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Vehicular Emission Estimates of Various Air Pollutants in Residential Region of Lucknow

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Abstract - *Air quality is an topic of social concern globally in the era of rising industrial and vehicular air pollution. The pollution do arise from different sources out of which vehicular emission is prime source of pollution of ambient air and there exists an urgent need to the extent of vehicular pollution, especially considering the growing population , Industrialization and Urbanization there has and is likely to continue to be a high increase in the stock of road vehicle traffic in the city . This paper presents the Vehicular Emission of various Air Pollutants in Residential Region of Lucknow . It was found that the average per hour emission of CO in air is was 1206.77 gm/hr , Average HC emission as 672.8 gm/hr , Average NOx emission as 403.08 gm/hr and average PM emission as 56.2 gm/km , as been estimated by using Emission Factors based on Bharat Stage (BS) IV norms as prescribed by CPCB. It was found that Bikes were the major source of Vehicular emissions accounting for 65% share in CO emission , 39% share in HC emission , 70% share in NOx emission and 52% share in PM emission. The probable strategies to curb down the vehicular emissions could be adaptation of AVOID, SHIFT and IMPORVE measures by the Nodal Agencies for Pollution Control in Lucknow along with Public Awareness and Involvement .*

Key Words **: Air Quality , Vehicular Emissions , CPCB , Bharat Stage (BS) IV , Pollution Control**

1.INTRODUCTION

Vehicular pollution can be regarded as the emission of harmful unwanted pollutants into the open environment by motor vehicles. These pollutants, have severe bad effects on human health and the ecosystem as a whole. Transportation sector is a prime source of air pollution in almost all countries around the world due to the high growth in number of vehicles been running on the roads. With the industrialization and Urbanization , the standards of living of people had increased so the purchasing power. An increase in purchasing power indicates that more people can now afford vehicles. The air pollution from vehicles in urban spaces particularly in big cities, has become a big topic of concern . The air pollutants been released from vehicles has led to rising concerns related to irritation of eyes, various bronchial problems and visibility issues as well as pollutants remain suspended in air.

The main reason of vehicular pollution is the rapidly increasing number of vehicles. The other factors of vehicular pollution in the urban areas may include : 2-stroke engines, degraded fuel quality, old vehicles, Improper maintenance, congested traffic, poor road condition with high Unevenness Index and quite old automotive technologies and inefficient traffic management system.

Air pollution in India is a concern causing serious health issues . Of the 30 most polluted cities in the world, 21 are of India in 2019. As per a study based on 2016 data, at least 140 million peoples in India breathe air that is 10 times or even more exceeding the WHO safe limit and 13 of the world's 20 cities with the highest annual levels of air pollution are in India.

The Air (Prevention and Control of Pollution) Act been passed in 1981 to regulate and control air pollution but has failed to achieve targets and reduce pollution because of poor enforcement of the rules and apathetic concerns among public.

In 2015, Government of India, with efforts of IIT Kanpur launched the National Ambient Air Quality Index. In 2019, India launched 'The National Clean Air Programme' with tentative national objective of 20%-30% reduction in PM2.5 and PM10 concentrations by 2024, considering 2017 as the base year for comparison. It was supposed to be rolled out in 102 cities which are considered to have air quality worse than the National Ambient Air Quality Standards.

According to the research been done by the WHO and Joint Research Centre (JRC) in 2015 on 50 leading countries of the world with motive to gain better understanding of the leading causes of urban air pollution , on studying and analyzing the data ; the Researchers identified Pollution due to Traffic as being the top contributor to Air Pollution . On India level the study been conducted by Indian Institute of Toxicology Research in Lucknow in 2020 in context to rising air Pollution have concluded that Vehicular traffic has been found to be the main source of air pollution in Lucknow city. The city has become denser with traffic congestion which increases the vehicle emissions and subsequent health impact mainly for drivers, commuters, and individuals living near roadways.

