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THE EFFECT OF AIR POLLUTION ON URBAN ENVIRONMENT

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ABSTRACT

The contamination of the environment is a growing concern in the world's urban and industrialized regions. It's been observed that the concentration of air pollutants in the troposphere has increased dramatically in recent years. Hyderabad, the capital of Andhra Pradesh, is a major economic and industrial hub in southern India. There are around 73,000 small, medium, and large industrial businesses located inside the broader metropolis, making it one of the most populated metropolitan regions in the world with almost 6.8 million residents. Motor cars are the primary cause of air pollution, followed by factories and other industrial sources. The current study was initiated to evaluate the air quality in Hyderabad, which is undergoing rapid urban and industrial development, because of the scarcity of data on the levels of ambient gaseous pollutants in tropical areas, especially Asian countries, and because of the health effects and economic burden associated with elevated levels of air pollutants. In order to determine the correlation between gaseous air pollutants and climatological factors, this study collected air samples at altitudes ranging from 1.5 to 3.0 meters above ground level to track the levels of particulate matter (PM), superfine particulate matter (SPM), oxides of nitrogen (NOx), and Sulphur (SO2). The data as a whole show that gaseous contaminants are progressively decreasing air quality. Our research led us to the conclusion that a combination of public education initiatives, media intervention packages, strong government action plans and programs, and the strategic distribution of high-quality fuels is necessary to reduce air pollution from cars.

KEYWORDS: Ambient air quality Automobiles NAAQS standards

INTRODUCTION

Rapid industrialization and urbanization have improved human existence and made it easier and more pleasant. Urbanization and industrialization, although beneficial in many ways, nevertheless pose threats to human health, the most serious of which is air pollution.

Air pollution in and around urban areas is referred to as "urban air pollution." Greater people mean more pollution in metropolitan areas. Both people and the weather may be negatively impacted by air pollution. The World Health Organization (WHO) estimates that air pollution kills 4.2 million people annually. Some urban air pollution comes from unavoidable natural processes, but the vast majority comes from human activity.

Volcanic eruptions, thunder, dust from the earth's surface, and naturally occurring particulate matter all contribute to poor air quality in metropolitan areas. However, human activities such as transportation, residential use of fossil fuels, industrialization, electricity production, combustion, agriculture, and cosmetic goods are substantial contributors to urban air pollution.

LITERATURE REVIEW

Xin-Lin Zhai (2022), Increased public and governmental attention has been paid to air pollution as a result of its effects on public health and the economy. Urban air pollution is mostly caused by vehicle exhaust emissions on roadways, which presents a serious risk to and has a substantial effect on the health of city dwellers. Source identification, pollutant distribution, and treatment strategies are the three facets that need to be explored in depth if we are going to find effective and cost-efficient solutions to the problems of excessive urban pollutants. This research examines and summarizes four factors—urban planning schemes, weather, roadside tree arrangements, and traffic flows—that affect the dispersal of pollutants on a regional metropolitan scale. Air pollution dispersion analysis techniques are outlined. In the meanwhile, China has issued a slew of regulations and guidelines for dealing with pollution, with positive effects.

Manisalidis I, (2022) Air pollution is one of the major problems of our day because of the havoc it wreaks on the environment and the health of the general public and individuals via rising rates of illness and death. A wide variety of contaminants contribute significantly to the spread of illness in people. Inhaling Particulate Matter (PM), which consists of particles with a varied but extremely tiny diameter, has been linked to a wide range of health problems, including asthma, heart disease, reproductive problems, neurological issues, and even cancer. High concentrations of ozone on the ground are damaging to human health, impacting not only the respiratory and cardiovascular systems but also causing damage to the eyes and skin. In addition, air pollutants that are hazardous to human health include noxious gases like nitrogen oxide and sulfur dioxide, as well as VOCs, dioxins, and PAHs. When inhaled in high concentrations, carbon monoxide may cause immediate poisoning. Heavy metals, when absorbed by the human body, may cause either acute poisoning or long-term toxicity. Chronic obstructive pulmonary disease (COPD), asthma, bronchiolitis, lung cancer, cardiovascular events, central nervous system dysfunctions, and skin illnesses are only some of the ailments caused by the aforementioned drugs. Finally, natural catastrophes and climate change brought on by human-caused pollution have a role in shifting the geographic range of many infectious illnesses.

