

# Assessing the Effectiveness of Punjab Traffic and Motorway Police's Anti-Smog Campaign on Reducing Smog Levels in Punjab (Pakistan)

Fahim Ali<sup>1</sup>, Syed Imran Ahmad Shah<sup>2</sup>, Ramiz Shafqat<sup>3</sup>,  
Muhammad Akhtar Abbas<sup>4</sup> and Mazhar Shah<sup>5</sup>

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## Abstract

Smog represents a critical environmental hazard contributing to severe health problems. Punjab faces significant environmental challenges, including resource scarcity, pollution, and climate change. This study assessed the effectiveness of anti-smog enforcement measures targeting motorists in Punjab. Time series data were collected from reputable sources, including the World Bank, Punjab Environmental Protection Agency, and Pakistan Bureau of Statistics. The data were analyzed using descriptive statistics and t-test methodology. Results indicated that air quality in most major cities of Punjab fall within the range of 101-150, classified as "unhealthy for sensitive groups." Further analysis revealed significant changes in enforcement actions between 2020 and 2024. The Punjab Traffic Police has truly made remarkable progress in enforcing traffic regulations across 36 districts of Punjab, issuing an impressive 179,170 tickets for smoke-emitting vehicle violations in just a few months of 2024. This surpasses the 160,973 fines issued in the entire year of 2023, representing an 11% increase in enforcement against pollution-causing vehicles. Fine collection from violators showed a corresponding significant increase. The t-test results demonstrated a significant decrease in vehicular emissions between 2020 and 2024. To establish Punjab as a model for smog-free roadways, these enforcement efforts must be sustained systematically.

**Keywords:** Anti-Smog Campaign, Role of Motorway Police, Reduction in Smog.

## Introduction

The weather patterns altered as a result of climate change, which can lead to variations in precipitation and wind. De Jesus et al. (2020) have observed that this can subsequently influence the dispersion and eradication of PM 2.5 from the atmosphere. Forecasts suggest that alterations in the climate will intensify problems related to air quality, with instances of extreme heat becoming increasingly severe and frequent. In numerous areas, severe pollution occurrences align with extreme heat, intensified by air stagnation phenomena where light winds impede ground-level ventilation, resulting in the accumulation of pollutants. Extreme heat events are often accompanied

<sup>1</sup>Civil Servant, Military Lands and Cantonment Department, Govt of Pakistan.

<sup>2</sup>PhD Media Studies, Spokesman National Highways and Motorway Police.

Corresponding Author Email: [imranshah537@gmail.com](mailto:imranshah537@gmail.com)

<sup>3</sup>Milano School of Policy, Management & Environment, The New School, New York, USA.

<sup>4</sup>Civil Servant, Police Service of Pakistan.

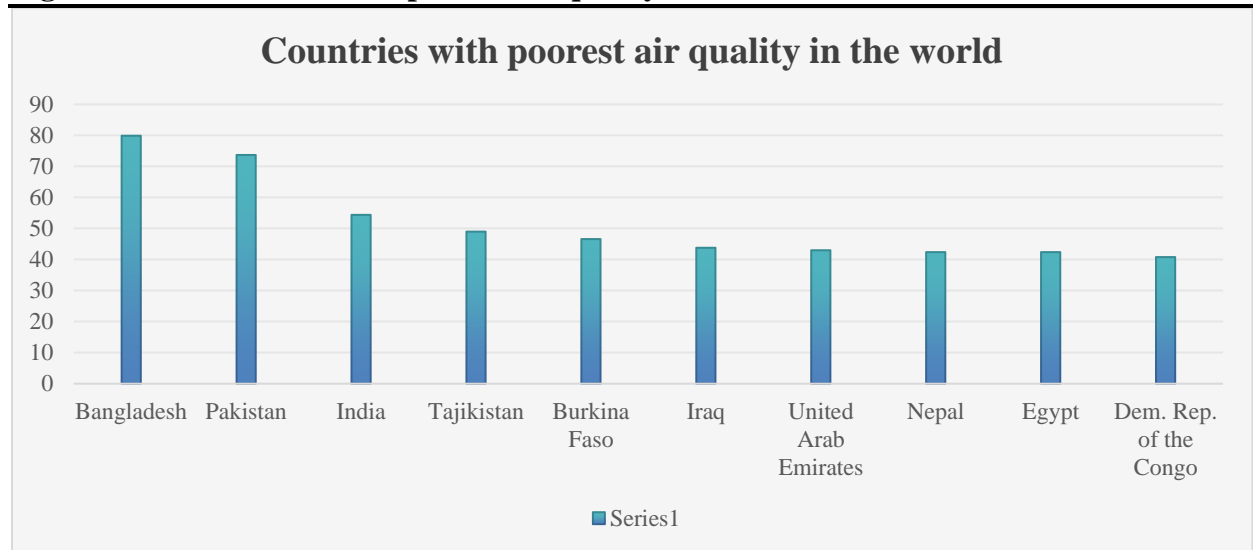
<sup>5</sup>Punjab Emergency Service, Government of the Punjab (Rescue 1122), Sargodha.