2. STUDY AREA

The proposed study area for the above mentioned objective Lucknow city, the capital city of Uttar Pradesh. The coordinate location of the city being 80º 57' E longitude and 26º 51' N latitude lying 123 m above sea level. The total area of city being approximately 610 sq. Km. Having good infrastructure and being with ever continuous growth and possessing various unmatched amenities, well feasible connected routes of transportation makes the city densely populated with a population of 28.15 lakhs (2011 census) and projected population of 37.65 lakhs in 2021 . Being the capital, Lucknow has a well-connected system of roads within itself and between other cities. Due to large population of the city and presence of number of roads, numerous vehicles run on the roads of the city ranging from public transport vehicles, heavy diesel vehicles, personal owned vehicles etc. The total vehicular population in Lucknow city(as per Reports by RTO , Lucknow) as on 31 March, 2020 was 2407190, which showed 9.70% growth in its number in comparison to previous year .

Fig -1: Selected Study Area on Map

2.1 Selected Location

In this phase of work, to estimate the vehicular emissions of Various Air pollutants (CO , HC , NOx and PM) in the month of July ; the Residential location of Aashiana has been selected.

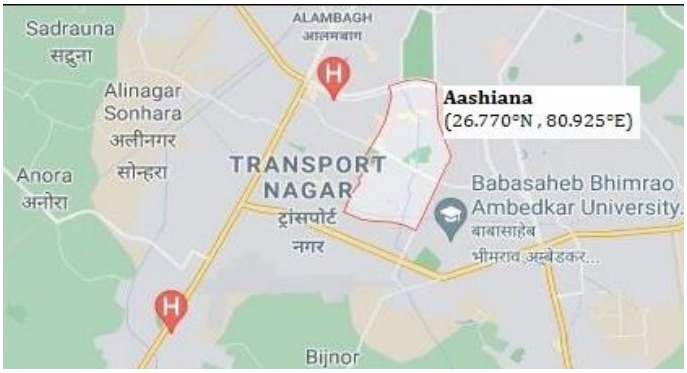

Fig -2: Selected Residential Location in Lucknow

3. METHODOLOGY

3.1 Data Collection

For calculating the Vehicular population in the selected site of work , A manual Traffic Count survey was been done at the interval of 15 minutes for 2 hours in Morning , Afternoon and Evening Hours , The time of traffic survey was so chosen that it covers variety of time zones ie. Normal working time , At the start of Office Hours and At the end of Office Hours . Vehicles have been categorized as Bikes , Scooters , Cars , Light Commercial Vehicles (LCV) , 3-Wheelers , Heavy Commercial Vehicles (HCV) , Buses and Tractors . As per Central Pollution Control Board (CPCB), 2015 Report Namely 'Status of Pollution generated from Road Transport in Six Mega Cities' , the classification of Cars can be done on fuel type i.e. Petrol (56%) , Diesel (40%) , and CNG (4%) . The Total number of Vehicles per Hour can be calculated from the observed Vehicle Fleet Survey Count.

3.2 Data Analysis

As per Auto Fuel Policy of Government of India , Bharat Stage (BS) IV fuel norms have been regulated in major cities of Uttar Pradesh along with Lucknow with effect from March 2015 . Hence keeping in view of BS IV norms , The emission factors as provided by CPCB have been taken into consideration (given in Table -1)

Table -1: Emission factors as per Bharat Stage (BS) IV norms

	CO	HC	NOx	PM
Bikes	0.744	0.251	0.271	0.028
Scooter	0.107	0.576	0.013	0.046
Petrol Cars	1.294	0.095	0.064	0.002
Diesel Cars	0.047	0.048	0.14	0.008
CNG Cars	0.06	0.46	0.74	0.006
LCV	2.65	0.946	1.484	0.081
3 Wheelers	0.69	2.06	0.19	0.118
HCV	4.345	0.259	6.041	0.071

The average estimate of emission of air pollutants over a specified length of road can be obtained by computing the Vehicle Kilometre travelled (VKT) and then getting the emission estimate by multiplying it with Emission Factors as per Bharat Stage (BS) IV norms given by CPCB.

VKT = Traffic count x Road length (Zone of Influence)

For computing the emissions over a specific road length in the region, The road adopted is Bijnour Road starting from Aurangabad Jangir intersection to Baba Bhimrao Ambedkar University, the Road length spanning about 1.8 Km.