Liang, L., Gong, P. (2022) While much is known about the consequences of air pollution on large cities, very less is known about the relationships between air pollution and small and medium-sized cities. This empirical research examines all 626 Chinese cities at the county level and above to determine the primary urban form drivers of decadal-long fine particulate matter (PM2.5) trends, since the most predicted urban expansion is expected to occur in these smaller-scale cities. This is the first research to compare the impact of urban design on air quality among cities of varying population numbers, stages of development, and spatial-autocorrelation locations. The results show that there are long-term effects of urban form evolution on PM2.5 level, but the dominant factors change across urbanization stages: area metrics play a role in PM2.5 trends of small-sized cities during the early urban development stage, while aggregation metrics determine such trends primarily in mid-sized cities. The geographical connectivity of urban patches is positively related with long-term increases in PM2.5 levels, especially in highly urbanized major cities.

Dandotiya, Banwari. (2019). Air pollution has become a serious problem in metropolitan areas around the world, both in developing and wealthy nations, in recent decades due to urban expansion and rising industrialization. People living in cities spend more time inside, where air contaminants may spread unchecked, making them more vulnerable to their effects. Increased mortality and hospitalizations from respiratory and cardiovascular disorders have been linked to exposure to air pollution. This section of the book discussed the causes and consequences of air pollution in India's major cities. Both gaseous and particle air pollution are present at higher amounts in most Indian cities.

Erika von Schneidemesser (2019) There are millions of avoidable deaths each year because of air pollution, making it a major worldwide problem. This is a problem not just in poor countries, but also in wealthy ones, with cities having the hardest time meeting air quality limit values necessary to sufficiently safeguard human health. The seemingly little time spent travelling or in the vicinity of traffic may have a disproportionately large impact on total exposure to air pollution. In this preliminary study, we rode a Discman to several locations to take measurements of particle concentrations. To better understand the elements that contribute to people being exposed to air pollution, we studied 18 tracks and their associated video material and categorized and quantified them. There is now a way to compare data from different routes while taking into account the fact that ambient average concentrations might change from one to the next. Variations in air pollution levels at the micro- and nano-scale were detected and measured for a variety of parameters, including street type, environment, and vehicle type. Particulate matter concentrations rise by 30% to 40% when one or more non-passenger automobile vehicles, such as buses, mopeds, or trucks, are present, compared to the typical ambient level. Particulate matter concentrations rise by 47% and 35%, respectively, in high-traffic scenarios such traffic jams and automobiles waiting at traffic signals. Compared to the average concentration in the atmosphere, particle number concentrations are reduced by 17% when bicycling through residential areas and by 22% when bicycling through parks and other green areas. Citizens who seek to limit their exposure to air pollution while traveling through a city may benefit from these data, as can policymakers and urban planners who have a say in infrastructure choices and can use them to better safeguard human health as they work to reduce air pollution overall.

Urban Air Pollution Sources

Transportation

The majority of pollutants in metropolitan areas come from people driving their own cars, especially older diesel models. The transportation sector is responsible for over 75% of VOC emissions (by weight), according to the US Environmental Protection Agency. Vehicles account for over a quarter of the world's particulate matter pollution.

Domestic use of fossil fuels

To this day, half the world's population uses only solid fuels for both cooking and heating. Wood, charcoal, and coal are all burnt in inefficient stoves, contributing to the emission of harmful particulate matter and pollutants that contribute to global warming. Air pollution and the danger of respiratory and cardiovascular ailments are exacerbated by the fact that an estimated 1.2 billion people use kerosene lamps for indoor lighting.

Industrialization

A significant factor in urban air pollution is industrialization, since areas with plenty of factories tend to have unhealthy air. The combustion of fossil fuels and the usage of chemicals in factories results in the production of several harmful gases. Both of these gas types, as well as other elements in the atmosphere, react with one another. Asbestos, dioxin, lead, and chromium are just a few of the estimated 80 distinct poisons present in factory air.

Power generation

A rise in population means more people needing to use power. Because of their low cost and abundance, fossil fuels are being employed extensively to meet this need. Coal-fired power stations contribute significantly to pollution levels in metropolitan areas.

Combustion and agriculture

Combustion of material is an activity that releases toxic gases in the atmosphere and contributes to urban air pollution. Combustion releases CO_2 and incomplete combustion releases CO. Both of these gases lead to urban air pollution. Agriculture activities also release other gases in the atmosphere such as NO_2 and Methane (CH_4).

Beauty Products

Recent research has shown that cosmetics may increase pollution levels in cities. Most fragrances and cosmetics emit VOCs into the air when used, adding to the pollution already present in cities. The expanding population means more of these cosmetics will be used, which in turn will increase pollution.

Air Pollutants

Ozone (O3), Particulate Matter (PM10, PM2.5), Sulfur Oxides (Sox), Nitrogen Oxides (NOx), Carbon Monoxide (CO), and Volatile Organic Compounds (VOCs) are all indicators of urban air quality (VOCs).