by periods of heavy pollution, which are made worse by air stagnation events, in which poor winds prevent ground-level ventilation, causing pollutants to build up. These kinds of catastrophes are expected to happen more often as a result of climate change (Bhattarai et al., 2024).

The dispersion of smoke can extend over vast distances, adversely affecting communities located far from the initial point of origin. Pollution from the air is the biggest environmental hazard to human health and is mostly caused by smoking. It is estimated that air pollution is responsible for one out of every nine fatalities globally. The World Health Organization (WHO) estimates that air pollution contributes to approximately seven million premature deaths globally each year (Khomenko et al., 2021). The presence of PM<sub>2.5</sub> air pollution contributes to and intensifies a variety of health issues, encompassing asthma, cancer, stroke, and lung disease, among others. Furthermore, exposure to heightened concentrations of fine particulate matter can hinder cognitive growth in children, contribute to mental health challenges, and exacerbate pre-existing conditions such as diabetes (Kim et al., 2020).

The regions of Central and South Asia present findings from a total of ten nations. The region is home to the four most polluted countries in the world for 2023: Bangladesh, India, Tajikistan, and Pakistan (Chaturvedi, 2024). Furthermore, this area hosts the ten cities with the highest levels of pollution worldwide. Among the subjects of study are densely populated urban areas with a significant history of pollution, including Delhi, India, and Lahore, Pakistan. An analysis of the annual average PM<sub>2.5</sub> concentrations across various cities reveals that 31% of the cities in the region reported levels exceeding the WHO annual average guideline value by more than tenfold, a figure that significantly surpasses that of any other region discussed in the report (Cheriyian & TB, 2023). These cities encompass some of the most densely populated urban centers in the region, housing over 44% of the region's population. In contrast, two cities in Kazakhstan demonstrated annual average PM<sub>2.5</sub> concentrations that fell below 5 µg/m<sup>3</sup>, thereby adhering to the WHO annual PM<sub>2.5</sub> guideline. Regular exposure to subpar air quality can affect health results for individuals subjected to contaminated air (Greenstone et al., 2022). In the region, it is prevalent to observe emissions from brick kilns and other industrial sources, alongside the burning of agricultural waste and the practices associated with cremation. The use of solid fuel sources for cooking and heating in colder months contributes to an increased pollution load. The interplay of geographical and climatological elements contributes to the concentration of air pollution in the heavily populated Indo-Gangetic Plain. This expansive terrain encompasses northern India, eastern Pakistan, and sections of Bangladesh. The pollutants produced in the area interact with those carried in by coastal winds, becoming ensnared by the Himalayas to the north. Temperature inversions intensify the trapping effect by reducing atmospheric mixing, which keeps pollutants near the earth's surface, leading to some of the most severe air pollution conditions globally (WHO, 2023).

