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ASSESSMENT OF AMBIENT AIR QUALITY STATUS IN TIRUCHIRAPPALLI CITY, INDIA

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ABSTRACT

The rapid growth of the industries, transportation and urbanization is the main cause of increase in ambient air pollution. Air pollutants ultimately deteriorate the health condition of living beings. The major air pollutants like Nitrous Oxides (NOx), Sulphur dioxide (SO_2), Particulate Matter (PM_{10}) especially Particulate Matter (PM) can be considered as invisible carriers. Secondary data were collected and those data demonstrate the fifteen years annual average concentration of SO_2, NOx, and Particulate Matter (PM_{10}) in five major locations of the city. The value of RSPM only exceeds the permissible limit of NAAQ. The results show the locations Gandhi market, Central bus stand and Main guard gate are considered highly polluted area and other Golden Rock and Bishop Heber are less polluted areas. Dirty air or air pollutants enter deep into our lungs, can cause respiratory illness like Chronic Obstructive Pulmonary Disease (COPD), asthma and respiratory allergy. This paper is to assess the air quality status of the city and its health impact. Therefore, it is observed that these areas are classified as vulnerable to respiratory diseases.

KEY WORDS : Air, Pollutants, Permissible, Respiratory diseases, Vulnerable

INTRODUCTION

Good air quality is essential for better health for living beings including humans. The increase in human population, urbanisation and economic growth leads to an increase in the consumption of resources paved the way for pollution. Air pollution is the major problem among the other. The Air (Prevention and Control of Pollution) Act, 1981 says, "air pollution is the presence of any solid, liquid, or gaseous substance in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or property or environment (CPCB, 2018). More than 25% of deaths around the world may directly be linked to pollution (Sharma *et al.,* 2019). In Asia, the highest levels of pollutants recorded were in 2015, when 35% of deaths were due to air pollution. Ambient air pollution is a complex mixture of thousands of components. It includes airborne Particulate Matter (PM) and the gaseous pollutants such as ozone, nitrogen dioxide (NO_2), volatile organic compounds, carbon monoxide (CO), and sulphur di oxide (SO_2).

Sulfur dioxide (SO_2) is formed when fuel containing sulfur, such as coal and oil, undergoes combustion and during petroleum refining. SO_2 dissolves in water vapour to form acid, and interacts with other gases and particles in the air to form sulphates and other respirable particulates (Chen *et al*., 2007). SO_2 remains in the ambient air for 1-7 days, during which time it can be converted to sulfates and sulfuric acid by sunlight, photochemical oxidants, or by the catalytic effect of certain particulates in the air. The ambient levels of sulfur oxides cause morbidity and mortality (Rall, 1974). NOx is produced from the reaction of nitrogen and oxygen gases in the air during combustion, especially at high temperatures. In the areas of high motor vehicle traffic, such as in large cities, the amount of Nitrogen oxides, emitted into the atmosphere as air pollution, can be significant (Wang *et al*., 2020). The nitrogen oxides (NOx) family, namely nitric oxide or nitrogen monoxide

(NO), nitrogen dioxide (NO2), nitrous oxide (N2O), and their derivatives has a wide range of health and environmental impacts. Nitric oxide (NO) spreads to all parts of the respiratory system because of its low solubility in water. Nitrogen oxides diffuse through the Alveolar-cells (epithelium) and the adjacent capillary vessels of the lungs and disrupt the Alveolar structures and their function in lungs (Boningari, and Panagiotis, 2016). Both PM types are emitted from vehicles, industrial exhausts, and household sources. It is acknowledged that the exposure effectiveness of PM is greatly influenced by local conditions such as weather, seasons, topography, sources of particles, concentrations being emitted, and microenvironments (Casati *et al.,* 2007). Particulate matter, which is a inhalable particles, cause problems in respiratory tracks. Concentrations and toxicity of particulate matter depend on their composition, shape, size of particles and with the presence of other pollutants and existing meteorological factors (Mukherjee *et al*., 2017).

The urban air pollution levels here are some of the highest in the country including Chennai and Coimbatore (Tamil Nadu), Hyderabad and Vishakhapatnam (Andhra Pradesh), Kochi (Kerala), and Bengaluru (Karnataka). Several large power plants also exist in the states of Punjab, Haryana, Delhi, and Uttar Pradesh, making the north and the north-eastern belt the most polluted part of the country (Guttikunda *et al*., 2014). Six cities - Agra, Bengaluru, Jaipur, Kanpur, Ludhiana, and Raipur, recorded 4–6 times higher the annual standard. These are among the fastest growing Indian cities, traditionally known to be dusty due to a lot of construction activities and dust on the roads which is resuspended when vehicles pass. (Guttikunda *et al.,* 2019). In most of the cities in India, the status of air quality is unhealthy status. The continuous exposure to pollutants like the Particulate Matter, (PM10 and PM 2.5) creates several respiratory related diseases. (Pant *et al.*, 2018). The most recent studies reports the respiratory diseases are significant contributors to morbidity and premature mortality in India.

About the Study Area

Tiruchirappalli city is the fourth largest corporation in the Tamil Nadu, India. It is situated on the banks of the river Cauvery at 10°00′ to 11°30′N latitude and 77°45′ to 78°50′E longitude. Total geographical area of the city is 169.2 km^2 with the total population of 847,387 as per 2011 census data. The average annual rainfall recorded was 747 mm, mostly occurring during the monsoon season. The temperature in winter varies from 18.6 ℃ to 23.1 ℃ and in summer the range of 36.40 °C to 44.10 °C. There are five zone and broadly classified into Traffic Intersection Zone, Commercial Zone, Residential Zone, Mixed Zone. The frequency of monitoring for RSPM was 24 hourly and 8 hourly with respect to SO_2 and NOx (Table 1).

