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Barriers to environmental compliance in public transport: A study on emission and noise pollution law awareness in Karachi

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Abstract

All types of vehicles release harmful pollutants in the form of smoke and noise, which is a critical environmental challenge for Karachi. Public transport, in particular, exacerbates this issue. Unfortunately, many people are unaware of these rules, leading to non-compliance with all regulations. This research seeks to determine whether public transport drivers in Karachi understand air and noise pollution laws. The study has been based on secondary data (Literature Review) to establish their knowledge about emission standards, noise level restrictions, and penalties for failing to comply with these laws. The research results indicate that most drivers are uninformed of these regulations and do not undertake vehicle maintenance routines that are likely to reduce pollution. Significant interferences to this knowledge include high rates of illiteracy, poor enforcement of laws, and poverty. The findings of this study strongly suggest the lack of a mandated structure for education, lack of policies, and motivation for developing environmentally conscious behavior among people.

Keywords: awareness, enforcement, pollution, public transport, regulation

Introduction

In developing countries like Pakistan, public transportation is becoming an increasingly essential mode of transportation since it is readily available and convenient for the general population (Habib et al., 2024). Noise pollution is a serious environmental hazard generated by artificial machines that badly affects human activities and the sustainability of life (Das et al., 2023; Latif et al., 2022). People consider Pakistan's transportation industry as the primary economic growth and developmental backbone.

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Evidence suggests that 6% of job opportunities in Pakistan are created by transportation services (Imran & Shutsha, 2025). With a population of about 207 million, the Islamic Republic of Pakistan is ranked as the world's 6th largest country and the 34th largest country based on its area of 796,096 square kilometers (Shah, 2021). Noise pollution is one of the harmful substances that intervene, disrupt, and impair the normal functioning of life (Khan et al., 2021). In Pakistan, polluted air is a big concern in urban cities as it stands in line; one of the significant issues is both an environmental one, a public health issue, and a cause for concern on the economic front (Sumair et al., 2024).

Since the United Nations approved the Sustainable Development Goals (SDGs) in 2015, the whole world has been trying to attain these goals by improving standards of living (Malik et al., 2023). Noise pollution, or unwanted sound from the actions of humans, is now recognized as a serious global issue, particularly in urban areas (Nath et al., 2024). Noise generated from transportation is a significant factor in the noise that inhabitants of a metropolitan area face (Ahmed et al., 2023; Cooper et al., 2010).

Air and noise pollution have particularly hit urban areas of Pakistan, such as the megacities, with the health and environment. Noise and air pollution are aggravated since most of the public vehicles have broken engines and emit a lot of smog. Although the country has regulations to restrict the effects on the environment, Pakistan does not comply by implementing them and ensuring enforcement, and the transport companies are hardly ever aligned with them. This paper is going to evaluate the level of understanding of the air and noise pollution rules by Operators of public transport in Karachi. Knowing the attitudes and level of knowledge of the regulations among people can help find the flaws in the practice and law enforcement.

Drivers of public transport have direct or indirect effects on pollution, and they can be more sensitive to the fact that they drive and that their cars are maintained in such a way that takes a toll on environmental degradation. The paper is going to use a structured survey in order to have statistical evidence of the knowledge of the drivers and what needs to be done by the government. Its findings will guide policymakers, environment, and transport agencies to develop more effective sensitizations, training programs, and regulations that improve compliance with pollution laws.

Methodology

This study employed a systematic review methodology, with research objectives established accordingly. A comprehensive literature review was conducted (Komba & Lwoga, 2020). Research findings were categorized based on their content (Hiver et al., 2021; Petticrew & Roberts, 2006), and classified information was incorporated into the study by organizing it into headings (Gan et al., 2021; Pawson et al., 2005). The evaluation of classified information and titles formed the basis of the study (Page, 2021; Rahi, 2017), ensuring the integrity of the research subject and its contents (Egger et al., 2022; Victor, 2008). The criteria for selection are enlisted.

Relevance: Researches that directly addressed the questions posed by this study are included.

Quality: Studies that meet a certain quality threshold (e.g., methodological rigor, bias risk) are included. Most of the research is from Scopus-indexed and Clarivate Analytics journals and reputed publishers.

Recency: Consideration of the publication date to ensure that the review reflects the most current evidence. Most of the studies are from the last three years.

Language: Only studies published in English are included.