**Figure 1: Countries with the poorest air quality**

Source: World Health Organization (2023).

In 2023, Pakistan is positioned as one of the most polluted nations globally, holding the second rank after Bangladesh. The annual concentration of PM<sub>2.5</sub> reached 73.7 µg/m<sup>3</sup> in 2023, indicating a persistent upward trend. Projections suggest that this figure is likely to surpass the peak value of 74.3 µg/m<sup>3</sup> recorded in 2018 by early 2025 (Down, 2024). In 2023, the annual PM<sub>2.5</sub> concentrations in Islamabad, the capital of the country, reached a record high in the seven-year history of this report, measuring 42.4 µg/m<sup>3</sup>, which is almost eight and a half times greater than the WHO's annual guideline level for PM<sub>2.5</sub>. While Lahore may not currently hold the title of the most polluted city globally, it is noteworthy that the city's annual average PM<sub>2.5</sub> concentration has increased by over 20 µg/m<sup>3</sup> in the last four years, culminating in PM<sub>2.5</sub> levels of 99.5 µg/m<sup>3</sup> in 2023. In November, Lahore's monthly average reached a concerning 251 /m<sup>3</sup>, leading to a significant environmental health crisis. Conversely, Peshawar has experienced a 16% reduction, with the annual PM 2.5 levels declining to 76.5 µg/m<sup>3</sup>. All Pakistani cities in the 2023 report had PM<sub>2.5</sub> readings over 30 µg/m<sup>3</sup>, six times the WHO yearly limit.

In early November 2023, an environmental and health emergency was declared in three cities within Pakistan's Punjab province. In response to the extremely high levels of air pollution, the cities of Lahore, Gujranwala, and Hafizabad were all shut down, and all public areas were made inaccessible. In late November, Punjab implemented a mandate requiring face masks for a week in communities affected by smog, including Lahore. Stronger actions are required to address the region's very poor and unhealthy air quality at its origins, which include car pollution, crop burning, and industrial pollutants, even if the public health initiatives are a good first step in safeguarding health.

In order to promote cooperative initiatives targeted at raising public awareness of air quality, IQ Air actively seeks to engage, inform, and inspire governments, educators, researchers, non-profit groups, companies, and people (Ogwu & Thapa, 2024). The mission of IQAir is to support informed dialogues and motivate actions that improve air quality and enhance the welfare of cities and people throughout the globe. The region of Punjab is confronted with considerable environmental challenges, such as the depletion of resources, contamination, and the impacts of climate change. These difficulties affect food security, transportation, and public health by posing

a complex web of ecological and socioeconomic concerns (Environmental Protection Agency, Punjab, 2023). The State of the Environment Report 2023 in Punjab uses existing environmental data to evaluate critical environmental issues and highlight places that need further measures.

In 2023, 10 out of the reporting 134 countries and regions succeeded in achieving the WHO annual PM<sub>2.5</sub> guideline value of 5 µg/m. With only 9% of globally reporting cities achieving the WHO annual PM<sub>2.5</sub> guideline, much more work remains to be done to combat air pollution (Xi et al., 2024; Jiang et al., 2023). While PM<sub>2.5</sub> poses direct health risks, its implications extend beyond human health to complex environmental processes impacted by the Earth's climate. Climate change, primarily driven by greenhouse gas emissions, plays a pivotal role in influencing concentrations of PM<sub>2.5</sub> air pollutants, and fossil fuel emissions are simultaneously responsible for the majority of PM<sub>2.5</sub> related deaths (Singh & Yadav, 2021). Due to high level of smog and the reports that shows that Pakistan is the second country globally in terms of poor air quality, Punjab province implemented various measures to reduce or eliminate smog, including the use of cameras to monitor vehicle smoke levels and issuing challans to violators. Simultaneously addressing air pollution and climate change goals is feasible, offering opportunities for comprehensive environmental improvements. According to the 2023 census, Lahore's population has surged to over thirteen million, growing at an annual rate of 3.41%, further straining the city's infrastructure and increasing vehicle and industrial emissions. This study is therefore conducted to answer the following research question.

