

# Molecular Effect of Pollutants on Human Diversity in Pakistan

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## Abstract

Environmental contamination and degradation have grown in importance as a non-traditional hazard to human diversity and security over the years, and it can now be considered an increasing threat to the environment and public health in Pakistan. A variety of toxins are constantly entering various environmental media (soil, water, and air) in Pakistan, posing a health risk. By studying the numerous causes of environmental degradation in Pakistan and exploring its impact on the various dimensions of human diversity, this review paper seeks to demonstrate a link between environmental contaminants and their impacts on human diversity in Pakistan. The data from secondary sources was analysed using qualitative methodology to evaluate the hypothesis that environmental deterioration is a new and unprecedented threat to Pakistan's human diversity and security. It reveals that sustainable development strategies can assist in addressing environmental degradation, which will have a good impact on Pakistan's human diversity. The data premise that environmental deterioration is a new and unprecedented threat to Pakistan's human diversity and security. This critical analysis shows that sustainable development strategies can assist in addressing environmental degradation, which will have a good influence on Pakistan's human diversity

**Keywords:** human diversity, soil, water, and air, posing a health risk.

## Introduction

Pollution and environmental deterioration have a substantial influence on Pakistan's human growth and economic prosperity (Meo et al., 2021). Environmental deterioration cost the economy \$25.1 billion in 2016 due to air pollution, water pollution, and soil contamination. Rapid population and industry growth, urbanization, inadequate management of existing natural resources, and a lack of state policy implementation are all contributing factors to the problem. Environmental deterioration has serious implications for human security and diversity, increasing the vulnerability of vulnerable populations that rely on natural resources (Aslam et al., 2021). Increased air, water, soil, and noise pollution are among anthropogenic causes of environmental deterioration in Pakistan (Amin et al., 2021; Aslam et al., 2021).

## Noise Pollutants

Noise is a significant and challenging issue in

metropolitan environments. It is classified as the most harmful pollution that persists over time. The scientific community is focusing on noise pollution studies because of the potential for harm to human health. It has an impact on the people who are exposed all over the world, and it is becoming more severe with the passage of time (Munir et al., 2021). Noise pollution has been shown to have negative impacts on the metabolic, neurological, respiratory, and cardiovascular systems (Münzel et al., 2021). Furthermore, noise has detrimental health impacts such as tinnitus or ringing in the ears (Pienkowski, 2021), frustration and sleep disturbance (Münzel et al., 2021), and negative emotions such as anger, anxiety, melancholy, and disappointment (Al-Taai, 2021) as shown in the figure (2). Traffic has a significant negative impact on the physiological and psychological wellbeing of people who live in noisy places. Traffic and transportation operations (Munir et al., 2021), noise-generating devices, noise created by construction and building activity, factories (Al-Taai,

2021), and aeroplanes are all prominent causes of noise pollution in metropolitan environments (Farooqi et al., 2021) as shown in figure (3) Noise pollution has the greatest impact on the people of Lahore (Iqbal et

al., 2021), Peshawar (Munir et al., 2021), Chiniot, Jhang (Farooqi et al., 2021), Karachi (Shareef & Hashmi, 2021), and Faisalabad (Saeed & Mahmood, 2021).