Data Completeness: Previous studies must provide sufficient data on outcomes of interest for practical synthesis; it is also ensured in this research.

This study did not use primary data from human participants; therefore, no ethics clearance letter from the ethics committee was required.

Review of the Literature

It has been shown that individuals exposed to a polluted environment are more exhausted, in a bad mood, and lacking attention (Cooper et al., 2010; Das et al., 2023). During breaks, people ought to wear protective gear and avoid lack of ventilation. The publication recommends that the authorities should improve the system of traffic control and encourage people to make use of public transport in order to diminish air pollution in Lahore (Aftab et al., 2023). Cities in Less Developed

Countries (LDC) are characterized by low car ownership rates, with a high proportion of the population being dependent on public transport for longer trips, in theory at least (Russell & Anjum, 2007).

A study was carried out to measure the intensity of traffic noise pollution in the city of Larkana. It was concluded that very high level of traffic noise levels was observed due to the unplanned and lack of sustainable planning (Chandio et al., 2010). Many problems in Pakistan's transportation system hinder people from moving easily and cause several health problems (Habib et al., 2024). Because the number of vehicles on roads is increasing, the present situation requires better road infrastructure (Latif et al., 2022).

Observing noise level records at various times of the day shows that the noise level changes. The data shows that the variation in temperature is statistically meaningful both over different times at any given location and in various spots. At the Karachi Company site, the levels of noise did not change much during the summer, unlike at the other places. It could be because of the constant business activity at this site. However, this part of the world had significant daily changes in data measurements during winter (Khan et al., 2021).

There are various causes of air pollution in Pakistan's cities, and they all help make the air worse and lead to more health issues. Much of the pollution comes from car exhaust, factories, and also from crop-burning practices in farming (Ahmed et al., 2023). Based on studies and reports from various sources, this section provides an entire explanation of these factors (Nath et al., 2023). Cars and their engines help release a good amount of dust, fine and coarse particle matter, nitrogen oxides, carbon monoxide, and volatile organic compounds in the air of Pakistan (Sumair et al., 2024).

Historical Context of Air and Noise Pollution Laws in Pakistan

The path of air and noise pollution legislation in Pakistan indicates how the country reacted slowly to the rising environmental issues. Until the 1980s, environmental problems such as pollution received little attention from legislation. But as urbanization, industrialization, and traffic increased there started air and noise pollution, which is a serious problem in the major cities of Pakistan such as Karachi, Lahore, and Islamabad.

In their turn, it resulted in the introduction of the Pakistan Environmental Protection Ordinance in 1983, which paved the way for environmental regulation. It was an earlier step but only partial in terms of coverage and effectiveness. There was a stronger structure that came about in the year 1997 after the placement of a law called the Pakistan Environmental Protection Act (PEPA) that ousted the previous directive. PEPA was used to give the federal and provincial Environmental Protection Agencies (EPAs) authority to prosecute offenders and enforce environmental norms.

To tackle air and noise pollution, in particular, the government came out with a new policy called the National Environmental Quality Standards (NEQS), which prescribed an acceptable degree of emissions and noise of vehicles, industries, and construction. Courts have also, in the long run, contributed by considering the right to a clean and healthy environment as a constitutional right to life. Though the legal framework is in place, enforcement is not uniform; this means that there is a need to build stronger institutional capacity and create awareness among the masses.

Theoretical Context of Air and Noise Pollution Laws in Pakistan

Environmental management, sustainable growth, and health protection are the concepts of laws that should be created in Pakistan to punish air and noise pollution. These rules are shaped by worldwide ecological concepts such as the Polluter Pays Principle, the Precautionary Principle, and the Wide Development Goals (SDGs), namely SDG 11 (Sustainable Cities and Communities) and SDG 13 (Climate Action) to consider.

Section 3 of the Pakistan Environmental Protection Act (PEPA) 1997 asks the government of Pakistan to maintain clean air and noise levels. According to environmental risk management, the National Environmental Quality Standards (NEQS) determines the volume of particulate pollutants that would be emitted by cars and factories. Lastly, the Motor Vehicle Ordinance of 1965, as envisaged in municipal regulations, takes into consideration the deterrence theory, which says that imposing fines prevents vehicles from emitting excess noises and emissions. Between the laws and law enforcement lies the challenge of the fact that the absence of capacity and good enforcement can prevent compliance.

