The emergency declaration underscores the urgency of tackling the environmental crisis affecting millions in the region.

[1/2] The 62-storey tower at the Bahria Icon Tower complex is seen through smog and air pollution on a morning in Karachi, Pakistan, November 15, 2024. REUTERS/Akhtar Soomro Purchase Licensing Rights

Source: https://www.reuters.com/world/asia-pacific/pakistans-punjab-shuts-construction-schools-lockdown-looms-fight-smog-2024-11-15/

According to the *Hindustan Times* (November 10, 2024), Multan's Air Quality Index (AQI) remains dangerously high, exceeding 1,900, as Pakistan grapples with an apocalyptic smog crisis. The unprecedented pollution levels, driven by industrial emissions, vehicular traffic, and crop burning, have caused severe visibility issues and health hazards across the region. With hospitals reporting a surge in respiratory illnesses, the crisis highlights the urgent need for stricter environmental policies and immediate mitigation efforts to safeguard public health.

The Hindu News to combat the hazardous pollution levels, authorities have deployed artificial rain technology alongside measures such as closing schools, restricting construction, and regulating industrial emissions. The smog, a recurring issue fueled by vehicular pollution, crop burning, and industrial activities, has significantly deteriorated air quality, posing serious health risks. The government's initiative aims to mitigate immediate impacts while highlighting the need for sustainable environmental strategies.

A man crosses a street engulfed in smog in Lahore on November 16, 2024. Pakistan's most populated province of Punjab on on November 15 extended school closures in smog-hit major cities by a week, with thousands hospitalised as the country battles record air pollution. | Photo Credit: AFP

Sucre: https://www.thehindu.com/news/international/pakistans-punjab-govt-declares-smog-health-crisis-uses-artificial-rain-to-combat-pollution/article68875756.ece/amp/

EFA-EPA November 16 (2024) reports that Pakistan has shuttered schools and enforced partial lockdowns in response to a worsening smog crisis, particularly in Lahore and Multan in Punjab province. The hazardous air quality, caused by industrial emissions, vehicular pollution, and agricultural burning, has severely impacted daily life and public health. Authorities have taken emergency measures, including restrictions on construction and traffic, to curb pollution levels. The crisis underscores the urgent need for long-term environmental reforms to address recurring air quality issues.

Figure 1: Smog in Center of Multan city, 2024

Smog significantly impacts online education by exacerbating health issues like respiratory problems and eye strain, which hinder students' ability to focus on screens for extended periods. Frequent power outages, often accompanying severe smog conditions, disrupt internet connectivity and access to online learning platforms. Hameed (2024)

https://www.youtube.com/watch?v=-SSBmVdJ66k

Environmental factors such as smog exacerbate the challenges faced by ESL (English as a Second Language) and EFL (English as a Foreign Language) learners in Pakistan. Smog not only poses health risks, affecting students' physical well-being and concentration, but also disrupts educational activities by limiting access to schools and outdoor learning spaces. For ESL learners, who often benefit from real-world interactions and immersive experiences, restricted mobility during smoggy conditions diminishes opportunities for practicing conversational English. Aljuhani (2024)

Similarly, EFL learners, who rely heavily on structured classroom settings for exposure to English, face interruptions in their learning trajectory due to school closures and reduced face-to-face interaction. These challenges highlight the urgent need for sustainable online learning alternatives and air quality management systems. Integrating advanced technologies, such as virtual classrooms and AI-driven language tools, can ensure continuity in language education even during environmental crises like smog. Al-Naser & Khataybeh (2025)

Significance of the research

Research on smog is critical for understanding its causes, impacts, and effective mitigation strategies, making it essential for public health, environmental sustainability, and economic development. Smog research helps identify the primary sources of pollution, such as vehicular emissions, industrial activities, and crop burning, enabling policymakers to design targeted interventions. It also aids in quantifying the health impacts, such as respiratory and cardiovascular diseases, helping governments allocate resources for healthcare and awareness campaigns. Additionally, smog research contributes to the development of cleaner technologies, improved urban planning, and sustainable agricultural practices, aligning with global efforts to combat climate change. Importantly, it informs air quality standards, enhances monitoring systems, and fosters regional and international cooperation to address pollution. By advancing knowledge, education and innovative solutions, smog research plays a pivotal role in protecting ecosystems, improving quality of life, and achieving sustainable development goals.