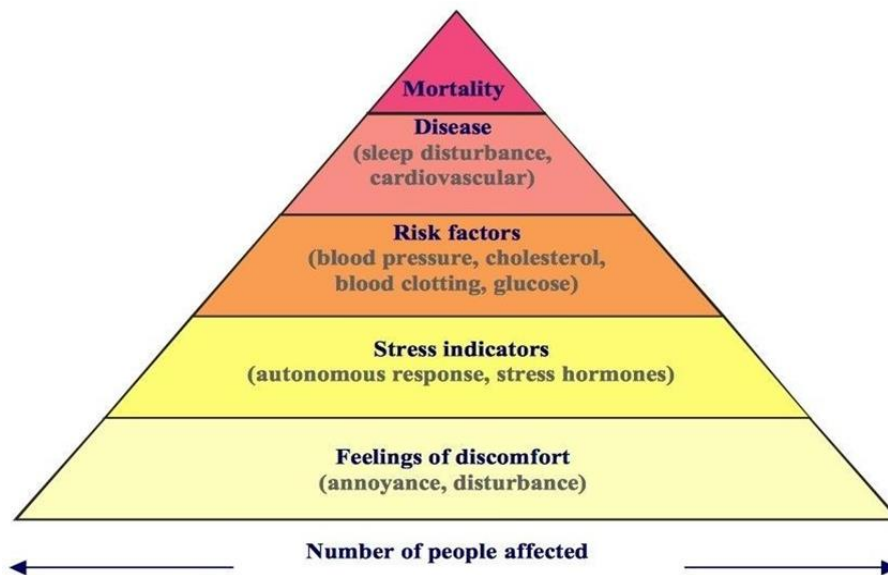


Fig 2: showing noise pollution hazards



Fig 3: indicating the causes of noise pollution

**Water Pollutants**

Water contamination has become one of Pakistan's most critical challenges as a result of industrialization and urbanization. Untreated sewage water from major cities including Karachi, Lahore, Faisalabad, Gujranwala, Sialkot, Sheikupura, and Kasur, as well as industrial chemical waste and excess agricultural drainage, contribute to the contamination of water bodies such as river, lake, & underwater reserves (Aslam et al., 2021) shown in figure (4 & 5). About 2M ton human waste, including toxic chemicals (industrial effluents such as alkalis, acids, and salts), untreated sewage, radioactive elements, and heavy

metals, as well as solid muck, are contaminating rivers and seas in Pakistan (Iqbal et al., 2021). In Pakistan, fertilizer consumption is growing, and these fertilizers pollute groundwater and surface water at levels far exceeding WHO safety guidelines. Salinization (the presence of sodium and chloride ions in groundwater) affects large areas of Sindh, Punjab, Baluchistan, and Khyber Pakhtunkhwa (Masood et al., 2021; Parvaiz et al., 2021). Intestinal infections, bladder cancer, bone deformation, hepatitis, stomach ailments, and a variety of skin disorders are all caused by this contaminated water (Aslam et al., 2021) as shown in figure (6). In Pakistan, illegal pharmaceutical discharge pollutes

the environment and leads to antibiotic resistance in a huge number of people due to antibiotic abuse or overuse. The ingestion of these antibiotics through

the food chain endangers human cell function and gut microbiome (Sardar et al., 2021; Sulis et al., 2021).



Fig 4: showing Poor drainage causing groundwater contamination.



Fig 5: fertilizers contaminating the water bodies.

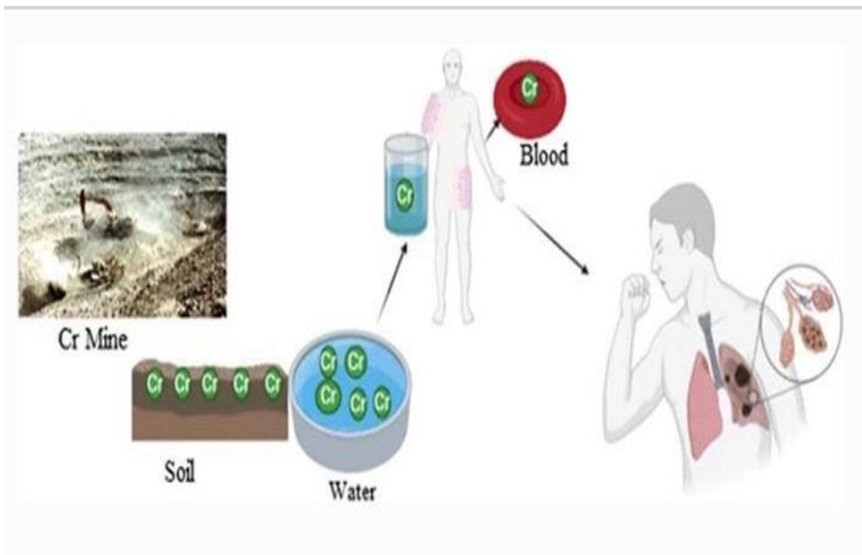


Fig 6: Effect of Heavy metals on human health by drinking contaminated water



**Soil Pollutants**

Anthropogenic activities associated to industrial, agricultural, and urban growth have made soil susceptible (Abbas et al., 2021; El- Hamid et al., 2021). Soil contamination occurs when quantities of certain harmful compounds surpass that suggested for human, animal, or plant health (Islam et al., 2021). Contaminants' negative impact on soil could be linked to a decrease of biodiversity. Pesticide production to meet food and industrial demands has risen dramatically over the world, particularly in developing countries (Taufeeq et al., 2021). In South Asia, Pakistan is the second-largest pesticide consumer (Zulfiqar & Thapa, 2021). As a result of the widespread use of pesticides and the lack of effective regulatory mechanisms, environmental matrices