Ozone (O_3)

Chemical reactions between nitrogen oxides (NOx) and volatile organic compounds (VOCs) under the stimulus of sunlight produce ground-level ozone, a pollutant hazardous to human health. Thus, ozone is produced when emissions from vehicles, power plants, and other combustion processes react with sunlight. Smog is formed when ozone levels go too high, making the air unhealthy to breathe.

Particulate matter (PM10, PM2.5)

Particles with an aerodynamic diameter of less than 10 m are referred to as PM10, whereas particles with an aerodynamic diameter of less than 2.5 m are referred to as PM2.5. The minute particles of PM may be ingested and go all the way to the bloodstream. Typically, the PM10 and PM2.5 concentration is employed as an indicator of air quality in metropolitan areas. PM generation due to human activity is particularly worrying in North America, Western Europe, Turkey, and the Republic of Korea. Particulate matter has been linked to serious health impacts, including respiratory problems, cardiovascular issues, and lung cancer.

Sulfur oxides (SO_x)

Colorless sulfur oxides are a common component of the lower atmosphere. These gases may be sensed by olfactory and gustatory senses at sufficiently high concentrations. To a large extent, this pollution is due to the combustion of sulfur-containing fossil fuels. The majority of human-caused sulfur dioxide emissions come from the combustion of high-sulfur coal in thermal power plants. There may be significant levels of sulfur dioxide in the nearby atmosphere due to emissions from both home coal burning and cars. Furthermore, sulfur oxides react with precipitation to form sulfuric acid.

Nitrogen oxides (NO_x)

Compounds of nitrogen may be found in fossil fuels, and the nitrogen oxides produced during burning are a direct byproduct of this process. Exposure to high concentrations of nitrogen oxides is detrimental to respiratory health and may trigger airway inflammation. On the other side, chronic exposure may impair lung function and heighten the body's reaction to allergens. Nitrogen oxides make up the bulk of Europe's manmade emissions. Combustion activities in homes, factories, and automobiles are the primary sources of these chemicals. When it comes to urban areas, the primary culprit is vehicle traffic. As an added bonus, NOx aids in the production of PM and ozone at ground level.

Carbon monoxide (CO)

Carbon monoxide is a deadly, odorless, and tasteless gas that pollutes the air. carbon monoxide (CO) is a byproduct of the incomplete combustion of fossil fuels such gasoline, natural gas, oil, coal, and wood. Vehicle emissions are the single most important human-made source of carbon monoxide.

Volatile Organic Compounds (VOCs)

At normal temperature, volatile organic compounds (VOCs) may easily evaporate. The human body cannot tolerate these chemicals. VOCs may be found in a wide variety of products, such as paints, varnishes, waxes, oil-dissolving solvents, cleaners, fuels, disinfectants, cosmetics, and glues. They may also be made by the combustion of tobacco and gasoline. Also, volatile organic compounds (VOCs) aid in the production of ozone.

MATERIALS AND METHODS

From January 2009 to December 2010, a full year's worth of air pollution readings were taken. To determine the link between gaseous air pollutants and climatic parameters, samples of air were taken between 1.5 and 3 meters above the ground in six sampling sites located in Basheerbagh, Punjagutta, RTC X roads, Begumpet, Narayanguda, and a control location in Hyderabad, A. P. The PM10 concentration was determined using a preweighed sheet of glass micro fi-bre filter paper (GFA/EPM 2000-Whatmann) and a gravimetric method using HVS-filtration technology. Using a gravimetric technique, samples of SPM were taken on GF/A Whatman filter paper. Samples were weighed using the BSI method (Bureau of Indian Standards Specification: BIS-5182), and concentrations of SPM were calculated. KIMOTO handy sampler (model HS-6) was used to collect air samples at 8 a.m., 4 hourly intervals, at a rate of 1.5 L/min for SO2 and NOx, and draw the air into borosilicate glass impingers containing 1% KI solution in 0.1 M phosphate buffer (pH 7.0), 0.04 M TCM (potassium tetrachloro mercurate solution), and 0.1% NEDA (n In the lab, a systemic UV VIS (Visible Spectrophotometer 108) was used to conduct spectrophotometric analysis of the gases that had been collected in the appropriate absorbents. Specifically, the samples' SO2 and NOx contents were determined using a modification of the West & Gaeke (1956) technique and the Jacob & Hoccheiser (1958) method, respectively.

RESULTS AND DISCUSSION

Table 2 shows a summary of the average concentrations of SO2 and Nox for the study period, and Table 3 shows the NAAQS standards that were used to establish those averages. The overall data show that the highest NOx and SO2 values were recorded between 8:00 and 11:00 am and 6:00 pm (5.00-8.00 p.m). According to the results, the Punjagutta sample station has the highest amounts of SPM (a high density of the vehicles during the peak hours). This is due to the poor condition of the roads, the lack of maintenance, the high volume of traffic, and the types of vehicles that use the roads year-round. Diesel automobiles are said to have higher suspended particulate matter in their emissions than gasoline ones. The largest concentrations of particulate matter (PPM) in the air come from diesel vehicles including tractors, semis, and buses.