According to the behavioral theory of environmental management, promoting sustainable practices and raising awareness can enhance adherence to laws. Although Pakistan's legal framework for air and noise pollution combines behavioral, economic, and regulatory approaches, successful environmental protection still requires increased enforcement and public participation.

Air and Noise Pollution Laws in Pakistan

Pakistan has many laws and legislation that aim at the control of air and noise pollution and are being conducted primarily within the frame of the Pakistan Environmental Protection Act (PEPA) 1997. The act gives the Pakistan Environmental Protection Agency (Pak-EPA) and the province's EPAs powers to enforce environmental norms, such as air and noise pollution laws. Under PEPA 1997, industry, cars, and other pollution sources must adhere to the National Environmental Quality Standards (NEQS), establishing allowable emissions and noise level limits. The Motor Vehicle Ordinance 1965 and Section 2G8 of the Pakistan Penal Code (PPC) regulate excessive automotive emissions and noise disruptions, establishing fines and penalties for violations.

The government has implemented measures to mitigate air pollution, including Euro-V gasoline regulations, the promotion of electric vehicles (EVs), and limitations on industrial emissions. To reduce noise pollution, authorities impose regulations on horn usage, construction activities, and industrial noise levels in urban areas. Regardless of these restrictions, enforcement is ineffective due to a lack of awareness, corruption, and inadequate monitoring. Enhancing implementation, public awareness, and technological innovations in pollution management is essential for ensuring adherence to environmental legislation and improving air quality in Pakistan.

Challenges for Air and Noise Pollution Laws in Pakistan

Pakistan presents considerable obstacles in implementing and enforcing air and noise pollution regulations while possessing a legislative framework. The challenges arise from inadequate enforcement, insufficient public knowledge, political and industrial opposition, inadequate infrastructure, and rapid urbanization.

Insufficient Enforcement and Regulatory Deficiencies: Pakistan in 1997, PEPA and NEQS were used as the primary legislation to regulate the air and noise pollutants in Pakistan. Nevertheless, the degree of consolidated action is low as the organizational structures on the two levels of environmental protection (EPAS) do not cooperate appropriately. Most industries and transport providers continue to pollute due to corruption in the system, influence by politicians, and lack of sufficient oversight.

Insufficient Public Awareness and Adherence: May be due to low levels of education and understanding of propaganda, people, entrepreneurs, and transporters face inconveniences since there is not enough information about the laws that regulate pollution and its outputs. Many enterprises working in the field of public transportation and industry lack knowledge about the safe level of emissions and noise. Lack of sufficient awareness permits pollution to grow further through vehicles, plants, and construction sites, hence rendering the environment and the people to suffer needlessly.

Poor and Unproductive Public Transport System: Air and noise pollution has become dramatically worse in Pakistan because of the undeveloped system of public transport in the major cities of Pakistan, such as Karachi, Lahore, and Islamabad. The majority of the public buses, rickshaws, and trucks run with old diesel engines that emit large quantities of smoke and harmful emissions, such as carbon monoxide (CO) and nitrogen oxides (NOx). Similarly, noise pollution is worsened by over-edged car honking, failure to service engines well as well as traffic jams.

Industrial Pollution and Absence of Green Technology: A lot of pollution is generated in Pakistan's major cities, mainly because industries do not follow the required environmental rules. Because many enterprises rely on coal and low-quality fuels, the air pollution caused by these practices is higher. In addition, most industrial areas do not provide proper methods for getting rid of waste or for purifying the air, which increases the air pollution problem.

Lack of an Effective Monitoring and Sanctioning System: Air and noise pollution are not always accurately monitored in real-time, as Pakistan's system for this task is not developed enough. Very few places for monitoring air quality, and most of the data isn't very precise. As well, some penalties for polluting may not be substantial enough to stop people from breaking the rules. A lot of transportation

and industrial companies still pollute since they are not worried about possible legal consequences.

Accelerated Urbanization and Unregulated Development: The escalation of urbanization and construction initiatives has exacerbated pollution levels. The proliferation of high-rise structures, road expansions, and infrastructure projects results in heightened dust, traffic emissions, and construction noise. Inadequate urban design leads to traffic congestion, heightened fuel usage, and exacerbated environmental degradation.