Research Objectives:

1. To identify and analyze the key factors contributing to smog in urban areas of Pakistan.
2. To assess the effects of smog on public health, including its impact on respiratory and cardiovascular health.
3. To investigate the educational disruptions caused by smog, with a focus on access to online education and the challenges faced by underprivileged students.
4. To recommend sustainable and effective solutions for improving air quality and mitigating the adverse effects of smog on health and education in Pakistan.

Research Questions:

1. What are the primary causes and contributors to smog in Pakistan, particularly in urban areas like Lahore and Multan?
2. How does smog impact public health and educational systems in Pakistan, especially during peak smog seasons?
3. What are the specific challenges faced by students in maintaining academic continuity during smog-induced school closures?
4. What strategies and policies can be implemented to mitigate the adverse effects of smog on public health and education in Pakistan?

Research methodology

To conduct the research secondary data was reviewed that involved analyzing existing datasets, reports, and studies to gain insights into air pollution patterns, sources, and impacts without the need for primary data collection. This included reviewing government and environmental agency reports, air quality monitoring data, health records, and scientific publications that document smog levels, trends, and associated health risks. Secondary data including historical records, satellite data, and census information to understand the spatial and temporal distribution of smog, its correlation with health outcomes, and the effectiveness of past policies was also consulted. By synthesizing and interpreting this existing information, researchers identify knowledge gaps, trends, and evidence-based recommendations for addressing smog.

Literature Review

Pakistan big cities with huge population, industries and agricultural wastage are sources of pollution (PM2.5) that poses a significant threat to respiratory health in these cities. There is a huge industrial emission, vehicular exhaust, and biomass burning that is great contributors to poor air quality. PM2.5 when inhaled for a long time with more exposure cause inflammation, reduced lung function, and increased risks of respiratory conditions.

Conditions of asthma, bronchitis, and chronic obstructive pulmonary disease (COPD). Children, elderly people and pre-existing health conditions may affect people more. (Lin et al, 2024).

Javed et al, (2021) study highlights that Smog poses serious health risks, particularly affecting the eyes, nose, and respiratory system. Exposure to smog can cause eye irritation, redness, and watering, making vision uncomfortable. It also leads to nasal congestion, throat irritation, and breathing difficulties, especially for individuals with asthma or other respiratory conditions. Prolonged exposure can result in skin allergies, headaches, and fatigue, while long-term effects may include lung damage and cardiovascular issues. Preventive measures, such as wearing masks and avoiding outdoor activities during high pollution levels, are essential to minimize health risks. Further, COVID-19 and smog represent two significant health challenges, each exacerbating the impact of the other. COVID-19, a respiratory disease caused by the SARS-CoV-2 virus, can cause severe respiratory distress, particularly in vulnerable populations. Smog, a type of air pollution comprising fine particulate matter (PM2.5) and harmful gases, can irritate the respiratory system and weaken immune defenses. Studies have shown that prolonged exposure to smog increases the risk of respiratory infections and can worsen outcomes for COVID-19 patients by reducing lung function and amplifying inflammation. Additionally, regions with high levels of air pollution often report higher COVID-19 mortality rates, highlighting the interplay between environmental and public health crises. Addressing these issues requires joint strategies that include air quality improvements and robust pandemic responses to safeguard public health.

Akbar et al, (2020) study highlights that COVID-19 pandemic necessitated a rapid transition to online learning in Pakistani universities, exposing significant challenges and opportunities within the education system. Limited access to stable internet and digital devices emerged as critical barriers, particularly for students in rural and underprivileged areas. Universities also faced difficulties in implementing effective Learning Management Systems (LMS), as many lacked the infrastructure to support large-scale online education.

