IJEMD-SS, 2 (2) (2023), 1 –6 https://doi.org/10.54938/ijemdss.2023.02.2.224

International Journal of Emerging Multidisciplinaries:
Social Science

Research Paper
Journal Homepage: www.ojs.ijemd.com
ISSN (print): 2957-5311 ISSN (online): 2958-0277

A Traffic Plan to Lessen Smog Season Air Pollution in Lahore, Pakistan

Shumaila Noreen
College of Arts and Science,
University of Nizwa. Nizwa, Oman

Abstract

Lahore has once again topped the list of the most polluted cities in the world. The situation becomes worse during the winter when the heart of Pakistan faces the "smog season". The transportation and industrial sectors are significant contributors to air pollution, which together hold 68% share of the total. It is therefore, highly recommended to minimize vehicular and industrial emissions in order to improve air quality. In this study, a straightforward approach is proposed to regulate industrial discharge and traffic throughout the winter. According to estimates, using this technique to the transportation sector, the air pollution can be reduced by 21.5%. The industrial sector may reduce air pollution by 12.5% by using a similar strategy. The compound model predicts an overall reduction in air pollution of 34%.

Keywords: Air pollution; PM2.5 concentration; Smog; Smog Prevention; Smog Sources

1. Introduction

Air pollution has been one of Lahore's main issue in recent years. Lahore is the second-largest city in Pakistan with a population of 11.1 million people (Nadeem et al., 2021; Riaz and Hamid, 2018) and has been regularly reported on the list of the most polluted cities globally (Naveed and Khayyam, 2022). In the past few years, the phenomenon of smog has gotten worse as a result of unrestricted tree cutting, urbanization and a highly polluted environment caused by a large number of factories, heavy traffic, exceptional construction work, the burning of crop waste by farmers and brick kilns (Hassan and Haq, 2022; Raza et al., 2021). From November through January, a thick layer of fog affects residents of Lahore. Smog outbreaks in the winter are mostly brought on by a lack of air pollution dilution under unfavorable weather circumstances, such as little wind (from continental directions) and a temperature inversion. In the vicinity of Lahore, this dense pollution causes visibility to drop by up to 20–25 meters. Due to inflammation of the lung tissues, coughing, and eye discomfort, it causes major health problems like respiratory tract illnesses, colds, and flu. The entire population of the pollution zone is impacted, but children, the elderly,

Email address: shumaila@unizwa.edu.om (Shumaila Noreen)

and persons who already have breathing or cardiac problems suffer the most (Rehman and Iqbal, 2016; Sughis et al., 2012; Brook et al., 2010).

The Energy Policy Institute at the University of Chicago (EPIC, 2020) created the Air Quality Life Index (AQLI), which links the level of PM2.5 to life expectancy. PM2.5 is a category of small particles that, when inhaled, seriously endanger human health (USEPA, 2020). It demonstrates that every additional 10 µg/m3 of PM2.5 exposure results in a one-year reduction in life expectancy. An average Pakistani loses 2.7 years of life at the present PM2.5 level, while an average Lahori resident loses 5.3 years (EPIC, 2020). In order to reduce air pollution during the smog season, both immediate and long-term preventive actions are required. Face masks, eye protection eyewear, avoiding outdoor activities, and attempting to spend as much time indoors as possible are some short-term solutions. Long-term solutions to the pollution problem are crucial. The air quality index must be improved through plantation. Controlling the emissions of pollutants from manufacturing, transportation, crop waste, and brick kilns is necessary (Asif et al., 2022; Raza et al., 2021; Butt et al., 2018). In this paper, a tactical approach for reducing emissions from transportation and industry has been put out. This is a quick fix that can be used to lower the air quality index during the months of intense smog.

A traffic model to control smog

Lahore's air quality has significantly worsened in recent years. The aver- age daily PM 2.5 concentration in Lahore is noticeably higher than both the 35 µg/m^3 and the 25 µg/m^3 standards set by the Environmental Product Declaration (EPD) and the World Health Organization (WHO), respectively. Lahore experiences daily average concentrations that can be up to 13 times the EDP's threshold throughout the winter. Lahore's average annual PM concentration was 117 µg/m^3, which is much higher than the WHO's (10µg/m^3) and the EPD's standards (15 µg/m^3) (Habib et al., 2021).