NOx levels have exceeded the WHO standard of 60 mg/m3, but are still significantly below the CPCB limit of 80 mg/m3. Summer has the lowest NOx concentrations of any season across the board. When it's raining, there's more traffic on the roads, and more of those cars use four-stroke ignition engines, so there's a larger concentration of nitrogen oxides.

Average SO2 concentrations were likewise found to be well under the WHO standards of 80 mg/m3 and 60 mg/m3 across the board. Compared to the wetter months of summer and the drier months of winter, average levels of sulfur dioxide (SO2) were higher in the winter. It's due to the huge volume of vehicles and the resulting inversion, which prevents the pollution from being dispersed. From the data, we can conclude that the prevalence of two-wheeled vehicles is a major contributor to the release of pollutants into the environment at all of the sample sites.

Table 1: Hyderabad, India's 2009-2010 climate

Month			Mean Monthly Values				
	Maximum temperature (0°C)	Minimum temperature (0°C)	Total Rain-fall (mm)	Relative Humidity 08:30 hrs	Relative Humidity 17:30 hrs	Average Wind speed (km/h)	Sunshine duration (hrs)
August	30.1	21.9	121	85	71	12	4.1
September	30.2	21.7	124	84	59	11	4.8
October	31.1	20.3	032	76	40	08	7.5
November	30.9	16.6	000	60	39	07	8.9
December	29.0	14.2	000	67	34	05	9.1
January	30.4	15.6	000	70	47	05	9.3
February	31.4	19.2	080	79	23	07	7.9

March	34.7	22.1	000	50	31	06	5.6
April	40.8	25.2	012	52	45	07	9.4
May	38.6	26.7	064	65	70	10	9.3
June	31.6	22.9	215	84	68	12	4.2
July	30.0	22.3	129	83	76	13	4.7

Table 2: Pollutant levels for each sample location.

Sampling station		PM in mg/m^3			SPM in mg/m^3		NOx in mg/m^3				SO in mg/m^3	
	Rainy	Winter	Summer	Rainy	Winter	Summer	Rainy	Winter	Summer	Rainy	Winter	Summer
Punjagutta	120	141	134	560	793	928	60	43	13	18	52	16
R.T.C X roads	126	122	114	867	379	304	98	69	43	19	55	37
Basheerbagh	113	124	130	485	523	582	55	39	24	27	57	36
Begumpet	110	125	120	228	567	433	68	41	30	25	55	39
Narayanaguda	106	121	125	158	304	476	64	57	17	27	57	36
Control area	104	120	98	42	40	43	18	18	9	17	25	28

Table 3: CPCB (Central Pollution Control Board) guidelines for safe air quality in India (NAAQS).

Pollutants	Industrial area	Concentration in Ambient air Residential area	Sensitive area
^{PM}10	150	100	75
SPM (mg/m^3)	500	200	100
NOx (mg/m^3)	120	80	30
SO_2 (mg/m^3)	120	80	30
Remarks	Inferior	Moderate	Good

When the combustion temperature of the fuel is extremely high, a rise in NOx concentrations is seen. The amount of sulphur in the fuel is inversely related to the amount of SO2 released. When compared to gasoline's 1 percent sulphur level, diesel's 3 percent is much greater. The SO2 emissions from diesel automobiles are also greater. Vehicles traveling at a slower-than-average pace also produce more carbon monoxide. Additionally supporting the current results are the studies on air quality conducted by Hemavathi & Jagganath (2004), Jonathan & Ojha (2004), and Gupta & Shukla (2004).

CONCLUSION

Pollutants in city centers are worsening as a result of fast industrialization, growing urbanization, and intensive rail and road activity. Air pollution may make people unable to move about, irritate their eyes and respiratory system, reduce vision, and block out the sun.

Two-wheeled vehicles are a significant contributor to urban air pollution due to their release of several gaseous contaminants. The majority of auto rickshaws contribute to air pollution because they use gasoline that has been tampered with. In addition to this, there are a number of other factors contributing to the increasing pollution load, such as a lack of driver awareness, a lack of a regulating mechanism, a lack of public knowledge on air pollution, and the practice of drivers idling their cars at intersections. Air pollution from automobiles must be addressed from a variety of angles, including via educational initiatives, media intervention packages, government action plans and programs, and the strategic distribution of high-quality gasoline by retailers.

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