4. RESULTS AND DISCUSSION

By the Manual Survey Count of Vehicles on the selected site the Traffic Composition is been shown in Fig-3 (y-axis Depicts the Average number of vehicle per Hour), It can be seen from the graph that bikes have the maximum share in Traffic population.

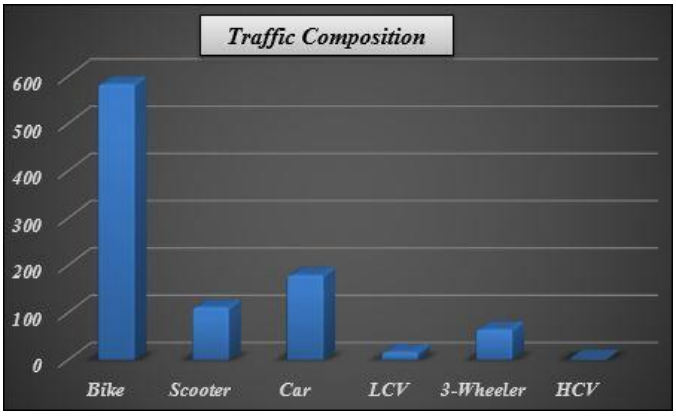

Fig -3:Average Traffic Composition
(per Hour Vehicles on road)

After computing the Average vehicle emission on the selected site over the designated length of road using the emission Factors as designated by CPCB , The average per hour emission of CO in air is calculated as 1206.77 gm/hr , Average HC emission as 672.8 gm/hr , Average NOx emission as 403.08 gm/hr and average PM emission as 56.2 gm/km .

From Fig-4 it could be concluded that Bikes contribute maximum (65%) followed by Cars (20%) in emission of CO in air while in the emission of HC (Fig-5) the second largest contribution is by 3-Wheelers (35%) and maximum being by the Bike (39%) .
Fig-6 Shows that Bike contributes to 70% in the emission of NOx followed by LCV contributing 11 % . PM emission are mainly dominated by Bikes contributing 52% and 3-Wheelers contributing 24% (Fig-7).