1. What is the level of air quality in the major cities of Pakistan?
2. What is the impact of enforcement against smoke emission vehicles on air pollution?
3. What strategy do they adopt in the fight against smoke emission in the major highways?

## Methodology

Punjab Province, with a population of 127.691 million, represents 52.87% of the national populace and accounts for 54.2% of the national GDP, is leading efforts to address air pollution and smog challenges. The influence of climate-induced weather patterns characterized by low windspeed, elevated relative humidity, and temperature inversion has emerged as a crucial factor contributing to the hazy conditions and smog prevalent in major urban areas of Punjab. The urban demographic has increased to 40.70%, rising from 31.3% in 1998. The province serves as a pivotal center for economic activity in Pakistan, showcasing employment growth rates that surpass the national average and excelling in various human development metrics and overall prosperity. The swift pace of urban development and increasing population demands enhancements in essential services such as water supply, sewage systems, access to drinking water, waste management, and sanitation facilities.

## Data Collection

This study was conducted to analyze the impact of action against smog in the Punjab Pakistan. The study used time series data for 5 years (2020 to 2025). The data were collected from districts of Punjab and some motor ways. Data on air quality were obtained from a world bank database.

## Data Analysis

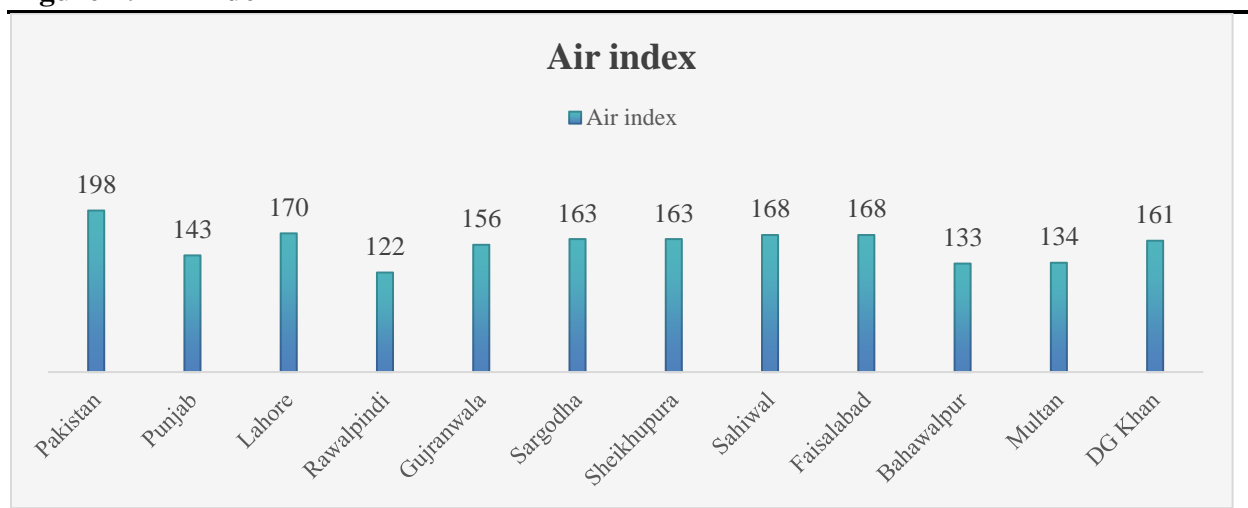
The data were analyzed using descriptive statistics (frequency, percentages), trend analysis and inferential statistics using T-test. The air quality value was categorized in to:

**Table 1: AQ values and level of health**

AQ Values	Level of Health Concern
0 to 50	Good
51-100	Moderate
101-150	Unhealthy for sensitive group
151-200	Unhealthy
201-300	Very Unhealthy
301 to 500	Hazardous

## Results and Discussion

Result of air quality index was presented in figure 2, as per the air quality value presented in the methodology section shows. They indicated that all the cities in the above figure have air quality index above moderate. The overall Pakistan air quality index fall in the unhealthy category which calls for urgent concern.