Political and Industrial Opposition: It is common for industrial lobbyists and political parties to oppose stricter measures for the environment. Industries usually do not want to use cleaner technology because it costs more. In the same way, some government officials may give preference to expanding the economy instead of taking steps to save the environment. Trying to follow laws for air and noise pollution management is challenging for Pakistan because of old facilities, little public awareness, and opposition from industrial sectors.

Better surveillance, harsher punishments, supporting environmentally friendly solutions, and raising awareness among the public help deal with these issues. As things stand now, the country will keep facing dangerous environmental and public health emergencies for some time.

Opportunities for Air and Noise Pollution Laws in Pakistan

Air and noise pollution in Pakistan have been regarded as the most serious environmental problems more so in urban centers like Lahore, Karachi and Islamabad. Industrialization, urbanization, and motorization have come so fast that the capacity of the country with respect to its environmental regulation capacity cannot keep up. Even though Pakistan possesses certain laws regarding pollution and response to it, both at the federal level the Pakistan Environmental Protection Act of 1997, and at the provincial level in the form of regulations, there is a great margin of growth and strategic development. These opportunities provide a way forward to improve efficacy, enforceability and international compliance of air and noise pollution laws.

The first big opportunity entails legislative reform. The existing laws tend to be vague especially on the stipulation of national standards of air quality, or even the maximum amounts of noise that can be allowed. Pakistan can establish more measurable and enforceable limits of pollution by upgrading its legal structure and adding them with comprehensive thresholds in accordance with the World Health Organization (WHO) and United Nations Environment Programme (UNEP) guidelines. Development of national ambient air quality standards (specification on the pollutant basis) and development of noise zones (residential, industrial, and silence zones) would provide the legal certainty as well as consistency between provinces.

Institutional reinforcing and harmonization, is another crucial opportunity. The federal and provincial environment protection agencies (EPAs) frequently experience poor administration, little technical competence, and lack of inter-agency collaboration. A more unified one, such as, an association between EPAs and urban development authorities, traffic departments and municipal corporations will guarantee EPA that pollution reduction is addressed in an organized method of enforcement. Such institutions can be assisted by international donors or multilateral agencies in embarking on capacity building activities that can enable them conduct periodic monitoring, data analysis and awareness creation to the populace.

The use of technology and data-driven monitoring presents a modern pathway to improved environmental governance. Installing low-cost air quality sensors and noise meters in major cities and industrial zones can provide real-time pollution data to both regulators and the public. Mobile applications and web dashboards can help citizens access pollution data and report violations, creating community involvement and pressure for compliance.

A further opportunity lies in public participation and legal empowerment. Environmental laws should allow for public interest litigation, citizen complaints, and transparent access to pollution data. Civil society organizations, educational institutions, and youth groups can be instrumental in raising awareness and advocating for change. By empowering citizens to demand cleaner air and quieter environments, the legal framework becomes a tool for participatory governance.

Moreover, pollution control can be incentivized through economic instruments. Introducing pollution taxes, congestion pricing, and subsidies for clean technologies (such as electric vehicles, solar-powered machinery, and noise barriers) can shift market behavior. Legal provisions can also require Environmental Impact Assessments (EIAs) for all major infrastructure and industrial projects, ensuring that air and noise impacts are considered from the start. Lastly, regional cooperation—especially with neighboring countries facing similar challenges—can help Pakistan adopt best practices in legislative design, pollution tracking, and enforcement. Air pollution, in particular, is a transboundary issue, and participation in South Asian environmental forums can facilitate knowledge exchange and collective action.

In conclusion, the opportunities for strengthening air and noise pollution laws in Pakistan are vast and multifaceted. Legislative reform, institutional capacity, technological integration, public engagement, economic incentives, and regional cooperation together offer a powerful blueprint for a cleaner, healthier future. With sustained political will and stakeholder involvement, Pakistan can transform its environmental laws into robust tools for sustainable development.

Discussion

This study highlights a considerable gap in public transport drivers' awareness of Karachi's air and noise pollution legislation. Despite the availability of regulatory frameworks such as the Pakistan Environmental Protection Act (PEPA) of 1997 and the National Environmental Quality Standards (NEQS), compliance remains low. The report finds illiteracy, poor enforcement, and poverty as primary barriers to drivers understanding and complying with environmental legislation. These concerns highlight the importance of structured awareness initiatives and policy actions to promote sustainable urban mobility. A significant issue is the outmoded public transportation system, in which many cars employ ancient, high-emission engines, exacerbating air pollution.