have been greatly degraded, resulting in a variety of less toxic to chronic effects on living organisms, including endocrine disruptions, tumor production, carcinogenicity, and neurobehavioral disorders. Pesticide poisoning has affected almost half a million people in Pakistan (Dave et al., 2021; Taufeeq et al. 2021). Heavy metals are naturally occurring elements of the earth's crusts, while others are introduced to the soil through fertilizer application, where they enter crops and food chains. Because of their persistent, non-biodegradable, and poisonous character, heavy metal(loid)s is considered dangerous to living things. For example, high consumption of Pb, a non-essential metal for the human body, can result in skeletal, neurological, circulatory, endocrine, enzymatic, and immune system problems (Jehan et al.2021) as shown in figures (7 & 8).

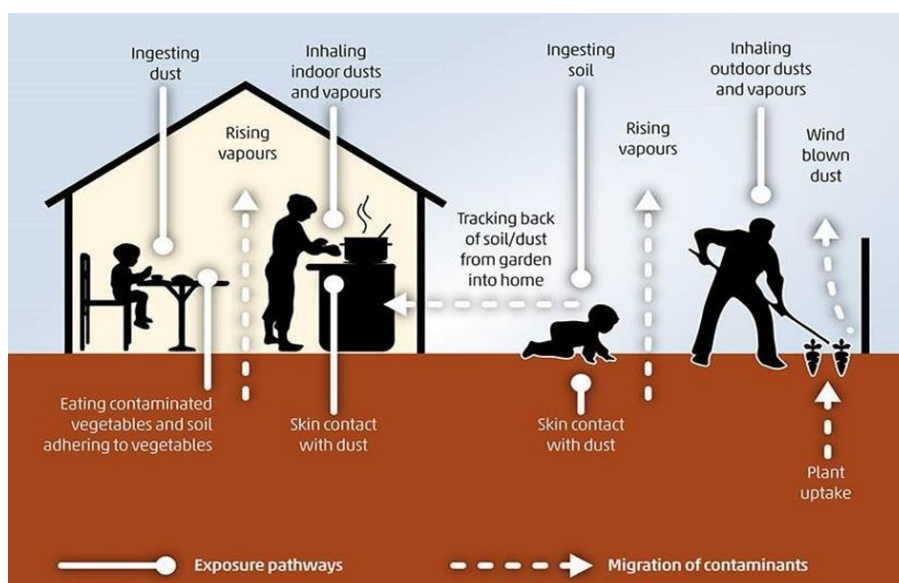


Fig 7: showing main exposure pathways to soil pollution

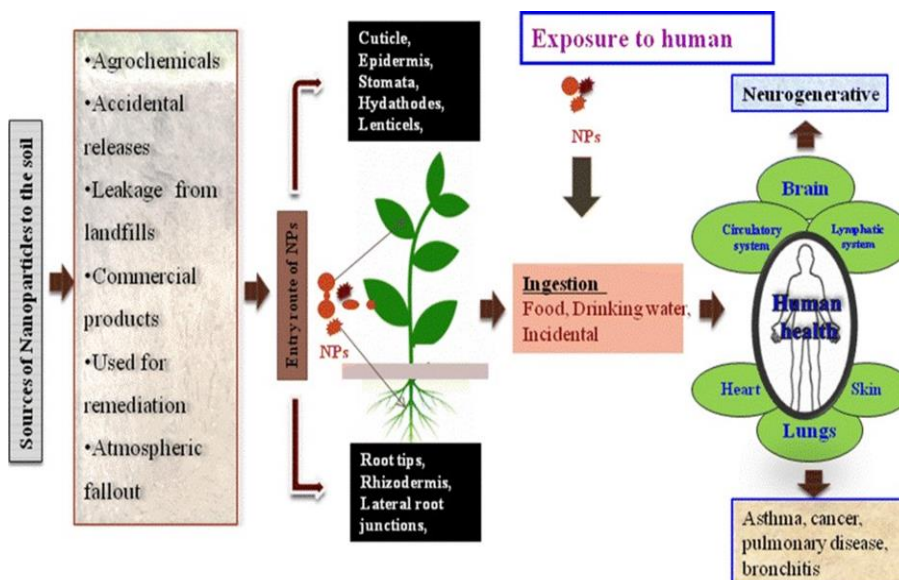


Fig 8: Overview of soil contamination and human health impacts.