**Figure 2: Air index**

This figure is in line with the (Samaa, 2024) which explained that the Spatial distribution of air quality pollutants observed through satellite revealed that main urban centers in Pakistan are more prone to air pollution.

### Procedure of Reducing Smog Vehicles in the Highways of the Punjab Pakistan

Results in Table 1 show the combined results from the four sectors (M-2(south), M-3, LMS&LEBP and MC-1). This result shows that in the year 2024 alone, 5129000 rupees were collected from motorists that failed to adhere to the traffic rules for reducing smog, this amount represents 73.05% of the fine generated since 2020. This result further revealed that only 23% of the total fines were collected from 2020 to 2023. From the result it is clear that effort has been intensified to reduce vehicle smog in the major road of the Punjab.

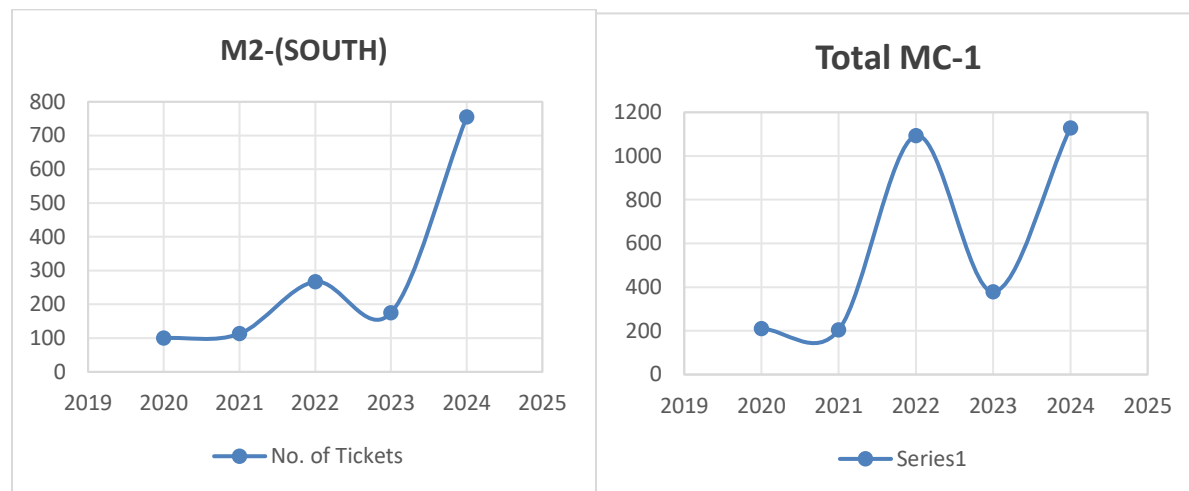
The result in table 2, further shows that only 5.43% (380,500 rupees) was collected in 2023. Similarly in 2022, the fine collected is 1093000 rupees representing 15.57%. Finally, the result shows that 2.91% and 3.06% were obtained in 2021 and 2000 respectively. The low fine in these