MATERIALS AND METHODS

Data Collection

The secondary data were collected from the TNPCB, Tiruchirappalli for the year 2003 to 2017. The data were calculated and analysed the annual mean concentration for fifteen years and also standard deviation was derived. The result was graphically represented using SPSS software.The statistical analysis was performed for further assessment.

RESULTS AND DISCUSSION

Annual mean concentration of SO_2 ranged from 9.84 μg/m^3 to 15.09 μg/m^3 the maximum level of 15.09 μg/m^3 observed in Gandhi Market and the least value is 9.84 μg/m^3 in Bishop Heber College as shown in Fig.1. For the parameter of NOx, the highest value is observed in the Gandhi market 20.58 μg/m^3 and the second highest value is 20.45 μg/m^3 in Central Bus stand and the range of other

Table 1. Types of Zones in Study Area

No.	Station Location Name	Latitude and Longitude	Type of Zone
S1	Gandhi Market	10.8162°N, 78.6966°E	Commercial zone
S2	Main Guard Gate	10.8267°N, 78.6934°E	Traffic intersection
S3	Bishop Heber College	10.8174°N, 78.6759°E	Mixed zone
S4	Golden rock	10.7857°N, 78.7246°E	Residential zone
S5	Central bus stand	10.7986°N, 78.6804°E	Traffic intersection

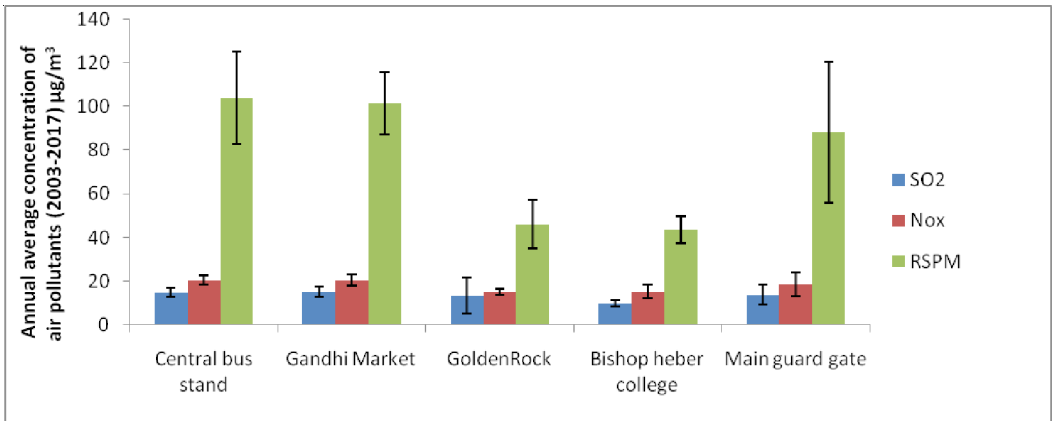

Fig. 1. Fifteen Years Annual Concentration of Air Pollutants (2003-2017)

Table 2. Mean and standard deviation of all the parameters

Location	Mean ± Standard Deviation		
	SO_2	NOx	RSPM
Central Bus stand	14.79 ± 1.98	20.45 ± 2.25	104.13 ± 20.98
Gandhi Market	15.09 ± 2.37	20.58 ± 2.54	101.50 ± 14.35
Golden Rock	13.35 ± 8.20	15.10 ± 1.43	46.18 ± 11.06
Bishop Heber College	9.84 ± 1.41	15.42 ± 3.00	43.46 ± 6.10
Main guard gate	13.68 ± 4.50	18.57 ± 5.59	88.07 ± 32.14

location are 15.10 µg/m³ to 18.57 µg/m³. The SO_2 and NOx are under the permissible limits of 80 µg/m³ (Fig. 1). The highest value in Central Bus Stand 104.13 µg/m³ and the second highest value in Gandhi market 101.50 µg/m³ both are exceeding the permissible limit of NAAQ and the least value observed in Bishop Heber College is shown in the Fig. 1. This is probably due to the heavy traffic and human activities as the market is located in the main part of the city. The overall findings thus, suggested that the magnitude of these pollutants varied with location depending on human activities at a given place. The data were statistically analysed which show the more variation in two location i.e. Main guard gate, Golden Rock and Bishop Heber College. The values of almost all parameters were found to be higher those locations (Table 2). The other location are showing minimum variation in all the pollutants. Therefore, the Central Bus stand and Gandhi market showed the high level concentration in all the parameters. Hence, both are considered as highly polluted area and the Main guard gate is under the moderately polluted area, Golden rock and Bishop Heber College are under the least polluted area.

CONCLUSION

The study revealed, among the three pollutants annual average concentration of RSPM was found to be slightly higher than the national standard of 100 mg/m³ in both location Central bus stand and Gandhi market. Other locations such as main guard gate are showing more variations. Increasing vehicular traffic emissions and traffic dust are the major reasons for the increasing trend in respirable suspended particulate matter. Therefore, people in the Central bus stand, Gandhi Market and Main guard gate may be categorized as vulnerable to respiratory diseases due to unhealthy air.

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