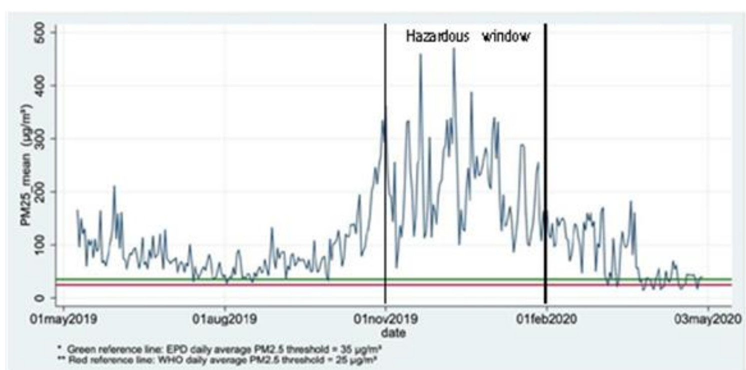

Figure 1: Lahore's daily average PM2.5 concentration, May 2019 - April 2020 (Habib et al., 2021)

Figure 1 shows the daily trend of Lahore's average particular matter 2.5 (PM2.5) concentration from May 2019-April 2020 in micrograms per cubic meter (µg/m3). These data imply that Lahore suffers high PM2.5 concentrations from November 1 to February 1, which is designated as a hazardous window. It is challenging to estimate how much air pollution sources con- tribute to total emissions in the absence of research data. The Food and Agriculture Organization (FAQ) published a report in 2020 that stated that the transport sector accounts for 43% of total air pollution. Industrial emissions account for 25% of emissions, agricultural emissions, namely from burning crops, account for 20%, and coal-fired power plants account for 12% of emissions in Punjab. The sectoral emission share of the sources of air pollution in the Punjab province is shown in Figure 2. The identical distribution of pollution share indicated in Figure 2 is anticipated for the city of Lahore in the absence of air pollutant data pertaining to the sectoral inventory of Lahore.

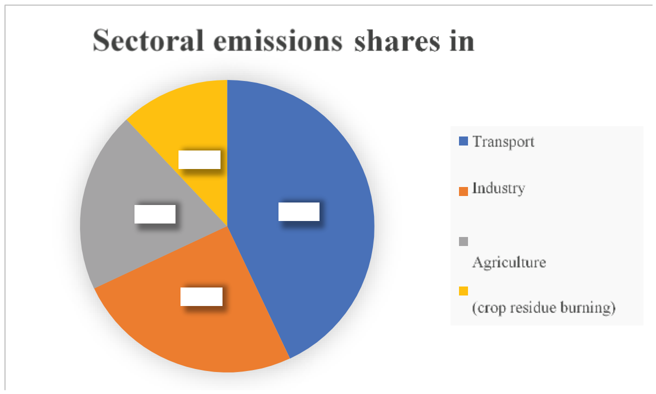

Figure 2: Sectoral air pollution share in Punjab - Oct, Nov (CUMULATIVE 2008-2017)

To improve air quality, reducing automotive emissions is absolutely essential. This can be done through fewer cars on the road, more public transportation, and better automotive maintenance. A strategic model is suggested to reduce the amount of traffic during the months that are included in the hazardous window. Suppose that Lahore has one million registered vehicles. We assume that registration numbers are evenly spread, all of which have even or odd digits. We further suppose that 0.5 million of these registered cars are driven every day on average. The traffic model for this scenario is detailed in Table 1 below. If the city's traffic is planned so that 50% of the vehicles operate on one day and the remaining 50% operate on the following day, then the vehicles with odd registration numbers will coincide with odd dates and the vehicles with even registration numbers will operate on even dates.

Traffic Model for hazardous window								
Date	1	2	3	4	5	6	7	...
Reg.No	Odd	even	odd	even	odd	even	odd	...

This strategy is named Model A. By implementing Model A in Lahore, it will be possible to cut the amount of air pollution produced by the transportation sector by 50%, and it will cut overall pollution by 21.5 percent. The industrial sector in Lahore can be organized using a similar methodology. Assume Lahore has 10,000 industrial units, numbered from 1 to 10,000, each of which is permitted to operate on a different day. Only odd dates will be used by the industries with odd numbers, and only even dates will be used by the industries with even numbers. Model B is the name of this design. Applying Model B will result in a 50% reduction in the total emissions produced by the industrial sector and a 12.5% decrease in overall air pollution. The combination of models A and B is named Model AB. The compound model in Lahore can reduce the overall air pollution produced from the industrial and transport sections by 34%. Although PM 2.5 concentration is above the green and red line for other months, we cannot implement this strategy to manage traffic over a long period.

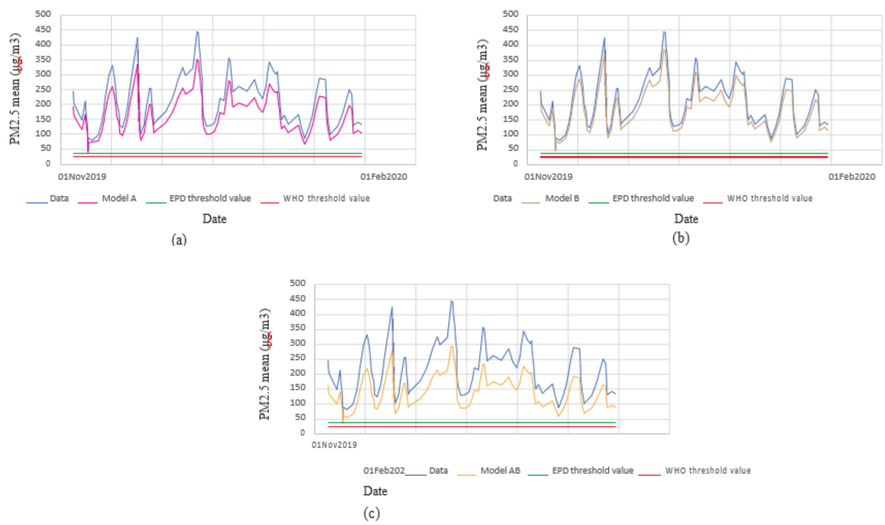

Figure 3: A comparison of Lahore's daily average PM2.5 concentration, Nov 2019 - Feb 2020 using literature values and after (a) applying Model A. (b) applying Model B. (c) applying compound Model AB. The software "GetData Graph Digitizer" has been used to extract data from Figure 1.