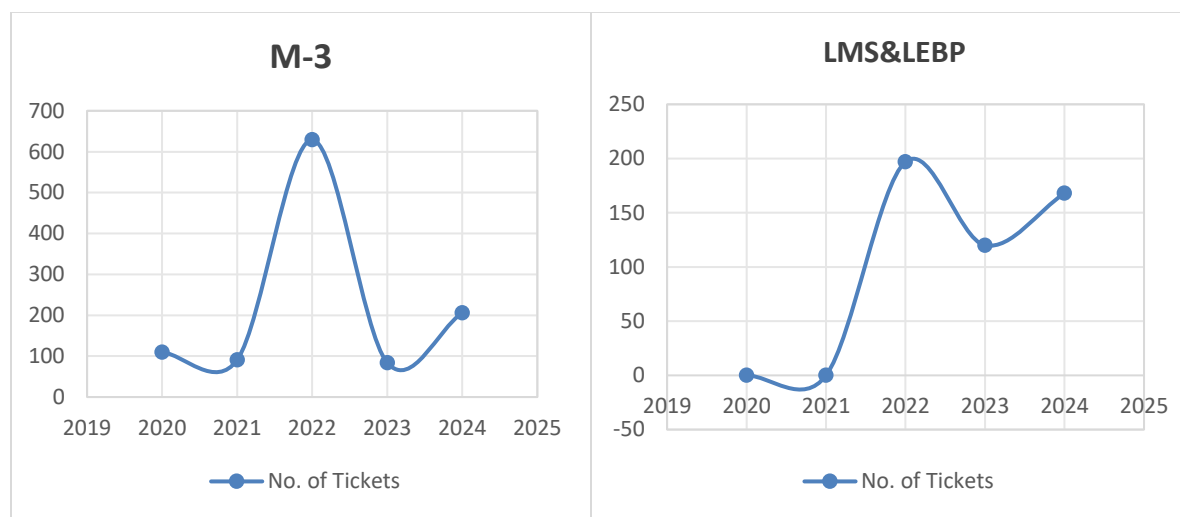
two years is attributed to the lockdown due to the COVID 19 pandemic which resulted in restriction of movement.

**Table 2: Fine collected on the Major Highways by Years in Rupee**

Year	M-2 (South)	M-3	LMS& LEBP	MC-1	Total	Percentage
2024	1586000	593500	385000	2564500	5129000	73.05
2023	88250	42000	60000	190250	380500	5.42
2022	133500	314500	98500	546500	1093000	15.57
2021	56500	45500	0	102000	204000	2.91
2020	52500	55000	0	107500	215000	3.06
<b>TOTAL</b>	<b>1916750</b>	<b>1050500</b>	<b>543500</b>	<b>3510750</b>	<b>7021500</b>	<b>100</b>

**Figure 3: Number of ticket issued in M2-(South) Figure 4: Number of ticket issued in MC-1**



**Figure 5: Number of tickets issued in M3 Figure 6: Number of tickets issued in LMS&LEMP**

With respect to tickets collected, the result in figure 3 indicated that in 2024 more tickets were collected in M-2 (south) (755) representing 53.55% higher than any other year under review. In the year 2023 only 175 were issued which was 12.41%. In the MC-1 highway (figure 4) the total ticket issued was 3015 of these figures 47.45% representing 1129 were issued in 2024. This was closely followed by 2022, which stood at 36.25% representing 1093 tickets. In 2023 the number of tickets issued was only 758 representing 12.57%. The result for M-3 as indicated in figure 5 shows that the highest number of tickets was issued in 2022, (629), representing 56.16%. This s followed by 2024 with 206 tickets representing 18.39%. The result (figure 5) further revealed that year 2023 and 2021 were having the least number of tickets issued (84 and 91) respectively. In the LMS & LEBP highway the tickets issued in the year 2022 were 197 representing 40.21%, this is followed by year 2024 with 168 tickets representing 34.64%.

**Table 3: Number of Ticket**

Year	M-2 (South)	M-3	LMS& LEBP	MC-1	Total	Percentage
2024	755 (53.55)	206 (18.39)	168 (34.64)	1129 (37.45)	2258	37.45
2023	175 (12.41)	84 (7.5)	120 (24.74)	379 (12.57)	758	12.57
2022	267 (18.94)	629 (56.16)	197 (40.21)	1093 (36.25)	2186	36.25
2021	113 (8.01)	91 (8.13)	0 (0)	204 (6.76)	408	6.77
2020	100 (7.09)	110 (9.82)	0 (0)	210 (6.67)	420	6.97
<b>TOTAL</b>	<b>1410</b>	<b>1120</b>	<b>485</b>	<b>3015</b>	<b>6030</b>	<b>100.00</b>

Similarly, considering the overall ticket issued in the whole of the sectors, (table 2) the result indicated that the number of tickets issues in the year 2024 was the highest 2258 representing 37.45%. This clearly showed that effort is being multiplied to eradicate or reduce emission by the vehicles in the major lines. To check if this campaign and measure yield result. Official data from Additional IG Office, Punjab Traffic Police were subjected to T-test, the result was presented in table 3.