**Air Pollutants**

Pakistan is at number 3rd all over the world due to air pollution-related death rate, with PM2.5 aerosol mass concentrations frequently surpassing WHO standards for air quality (Bilal et al., 2021a). High number of various types, such as particulate matter (PM), ozone, nitrogen dioxide (NO<sub>2</sub>), volatile organic compounds (VOC), carbon monoxide (CO), and Sulphur dioxide (SO<sub>2</sub>), cause air pollution, all of which have negative health effects such as asthma, cardiovascular disease, and neurological disorder (Chen and Chen, 2021) shown in figure (9). Pakistan is burdened by air pollution, as it is one of the poorest and most populated countries in South Asia. Air pollution, according to existing emission control

regulations, will reduce expected life 100 months in the year 2030. (Cicala et al., 2021). According to reports, all population of Pakistan is wide-open to PM 2.5 since 1990. Pakistan has mortality rate of 128,000 people dying each year due to air contamination (Ali et al., 2021). Lahore, Peshawar, Islamabad, and Karachi, in accordance with Pakistan Air Quality Initiative, are highly polluted areas in Pakistan, with air quality failing to exceed WHO criteria during the fall and winter months (Tainio et al., 2021). PM 2.5 concentrations in Lahore exceeded WHO and national air quality limits virtually every day in 2019. (Anjum et al. 2021). Outdoor air contamination has resulted in 22,000 early adult mortalities in Pakistan, according to World Health Organization (Ain et al., 2021).

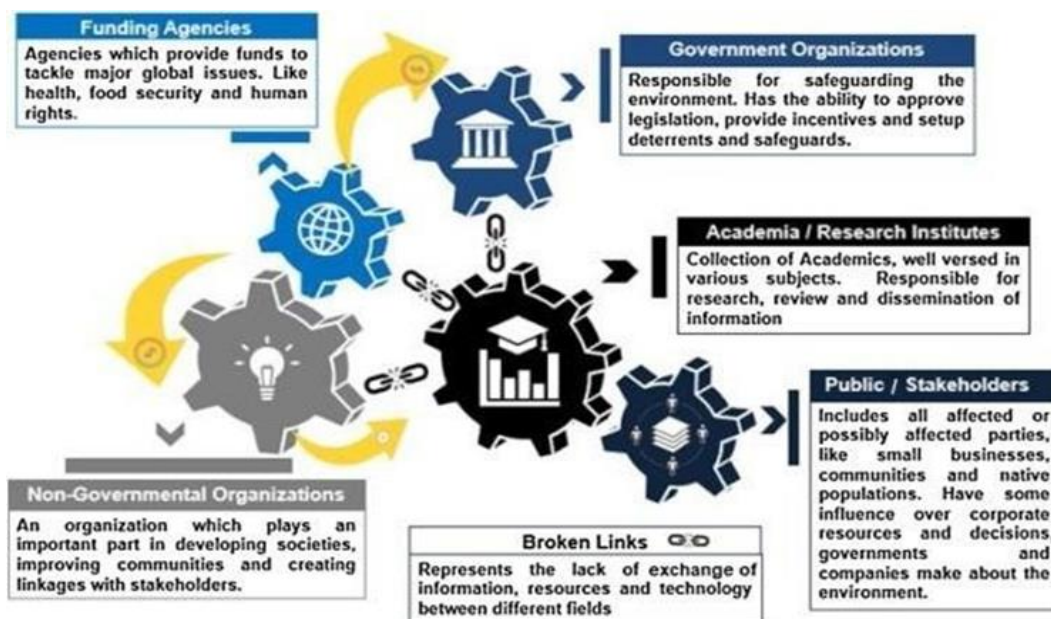


Fig 9: Air Pollutants

**Methodology**

We did a scoping review from January 2021 till now, which included a quality evaluation (Levac et Al.,2010)

**Eligibility Criteria**

There were limitations on the study design, publication year, and study location. As the publication year is 2021 and study location is Pakistan. While the subject of study is human population of different cities of Pakistan. We preferred only those studies that were available in English language and were accessible online and free online research resources as provided by University of the Punjab Lahore. Only those articles were selected in which authors focused on different types of pollutants such as air pollutant, noise pollutant, water pollutant & soil pollutant, their mode of affecting the human

diversity. It also included those studies in which comparative analysis were made among population diversity of different regions of Pakistan regarding the effect of different pollutants.