Sumair et al, (2024) research highlights that the country's limited resources and weak regulatory frameworks exacerbate the issue, leaving urban populations' particularly vulnerable to respiratory and cardiovascular diseases. Effective strategies to combat smog include transitioning to cleaner energy sources, enforcing stricter emissions standards, and investing in public awareness campaigns. Studies also emphasize the importance of enhancing healthcare infrastructure and adopting successful models from other countries to mitigate smog's impact on public health and the environment.

Raza et al, (2021) study find out that urbanization, industrialization, and the rising consumption of fossil fuels are widely recognized as key contributors to deteriorating air quality. Smog, a visible form of air pollution, results from the complex interaction of pollutants such as nitrogen oxides (NO_x) and volatile organic compounds (VOCs) under sunlight. This environmental hazard poses severe health risks, including pulmonary, respiratory, and skin diseases, particularly in densely populated urban areas. Addressing smog requires coordinated efforts to regulate emissions, promote cleaner energy sources, and improve public health measures.

Chaudhary & Piracha (2021) reveal that natural and manmade disasters are catastrophic events that disrupt lives, economies, and the environment, though their causes differ. Natural disasters, such as earthquakes, floods, hurricanes, and wildfires, result from natural processes of the Earth or climate systems. These are often unpredictable and can lead to widespread devastation. In contrast, manmade disasters, like industrial accidents, oil spills, deforestation, and armed conflicts, stem from human actions, negligence, or technological failures.

Coleman, L. (2006) in the study on manmade disasters shared that natural disasters highlight the vulnerability of human systems to nature; manmade disasters underscore the responsibility of humans in preventing avoidable crises. Both types of disasters require robust preparedness, effective mitigation strategies, and coordinated response efforts to minimize their impact.

Zhang, & Samet (2015), clean Air Act (U.S., 1963), set air quality standards to limit emissions from industries and vehicles. There are global initiatives to prevent from smog and minimize its impacts. International treaties and protocols, like the Kyoto Protocol and Paris Agreement, aimed to reduce emissions that contribute to smog and climate change.

Smog has influenced literature, art, and public policy. For example, the "pea-soup fog" of London was a recurring motif in Victorian literature, while modern awareness campaigns emphasize its health and environmental risks.

There is a complex relationship among natural resources, economic growth, and carbon emission. There is a role of information technology (IT), and corruption in development projects. Natural resource management is more important when it is question to use natural resources for sustainable development. Combining role of Fintech and IT can help by enabling optimal utilization of natural resource management, promotion of use of renewable energy resources, and facilitating carbon trading systems to reduce emissions. However, there is corruption, which may effect and damage planning and execution of plans and strategies. Transparency and accountability is much needed at all the level and by independent third party monitoring and evaluation. This may be a combating corruption, nations can better balance economic growth with environmental sustainability and achieve lower carbon footprints. (Jia et al, 2024).

There is growing asthma cases reported in Karachi, Pakistan these are due to poor urban expension and having no focus on plantation. There are various socio-environmental and genetic factors. One of key contributing factors is exposure to air pollution, particularly fine particulate matter (PM2.5). dust and hazardous air elements are damaging indoor air pollution from biomass fuels. Family history of asthma have potential in case of smoking and obesity may further exacerbate its incidence. Worst urban planning, lack of green spaces, and inadequate healthcare facilitation are main factors. Public awareness, campaign, investment in health and effective planning with implementation on laws may contribute to improve air quality of Karachi. (Razzaq et al, 2018).

Lahore city experienced as worst fog in last few years and there is ambient air pollution that played a significant role to spread asthma among various population groups. There was vehicular emissions and industrial wastage and burning of agricultural wastage that caused high levels of pollutants like particulate matter (PM2.5 and PM10), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2). Children, elderly people, people with disabilities and pre-existing respiratory conditions have more potential to be more effected by prolonged exposure to polluted air. Such vulnerable groups may trigger asthma attacks, lungs infection, and pulmonic issues. Dense urban setups, lack of green belts, and more air conditioning units further exacerbate the issue. There should be law and regulation, public awareness and sustainable development through urban planning and mitigation strategies. This may contribute to decrease air pollution in Lahore. (Aslam et al, 2023).