Uncontrolled horn use and engine noise contribute to excessive noise pollution, which disrupts urban life. The lack of adequate monitoring mechanisms and substantial penalties encourages continued incidents. Without proper car maintenance and driver education, pollution levels will continue to rise, threatening public health and environmental sustainability. According to the findings, addressing these challenges will require collaborative efforts among legislators,

transportation authorities, environmental agencies, and local communities. Mandatory driver training programs, stricter emission testing, and incentives for environmentally friendly automobiles could increase compliance.

Furthermore, more extraordinary enforcement methods, such as higher fines and frequent inspections, would deter non-compliance. Finally, addressing air and noise pollution in Karachi necessitates regulatory changes, awareness efforts, and technology improvements. The government must prioritize sustainable transportation regulations to make cities cleaner, healthier, and more suitable for living.

Conclusion

This study points out that most public transport operators in Karachi are not aware of air and noise pollution regulations. Even with PEPA 1997 and NEQS in place, strict enforcement, lack of education, and poverty are significant barriers to education for children. Because of old public transit systems, unclean cars, loud use of horns, and poor vehicle upkeep, pollution has increased. Besides, when nations do not closely monitor North Korea, punishments are inadequate, and laws are rarely enforced, the situation worsens.

Since these problems affect many groups, all three groups should join forces to solve them. Actions must be taken, for example, by training drivers, setting stricter laws for harmful air pollution, giving benefits to using environmental transportation, and making better systems to check results. If no action is taken right away, pollution will lead to harm to both humans and nature. Stronger regulations and proposals for renewable transport have to be made to make Karachi healthier and help protect the environment for longer.

Recommendations

- The employees of all the government transport should get regular training on environmental regulations, vehicles and environmentally friendly driving to keep the pollution levels low not only in the air but also in the noise levels.

- Enforcement practices of PEPA and NEQS should be improved by increasing inspections and monitoring, as well as imposing heavy penalties on the offenders.
- Ensure the protection of the environment and upgrade the system of public transportation with the help of environmentally safe buses, low-emission cars, and efficient fuel decisions.
- Every single vehicle involved in public transport should be periodically checked concerning the emission, and no fitness certificate is supposed to be awarded until such time when the results of the check correspond to the needed environmental standards.
- Some restrictions on the unusual use of horns and engine adjustments that worsen noise pollution, causing penalties to lawbreakers, should be implemented.
- Subsidize and provide tax benefits and financial incentives to the operators of public transport that shift to eco-friendly or electric cars.
- Installation of a Monitoring Network: There is a necessity to have monitoring stations on air and noise pollution that are real-time incorporated in Karachi in potentially dangerous areas to determine the extent of pollution available and perform actions against it.
- To sensitize people and employees working on public transport regarding the hazards of pollution to health and the environment, you can organize media, social, and community-based days of education.
- Work out a system composed of environmental, transport, law enforcement, and non-profit organizations that create a single response to managing pollution.
- Advocacy of Sustainable Urban Planning: Advocate sustainable traffic that is well managed and increase the number of parks and walking and cycling paths since they will diminish the issue of heavy traffic and air pollution in the city.

Research Implications

Policy Implications: Strict enforcement of environmental regulations and the establishment of driver education programs that would boost pollution regulation compliance are necessary. The operators of the public transportation authorities are supposed to certify and train on the environmental regulations.

Implications for the Environment: Better driver sensibility may lead to positive changes that must improve the maintenance of cars, their emissions, and noise pollution, and this aspect will make the urban environment of Karachi cleaner.

Implications for Public Health: Improved compliance with the air and noise pollution rules by abating respiratory infections, wearing down, and other health concerns connected with pollution can lead to a healthier population.

Implications for Research: This paper lays the framework for future studies on the effectiveness of policy, behavior changes, and the long-term impact of pollution awareness initiatives amongst the transportation workforce.

Future Research Directions

- More studies should focus on ensuring that people's behaviors remain different.
- If you look at how well cities in Pakistan are aware, you can notice differences between the regions and use the information to target your strategies more effectively.
- Look into the ways in which present regulations are working by comparing pollution in the environment before they were put in place and afterward.
- Using vehicle emission monitoring, reducing car noise, and spreading digital awareness might help manage pollution more effectively.
- How people feel about pollution controls should be explored, and research should also assess the impact of community contributions on sticking to rules by transportation leaders.

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