**Search Plan**

We used multiple databases for the identification of sources for article review in August 2021. To begin, we used Google Scholar to get a sense of what kinds of articles were available. We also searched the articles via other electronic databases. While considering the objective of this review article, each of the search terms used was selected for its correctness and interrelation.

Sources were investigated in accordance with the number of standards. Firstly, it must be well- suited with the objective of the literature review on the basis of research questions in the paper. Then the sources

focusing on secondary sources research were also considered. Thus, we gave greater importance to articles that focused on comparative analysis of pollutants on human diversity. We also searched the journals that would be characteristics of their respective fields such as Pakistan Journal of Earth and Sciences. We also evaluated the data after considering all of these parameters. We also looked at the references of pertinent research.

### Study Screening & Selection

The flow chart below shows how reviews analyses are used to screen and select studies. After evaluating the literature, we deduplicated studies in EndNote (Clarivate Analytics). We independently reviewed the titles and abstracts of the retrieved publications and applied the inclusion criteria. We gathered the whole texts of papers that satisfied these criteria for this review. We were able to resolve differences in study inclusion by discussion and consultation with co-authors.

### Charting the data

We abstracted the key research outputs of each study and structured them in a chart using the headings: initial author and year of publication, kind of pollutant (Soil, water, noise, air), study design, targeted population and geographic location of study, and primary consequences.

### Results

Pakistan's human security and variety have been harmed by environmental degradation. It has lowered people's quality of life and led to an increase in significant health problems among a variety of people in Pakistan's cities (Akmal & Jamil, 2021). National environmental quality regulations, according to the Environmental Protection Agency, limit traffic noise to 85 decibels (Chhachhar et al., 2021). Different noise pollution levels are listed in Table 1 for several cities in Pakistan, along with their possible sources, where noise levels were found to be higher than WHO and Environmental Protection Agency permitted limits (EPA).

**Table 1:** Noise Levels in different cities of Pakistan along with their sources and health issues

Noise Pollution Level	City	Major Sources	Possible Health Hazard	References
76.5 DB	Karachi	Airports, rickshaws, tankers, industrial noise, traffic	Hearing problems, more cardiovascular diseases, negative psychological behaviors, headaches	(Chhachhar et al., 2021)
High than 70-80 DB	Lahore	Autos like buses, trucks, traffic, rickshaws, airports, orange train construction, congestion	Hearing issues, High Blood Pressure, Sleep disturbances, Learning disabilities, High risk of heart diseases, stress, depression	(Younes et al., 2021)
72.5 DB	Islamabad	Heavy traffic, airports	Non- auditory health related problems, psychological issues, headache	(Chhachhar et al., 2021)
82-100 DB	Faisalabad	Industrial noise, traffic vehicles, rickshaws, transport vehicles, congestion	Hearing disabilities, increased risk of cardiovascular illnesses, negative behaviors, headache	(Saeed & Mahmood, 2021)
86 DB	Peshawar	Traffic, congested areas, transportation vehicles, generators	Increased risk of cardiovascular diseases, annoyance, sleep disturbance	(Munir et al., 2021)

The percentage of different populations affected with the exposure of water pollutants is given in table (2) along with the human health risks associated with water pollution.

Pesticides are used extensively in agricultural production, resulting in increased health risks and expenses, productivity loss, and environmental damage (Mehmood et al., 2021). Different chemicals are presented in table (3), along with how hazardous they are to human health and the health concerns they cause.

In terms of air pollutants, Fig. 1 shows the by-month

fluctuations of 2003–2020 monthly mean PM<sub>1</sub>, PM<sub>2.5</sub>, and PM<sub>10</sub> conc. for the highest ten polluted cities. Similar patterns for PM<sub>2.5</sub> and PM<sub>10</sub> are only seen from Sep-Apr, while different forms owing to magnitude differences are visible from May to August.