Figures 3a and 3b show the effects of Models A and B on PM2.5 concentration, respectively, whereas Figure 3c displays the trend in PM2.5 concentration as predicted by the compound model. Figure 3 shows that if traffic is scheduled so that the number of cars would be cut in half during the months that lie in the hazardous window, PM2.5 concentrations will become low. Likewise, the amount of PM2.5 concentration can be reduced by reducing industrial emissions during the months of the hazardous window.

2. Conclusion

Smog has a significant impact on Lahore, Pakistan's second-largest city, throughout the winter. The main causes of haze in Lahore include urbanization, vehicle emissions, industrialization, and crop burning. On a national level, smog prevention measures must be both immediate and long-term. In this work, a straightforward strategic approach for scheduling city transportation and Industrial activity during months of intense smog is offered. Vehicle and industrial emissions can be reduced by 50% as a result. Although air pollution can be somewhat regulated by reducing industrial and vehicular emissions, the intended results are still awaited. Better facilities can be used to promote the use of public transportation. Policies for vehicle upkeep and inspection should be implemented. To reduce industrial emissions, industrial policies also need to be put into practice. The public must have access to air quality information because when they are aware of how much dirty air they are breathing, they are better able to protect themselves and work to minimize air pollution.

Declarations

"All authors have read, understood, and have compiled as applicable with the statement on "Ethical responsibilities of Authors" as found in the Instructions for Authors".

Consent to Participate

Not applicable

Consent to Publish

Not applicable

Authors Contribution

The author confirms sole responsibility for manuscript preparation.

Availability of data and materials

The author confirms that the data supporting the findings of this study are available within the article.

Funding

The author declares that no funds, grants or other support were received during the preparation of this manuscript.

Competing Interests

The author has no relevant financial or no-financial interests to disclose.

3. References

[1] Asif, M., Rasheed, B., Rafaq, A., Impact of health capital on economic growth in pakistan. International Journal of Emerging Multidisciplinaries: Social Science **1,** 1–8 (2022).

[2] Brook, R.D., Rajagopalan, S., Pope III, C.A., Brook, J.R., Bhatnagar, A., Diez-Roux, A.V., Holguin, F., Hong, Y., Luepker, R.V., Mittleman, M.A., et al., Particulate matter air pollution and cardiovascular disease: an update to the scientific statement from the American heart association. Circulation **121,** 2331–2378 (2010).

[3] Butt, M., Waseef, R., Ahmed, H., Perception about the factors associated with smog among medical students. Biomedica **34,** 264 (2018).

[4] EPIC, "Air Quality Life Index (AQLI): Pakistan Factsheet." Energy Policy Institute at the University of Chicago, 2020.

[5] Habib, A., Nasim, S., Shahab, A., Charting Pakistan's air quality policy landscape, 2021.

[6] Hassan, S.A., Haq, I., The role of renewable energy sources in energy imports: Evidence from bric countries. International Journal of Emerging Multidisciplinaries: Social Science **1,** 1–20 (2022).

[7] Nadeem, M., Aziz, A., Al-Rashid, M.A., Tesoriere, G., Asim, M., Campisi, T., Scaling the potential of compact city development: The case of lahore, pakistan. Sustainability **13,** 5257 (2021).

[8] Naveed, Z., Khayyam, U., Smog and cognitive issues in the school going children of lahore and islamabad, pakistan. International Journal of Environmental Science and Technology, 1–16 (2022).

[9] Raza, W., Saeed, S., Saulat, H., Gul, H., Sarfraz, M., Sonne, C., Sohn, Z.H., Brown, R.J., Kim, K.H., A review on the deteriorating situation of smog and its preventive measures in Pakistan. Journal of Cleaner Production **279,** 123676 (2021).

[10] Rehman, S., Iqbal, R., Smog. Pakistan Journal of Medical Research **55,** 98 (2016).

[11] Riaz, R., Hamid, K., Existing smog in Lahore, Pakistan: an alarming public health concern. Cureus 10 (2018).

[12] Sughis, M., Nawrot, T.S., Ihsan-ul Haque, S., Amjad, A., Nemery, B., Blood pressure and particulate air pollution in schoolchildren of lahore, pakistan. BMC Public Health **12,** 1–8 (2012).

[13] USEPA, "Particulate Matter (PM) Basics." United States Environmental Protection Agency, 2020.