**Table 4: Comparison of Emission of vehicle smoke from 2020 to 2024**

Combination	Mean	Std.	Std. Error	Lower	Upper	T-Value	Sig.
2020/2021	340.86111	1511.77145	251.96191	-170.64876	852.37098	1.353	.185NS
2020/2022	164.05556	5096.52391	849.42065	-1560.36004	1888.47115	.193	.848NS
2020/2023	-7326.13889	8820.56505	1470.09417	-10310.58873	-4341.68905	-4.983	.000***
2020/2024	2316.30556	5546.35226	924.39204	439.68994	4192.92117	2.506	.017***
2021/2022	-176.80556	4730.35512	788.39252	-1777.32746	1423.71635	-.224	.824NS
2021/2023	-7667.00000	9053.97459	1508.99576	-10730.42427	-4603.57573	-5.081	.000***
2021/2024	1975.44444	5555.11500	925.85250	95.86394	3855.02495	2.134	.040**
2022/2023	-7490.19444	6096.69161	1016.11527	-9553.01811	-5427.37078	-7.371	.000***
2022/2024	2152.25000	9085.75723	1514.29287	-921.92796	5226.42796	1.421	.164NS
2023/2024	9642.44444	12114.24650	2019.04108	5543.57313	13741.31576	4.776	.000***

The result of T-test was presented in table 4. The result indicated that there is a reduction in the quantity of smoke emission from 2020 to 2024. From the result there was no significant difference between the mean quantity of smog emitted in the study area at 5% prob. level from 2020 and 2021. Similarly, between the year 2020 and 2022 there was no significant difference in the emission level. However, the result indicated that there was significant reduction in smog from 2020 to 2023 at 1% probability level (000\*\*\*). The results also indicated that there was a significant difference in the mean emission between 2020 and 2024 at 5% confidence interval. The result further shows that there was significant difference between the year 2021 and 2024 at 5% prob level. Meanwhile, the result indicated that smog reduced significantly from 2023 and 2024 (1%) probability level.

## Conclusion

The past recent years there is a surge of commendable efforts from the government of Punjab to tackled environmental issues more importantly (groundwater depletion, and air pollution). The environmental protection agency, Punjab stands firmly in this endeavor: they implemented multi-dimensional sectoral policy changes, by establishing robust regulations to control air pollution, and promoting sustainable resource management practices. These initiatives encompass revising environmental quality standards, implementing real-time air quality monitoring, developing sustainable infrastructure projects, and mandating environmental considerations in all planning and development efforts. This study used time series data from different sources to investigate the impacts of these policies in converting air pollutions challenges for sustainable development. The data were analyzed using descriptive (frequency and percentages) and inferential statistics (T-test). From the results we can conclude that the enforcement against smoke-emitting vehicles in Punjab by Traffic Police is showing promising results. Similarly, the National Highway and Motorway Police (NHMP) have also been actively working to ensure compliance with regulations. Their vigorous campaigns against smoke-emitting vehicles demonstrate their commitment to reducing smog on Highways and Motorway. The issuance of fines to motorists that their vehicle smoking level exceeded the recommended level serves as deterrent to others and hence motorists are now careful to avert being fine. To confirm this assertion, the result in table 4 showcased that smog in the major highways reduced significantly in the year 2023 and 2024. This effort has led to the significant reduction in the smog in the Punjab. If this continues, the province in the near future will move towards becoming a model for smog-free roads and modern policing.



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