Figure (1) Monthly average changes in PM<sub>1</sub>, PM<sub>2.5</sub>, and PM<sub>10</sub> conc. in the highest ten polluted cities over a 10-year period (2003–2020). (See legend). Cities are ranked in order of how filthy they are, from the most polluted to the least polluted (Bilal et al., 2021b). Pollutant concentrations were measured at various time periods in several Pakistani cities. As stated in



Table (4), the primary sources of pollution were also identified.

Table 2: Effects of water pollutants on different populations in the four provinces of Pakistan

Chemicals their sources & uses		Toxicity to humans	Health outcomes	
Province (Population affected)	Major Cities	Potential Pollutants	Health Risks	References
Balochistan (72%)	Quetta, Khuzdar, Loralai	Antibiotic residues, microbial contamination, industrial/municipal wastewater, heavy metals	Water-borne diseases, metal toxicity, allergies, body impairments, death	(Akhtar et al., 2021; Zainab et al., 2021)
Punjab (80%)	Lahore, Kasur, Faisalabad, Gujranwala, Bahawalpur, Multan, Sialkot	Heavy Metals, Pharmaceuticals, trace metals (Li, Zn, etc) in groundwater, Microbial contaminations, pesticides	Metal Toxicity, Water-borne illnesses, infant mortality, cancer, hormonal disruption, Acidity, impaired immunity, death	(Khan et al., 2021)
Sindh (24%)	Hyderabad, Karachi, Sukkur	Heavy metals, industrial wastewater, municipal waste, microbial contamination, antibiotic residues	Muscles cramps, Hepatic/peptic disorders, Black foot disease, Urine infections, Acidity, Kidney stones, death	(Adnan & Husain, 2021; Soomro et al., 2021)
KPK (46%)	Mardan, Peshawar, Abbottabad, Mangora	Microbial contamination, Fluorides, agricultural runoff, heavy metals, mining waste	Impaired immune system, nervous/heart/renal disorders, endocrine disruption, toxicity, sterility, death	(Bhatti et al., 2021)

Table 3: Chemicals, their toxicity and the health outcomes associated with them

As Pesticides; Au, Pb, Cu, Ni, Fe and steel mining.	As rich water given to food crops	Gastroenteritis, skin/heart/liver and brain damage. Diabetes. Bone marrow and blood disorders. Cancer-causing
Asbestos Mining the raw asbestos for construction and production	Enters through inhalation, but also through ingestion or skin penetration	lung cancer
Cd Zn smelting, mining, burning coal or trash having cd, rechargeable batteries	through irrigation, it can accumulate in plants then enter the food chains	Hepatic and cardiac damage, low bone density.
Fluoride	Linked to high water fluoridation	osteosclerosis, calcification of tendons and ligaments, bones deformities.
Lead Batteries, solder, ammunition, pigments, dyes, mining, burning of coal, water pipes.	fuel and mining are common sources	Brain damage Low IQ and concentration Bone deterioration Hypertension Kidney disease
Mercury Insecticides, medical waste, burning fuels.	directly ingesting soil by children	nervous and stomach disorders, impaired brain, low IQ
Hazardous pesticides	Organic ones enter in the human food chains	Organic pesticides associated with a number of health issues

Table 4: the primary sources of pollution were also identified.

Location	Interval of monitoring	Specie above standards of WHO	The primary cause of pollution	Maximum pollutant conc. sites
Lahore, Islamabad	April to May 2000	PM10, NOx	Ox more than standard	Information available
Lahore	Feb to March 2006	PM2.5	Vehicular and industrial discharges	Johar town, Lahore.
Lahore	12 Jan 2007 to 19 Jan 2008	PM10 and PM2.5	Coal combustion, biomass burning	UET, Lahore.
Rawalpindi, Islamabad	March to June 2010	NO2	Vehicular discharges	Islamabad Airport
Faisalabad	Jan to Dec 2013	PM2.5	Vehicle's emissions	Station Chowk
Karachi	Aug 2008 to Aug 2009	PM2.5	biomass, heating discharges	Korangi Winter
Faisalabad	May 2012	PM2.5, PM10	Fuel burning in small industrial units	Ali, Kamal, Q. Rasheed textile