People of Lahore are facing worst smog situation in Pakistan. It is worst in urban centers where there is a severe environmental challenge and public health crisis. This is due to unchecked vehicular emissions, industrial wastage pollution, crop residue burning, and reliance on fossil fuels. There are some seasonal weather patterns, including winter inversions, trap pollutants and smog that reduces air quality. There are health impacts include respiratory diseases, reduction in life expectancy and cardiovascular issues. There are many

issues due to poor visibility as accidents increase and may cause wastage of resources and causalities too. There may be more preventive measures include transitioning to cleaner energy sources, monitoring and evaluation of vehicles and industries, and increasing urban green spaces. Regional Corporation, and cooperation with neighboring countries may contribute for sustainable development. (Raza et al, 2021).

The report of the Working Group on Polycyclic Aromatic Hydrocarbons (PAHs) by the Joint Task Force on the Health Aspects of Air Pollution of Pakistan is horrible. There is underscores the significant health and environmental risks posed by PAHs. There is incomplete combustion of organic materials; biomass and tobacco are factors in decreasing air quality index. PAHs are linked to carcinogenic, mutagenic, and asthmatic effects, and badly affecting people in urban areas resulting exposure from motor vehicles. There is industrial emissions, agriculture wastage, use of pest control chemicals and residential heating. There is need to improve monitoring and evaluation system, control on implementation on emission regulations, and effective public health awareness strategies. There is need of international cooperation and policy frameworks. (World Health Organization, 2021).

There is a role of World Bank in minimizing pollution from Pakistan through projects and collaboration. World Bank had a significant impact through the development of various industries and standard for defusing industrial wastage. They have technical guidance for improved infrastructure, advanced technology and economic diversification. There is financial support along with technical expertise in key sectors including alternate energy, agriculture, manufacturing, and transportation. Additionally, the World Bank's has a focus on capacity building and the priority area is institutional reforms. They aware and convince government to ensure regulatory frameworks, and private sector involvement. World bank has great contribution to sustainable development and governance in the country. (BHORAT, 2024)

There is worst impact of smog and poor air quality on the economic development, health conditions, and environmental quality in large cities of Pakistan. The smog has many causes, key causes are vehicular emissions, industrial pollution, and agricultural practices. These left significant impact on health and lives of people. Due to smog people of big cities are facing economic challenges due to lock down and reduction in market timings. Government impose penalties on business not following guidelines. Economic conditions in big cities are badly effected as people can't approach work spaces, face poor health, and potential to accidents due to low visibility. There is decreased tourism, transportation disruptions, and reduced agricultural yields that cause poor economic conditions. (Nasir et al, 2025)

Nadeem et al (2024), the smog has caused serious health concerns, including respiratory illnesses, eye irritation, and throat problems. Over 1.8 million people in Punjab have reportedly been affected, with children being particularly vulnerable. To address the crisis, the Pakistani government has implemented measures such as closing schools, limiting outdoor activities, mandating remote work, and setting up mobile health clinics

Khalid et al (2024), to address the crisis, local authorities in Punjab have declared a "smog emergency." Measures include closing schools, restricting outdoor activities, and promoting remote work where possible. However, enforcement of these measures and the adoption of sustainable solutions remain challenging

DISCUSSION

Impacts of smog in Pakistan

Smog causes respiratory and cardiovascular problems, eye irritation, and an increased risk of asthma and other chronic conditions, reduced visibility, damage to crops, and degradation of

infrastructure. The impacts of smog in Pakistan are profound, impacting public health, the environment, and the economy. Here's a detailed overview of its consequences:

Health Impacts

Smog is a significant health hazard, particularly due to fine particulate matter (PM2.5) and ground-level ozone (O_3).

Respiratory Issues: Increases cases of asthma, bronchitis, and other chronic obstructive pulmonary diseases (COPD). Causes irritation of the respiratory tract, coughing, and shortness of breath.