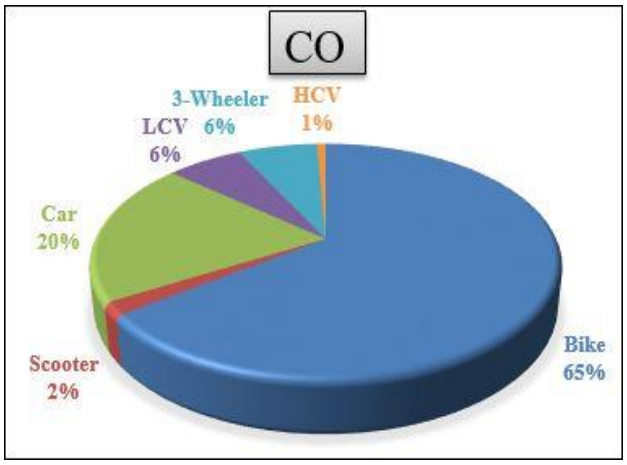

Fig -4 : Share of different vehicle Categories in emission of CO

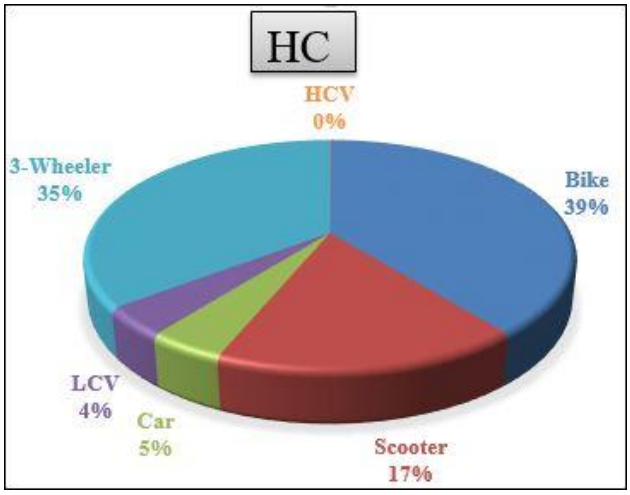

Fig -5 : Share of different vehicle Categories in emission of HC

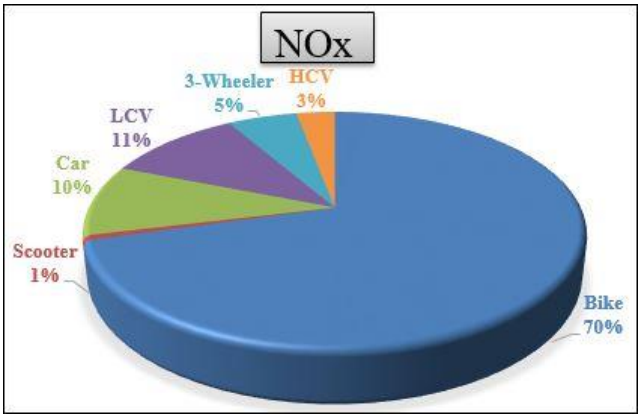

Fig -6: Share of different vehicle Categories in emission of NOx

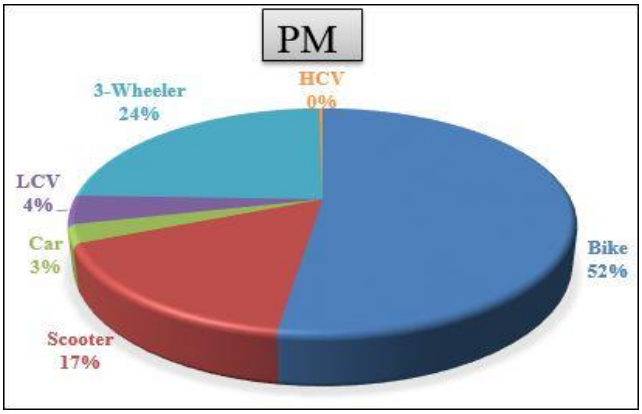

Fig -7: Share of different vehicle Categories in emission of PM

5. CONCLUSIONS

Air quality has always been an issue of Health concern worldwide amidst the rising industrial and vehicular air pollution. While pollution does rise from sources, vehicular emissions is an critical cause of pollution in ambient air and there is an urgent need to have check on the extent of vehicular pollution.

Vehicular traffic is a major source of air pollution in mega cities like Lucknow . The growth in number of vehicles is quite obvious with increase in population and industrial Growth. Locally, vehicular emissions depend on traffic levels, infrastructure design, driving patterns, vehicular characteristics and the type and Quality of fuel being in use. Emissions from mobile sources contribute to primary and secondary air pollutants that have potential to affect human health, damage ecosystems and influence climate Change Patterns. There has been a heavy load of wide variety of pollutants, principally carbon monoxide (CO), carbon dioxide (CO2), oxides of nitrogen (NOx), particulate matter (PM) and hydrocarbons (HC) or volatile organic compounds (VOCs) in the air which have a major long-term impact on air quality and Biome existing . The type of Vehicle and there Engine Design considering How the Fuel is burnt in engine affects the release of Contaminants. In the study done here it is found that in Residential Region Aashiana of Lucknow the maximum contribution in air pollution is accounted by Bikes. To improve the current Situations of alarming Pollution levels, Auto Fuel and Vision Policy 2025 must be enforced with strictness and new Vehicles must be designed as per BS VI norms which is an revision and improvement over the previous one.

The probable strategies under the spectrum of AVOID, SHIFT and IMPORVE would surely work in reduction of traffic emissions which have both short and Long Term detrimental consequences on Environment and Human Health. The AVOID strategies can lead to the reduction in the mobility demands, SHIFT strategies like enhancement of public transport will encourage people to switch to cleaner and efficient modes of transport. On “Improvement”, it can be identified that progressive advancement of emissions norms is a must to mitigate emissions from the sector in the longer run. Emissions from existing vehicles also need to be controlled by taking measures which have immediate effect. These may include commissioning of effective I&M systems, and restrictions over old commercial vehicles. Introduction of cleaner gaseous fuels can be considered in the cities where it is logistically possible.

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