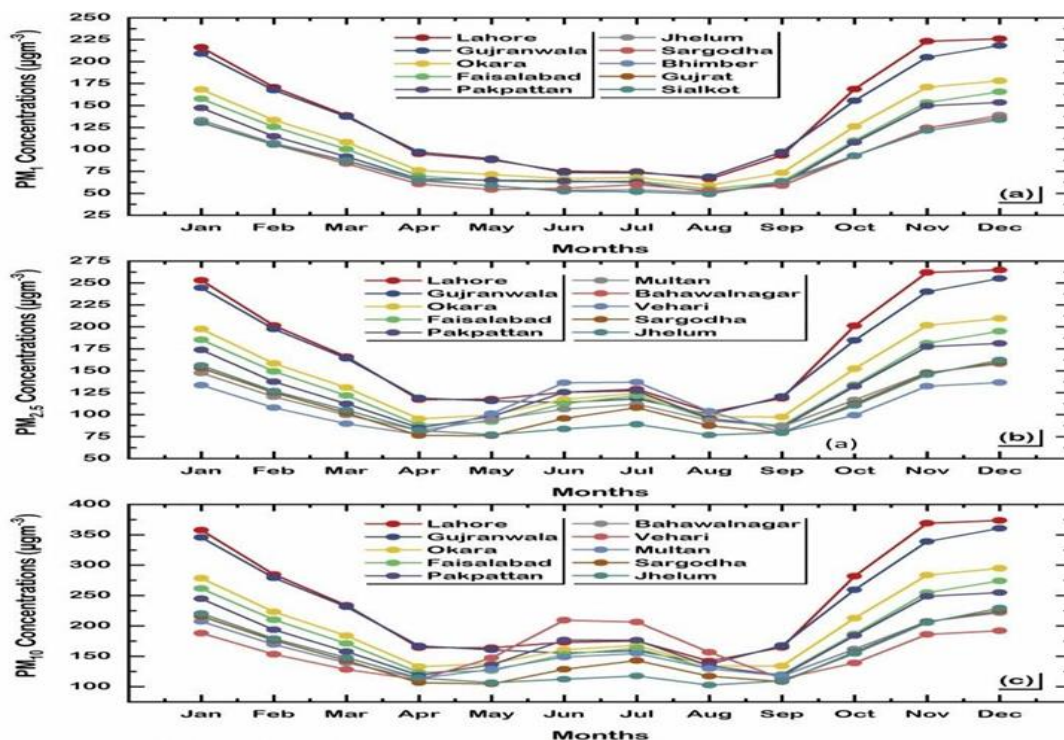


Fig 1: Monthly average changes in PM1, PM2.5, and PM10 conc

**Discussion**

As indicated in table 1, the greatest levels of noise pollution are found in Faisalabad and Peshawar, followed by Lahore, Karachi, and Islamabad. The higher the amount of noise pollution, the more the population will be exposed to a variety of health risks (Chhachhar et al., 2021), as shown in table 1. The congestion of the city owing to overpopulation and limited land availability is the cause of excessive noise pollution in Faisalabad and Peshawar. It results in increased traffic flow in a given area, resulting in increased traffic noise as well as noise from transportation vehicles. Another issue is that residential areas and industrial areas are not divided, exposing residents to industrial noise (Munir et al., 2021; Saeed & Mahmood, 2021). However, according to Younes et al., 2021, the building of the orange line (construction activity) contributed significantly to the increase in noise pollution in Lahore city. Hearing difficulties, sleep disruptions, learning impairments, heart problems, and stress have all been reported among the Lahore population. While Karachi's population is adversely affected by industrial and transportation vehicle noise, its noise level is modest (76.5 DB) when compared to other heavily polluted cities such as Faisalabad (82-100 DB), Peshawar (86 DB), and Lahore (70-80 DB) (Chhachhar et al., 2021).

In terms of water contaminants, they have had a significant impact on Punjab's population, with around 80% of the province's population ingesting polluted

drinking water, resulting in major health consequences (Khan et al., 2021). The presence of several businesses and manufacturers in Punjab's larger cities, which have been dumping their effluents straight into freshwater bodies, is the cause of the high pollution rate (Aslam et al., 2021). Following that, a small reduction in the population of Baluchistan (72%) who are suffering from a variety of ailments as a result of drinking polluted water with antibiotic residues, microbiological pollution, industrial effluent, and heavy metals has been observed as compared to Punjab (Akhtar et al., 2021; Zainab et al., 2021). According to Bhatti et al., KPK is Pakistan's third most polluted province, with about 46% of the population suffering from water contamination caused by microbial contamination, fluorides, agricultural runoff, heavy metals, and mining waste, resulting in significant health problems and even death. In compared to the other three provinces, Sindh's population consumes contaminated water at a rate of around 24% (Adnan & Husain, 2021; Soomro et al., 2021), which is much lower than the population impacted in the other provinces.