Cardiovascular Problems: Fine particles in smog penetrate the bloodstream, increasing the risk of heart attacks, strokes, and hypertension.

Eye and Skin Irritation: Causes eye irritation, redness, and watering. Long-term exposure can lead to skin damage and allergic reactions.

Child and Elderly Vulnerability: Children, the elderly, and individuals with pre-existing health conditions are most at risk from smog-related illnesses.

Premature Deaths: According to studies, thousands of deaths in Pakistan are attributed to air pollution annually, with smog being a significant contributor.

Environmental Effects

Smog harms ecosystems and the natural environment. Dense smog lowers visibility, causing accidents on roads and delays in air and rail transport. Pollutants like ozone damage crops, reducing agricultural yields. Smog disrupts photosynthesis by blocking sunlight, affecting plant growth. The presence of black carbon and greenhouse gases in smog contributes to global warming and regional climate disruptions.

Economic Impacts

Increased healthcare expenditure due to smog-related illnesses strains public and private resources. Workers and students suffer from reduced productivity due to illnesses and smog-related disruptions. Lower crop yields and damage to vegetation directly impact the income of farmers and the agricultural economy. Reduced visibility disrupts road, rail, and air transport, causing financial losses and logistical challenges. Smog in cities like Lahore and Islamabad deters tourists, impacting the hospitality and tourism sectors.

Impact on Education ESL/EFL Perspective

The impact of smog on education in Pakistan is significant, affecting students' health, attendance, and overall learning environment. During severe smog episodes, schools often close to protect children from the hazardous air quality, disrupting academic schedules and reducing instructional time. Prolonged exposure to smog can lead to respiratory illnesses, eye irritation, and fatigue, impairing students' ability to focus and perform well in studies. Teachers and school staff are also affected, contributing to absenteeism and a decline in the quality of education. Additionally, outdoor activities like sports and physical education are limited, depriving students of essential physical and mental stimulation. These challenges highlight the urgent need for policies that address air pollution and ensure a safer, healthier educational environment.

During the COVID-19 pandemic, online education posed significant challenges for ESL (English as a Second Language) and EFL (English as a Foreign Language) learners in Pakistan. Limited access to reliable internet and digital devices disproportionately affected students in underprivileged areas, restricting their ability to engage effectively with online lessons. For ESL learners, the lack of face-to-face interaction hindered opportunities to practice conversational skills, reducing exposure to authentic language use. Farooq et al, (2020)

Suggestion to cope with smog

Coping with smog requires a combination of individual actions, community efforts, and government policies to mitigate its health and environmental impacts. Here are effective strategies at various levels:

- Health protection by wearing use of high-quality masks, such as N95 or N99, to filter out fine particulate matter (PM2.5).
- Limit outdoor activities, especially during peak smog hours (early morning and late evening).
- Install air purifiers at home to reduce indoor air pollution.
- Close windows and doors to prevent outdoor pollutants from entering.
- Reduce exposure
- Use apps or websites to track real-time air quality indexes (AQI) and plan activities accordingly.
- Seek medical advice if you experience respiratory or cardiac issues.
- Educate communities about the dangers of smog and how to reduce exposure.
- Promote alternatives to harmful practices like burning waste or crop residues.
- Reduce the number of vehicles on the road to minimize vehicular emissions.
- Establish educational institutions with on campus and distance based learning with same effectiveness and efficiency
- Learn from cities like Beijing, which reduced smog through strict emission controls, cleaner energy adoption, and public transportation improvements.
- Adapt Singapore's haze management strategies, including real-time air quality monitoring and public advisories.

By combining these strategies and fostering cooperation across individual, community, and governmental levels, it is possible to mitigate the impacts of smog and improve air quality sustainably.

Conclusion

Smog is a critical barrier to achieving sustainable development, particularly in rapidly urbanizing and industrializing regions. Addressing smog requires integrating environmental policies with development strategies to ensure a balance between economic growth, social equity, and ecological health. By taking a proactive approach to reduce smog, countries can make significant strides toward sustainable development and improve the quality of life for current and future generations

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