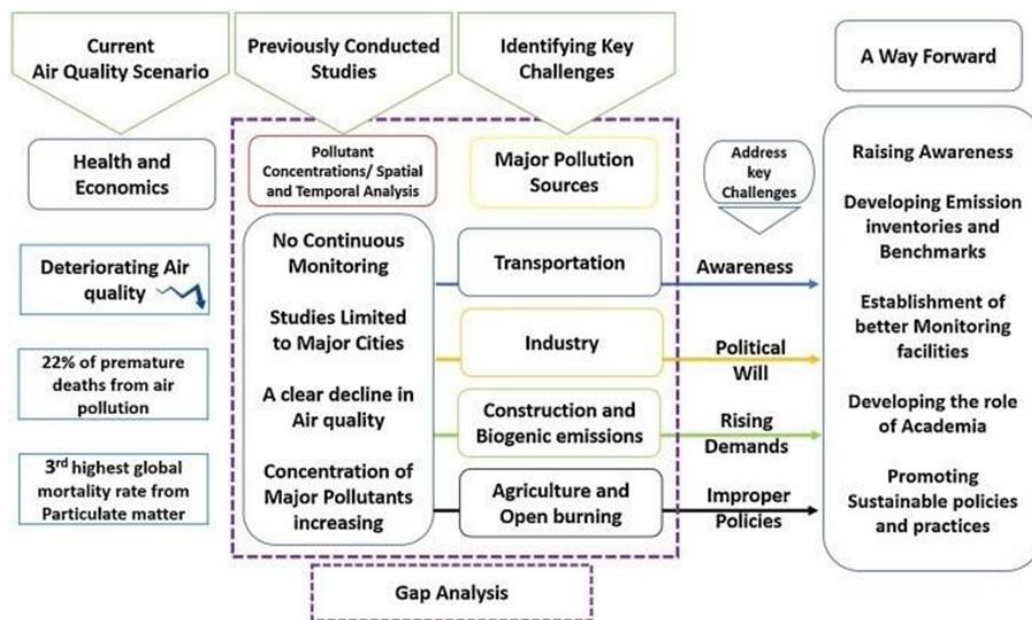
According to table 3, the presence of heavy metals as inorganic pollutants poses a hazard to people, flora, and fauna when concentrations in soil above a specific threshold (Abbas et al. 2021), although some of these are helpful when consumed as food or supplement at suitable, less amount. Cadmium, lead, and mercury, on the other hand, are poisonous to humans and have no recognised biological purpose. It has been claimed that toxicity is not limited to the



target pest as a result of widespread use; in fact, 99 percent of applied pesticides end up in the environment, causing ecological damage (Taufeeq et al. 2021).

From November to February, there were major positive patterns in PM1, PM2.5, PM10, NO2, and SO2, especially at Lhr, Isb, Gujranwala, and Fsd. The greatest levels of PMx and trace gases were found in the winter months of Oct-Feb, when atmosphere is stable and the borderline is shallow, and discharges from man-made events and biomass burning are

greater than in other times. This study's findings are consistent with previous research findings (Lalchandani et al., 2021). The number of pollutants is dramatically rising due to large-scale industrial and transportation operations. Due to NO2, PM2.5, and PM10 emissions, poor air quality is found in regions with considerable traffic. The primary sources of PM2.5 were recognized as traffic and road dust re-suspension, burning of coal, vehicle discharges, biomass combusting, and 2ndry aerosols generation (Ahmad et al., 2021), as shown in the figure (10) below.



## Conclusion

Pollution and Environmental degradation are a big problems all over the world. Anthropogenic activities are the reason for the production of pollutants into the environment. Many adverse effects have been also observed in Pakistan because of soil pollutants, water pollutants, noise pollutants, and air pollutants on human diversity. The air pollution and noise pollution is seemed to be highest in Punjab as compared to other provinces of Pakistan because of heavy traffic. While soil and water pollution are also seemed to be highest in Punjab because of industrial pollutants. Thus, in order to overcome the disaster of pollution different measures should be taken into account to save the biosphere of Pakistan which includes raising awareness, the development of role of academia, and the development of sustainable policies and practices.

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