

Analysis of Air Pollution for Vehicle Population in Coimbatore

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Abstract-Transport sector emission inventory for Coimbatore city has been estimated to quantify vehicular emissions loads. In this study it also explains the limitations of the inventory model and various difficulties faced during the survey. Emission factor and vehicle utilization factor based approach as recommended by IPCC (2006) have been used for estimating emissions. Pollutants level were found to increase continuously during the study period, which clearly indicates the absence of stricter emission norms and compressed natural gas conversion of public transport. However, two-wheelers and four-wheelers population were found to be a major contributor towards the air pollution load. An effort is made to explain the limitations of the traffic emission inventory model and difficulties faced during the implementation of the model in the Coimbatore city.

Keywords-Emission factors, Natural gas, Vehicle population .

I. INTRODUCTION

The urbanization is a part and parcel of the human development process and, therefore has witnessed a sharp increase in the last few decades of Industrial era. The industrialization has totally changed the human settlement pattern. The transportation sector is a major component of the urbanization and development. In order to study the impacts of transport sector on the environment in the mega-city, an attempt has been made to calculate the emissions.

Transport sector is one of the major contributors of greenhouse gases and has even more importance for the emission of polluted gases like NO_x, SO₂, CO, particulate matter into the atmosphere. Worldwide most urban areas suffer from serious air quality problems due to increasing population levels, combined with changes in land use and increases in vehicular traffic.

II. METHODS AND MATERIAL

2.1 STUDY AREA:

It is known that the number of vehicles registered in Coimbatore is not the exact figure running on Coimbatore's roads. Many number of vehicles regularly travel daily from

nearby towns. In addition, large number of goods vehicle pass through the city at night and hence contributing significantly to the rising air pollution level in Coimbatore city. The two-wheeler population was categorized into 2- stroke (2S) and 4-strokes (4S). Since 4S two-wheelers emit less pollution load in comparison to 2S two-wheelers, for studying the relative advantage of 4S two-wheelers over 2S two-wheelers we have taken 8:1 ration of 2S-4S two wheelers to calculate their respective numbers as per Biswas (2006).

2.2 EMISSION INVENTORY

Emission inventories are used for assessing and simulating air quality and to evaluate policy decisions in air quality management. The emissions inventory is built for the following pollutants – particulates in two bins (PM10, PM2.5), sulfur dioxide (SO₂), nitrogen oxides (NO_x), carbon monoxide (CO), volatile organic compounds (VOC), black carbon (BC), organic carbon (OC) and Carbon Dioxide (CO₂).

Emission models can be used in the context of Decision Support Systems (DSS) to provide the analyst and the decision maker with quantitative estimates, trends, and insight on the policies simulated. These models can be used for estimating emissions from urban on-road vehicles in developing countries like India where paucity of extensive and exhaustive dataset limits the use of sophisticated models frequently used in advanced countries.

2.3 MAJOR VEHICULAR POLLUTANTS

- Carbon Dioxide (CO₂)
- Carbon Monoxide (CO)
- Particulate Matter (PM)
- Nitrogen Oxides (NO_x)
- Lead and Hydrocarbons (HC)

A. Air Toxics

- Aldehydes (CHO)

- Formaldehyde (CH₂O)
- Acetaldehyde (CH₃CHO)

These pollutants have their own adverse effect on the environment and human health. The health effects due to the vehicular emissions are given below.

2.4 HEALTH EFFECTS:

With urban growth and industrialization the air pollution has attracted high priority in respect of environmental regulation since the environmental damage due to such pollution mostly affects human well-being directly by way of adverse health effects on the population exposed to it. The significance of motor vehicles in contributing to the total damage value that a society suffers due to air pollution, has increased. The fuel like high speed diesel (HSD) has become a greater danger for human health than apparently more visible source of road dust (Dockery et.al. 1993; Marrack)

2.4.1 Volatile organic compounds:

Volatile compounds can cause irritation of the eye, nose and throat. In severe cases there may be headaches, nausea, and loss of coordination. In the longer run, some of them are suspected to cause damage to the liver and other parts of the body.

2.4.2 Formaldehyde:

Exposure causes irritation to the eyes, nose and may cause allergies in some people.

2.4.3 Lead:

Prolonged exposure can cause damage to the nervous system, digestive problems, and in some cases cause cancer. It is especially hazardous to small children.

2.4.4 Radon:

A radioactive gas that can accumulate inside the house, it originates from the rocks and soil under the house and its level is dominated by the outdoor air and also to some extent the other gases being emitted indoors. Exposure to this gas increases the risk of lung cancer.

2.4.5 Ozone:

Exposure to this gas makes our eyes itch, burn, and water and it has also been associated with increase in

respiratory disorders such as asthma. It lowers our resistance to colds and pneumonia.

2.4.6 Carbon monoxide:

CO (carbon monoxide) combines with hemoglobin to lessen the amount of oxygen that enters our blood through our lungs. The binding with other haeme proteins causes changes in the function of the affected organs such as the brain and the cardiovascular system, and also the developing fetus. It can impair our concentration, slow our reflexes, and make us confused and sleepy.

2.4.7 Sulphur dioxide:

SO₂ (sulphur dioxide) in the air is caused due to the rise in combustion of fossil fuels. It can oxidize and form sulphuric acid mist. SO₂ in the air leads to diseases of the lung and other lung disorders such as wheezing and shortness of breath. Long-term effects are more difficult to ascertain as SO₂ exposure is often combined with that of SPM.

2.4.8 SPM (suspended particulate matter):

Suspended matter consists of dust, fumes, mist and smoke. The main chemical component of SPM that is of major concern is lead, others being nickel, arsenic, and those present in diesel exhaust. These particles when breathed in, lodge in our lung tissues and cause lung damage and respiratory problems. The importance of SPM as a major pollutant needs special emphasis as a) it affects more people globally than any other pollutant on a continuing basis; b) there is more monitoring data available on this than any other pollutant; and c) more epidemiological evidence has been collected on the exposure to this than to any other pollutant.

2.5 MEODOLOGY:

Emission factors and activity-based approach recommended by IPCC (2006) have been used for the calculation of vehicular emissions from the road transport sector in Delhi (Eq. (1)). A simple spreadsheet model (Microsoft Excel 2007) has been used for calculating emissions loads from transport sector using Eq. (1).

$$E_i = \sum (V_{ehj} \times D_j) \times E_{i,j} \text{ km}$$

E_i = Emission of pollutant (i)

V_{ehj} = Number of vehicles per type (j)

D_j = Distance travelled by per vehicle in per year or vehicle utilization factor (j)

$E_{i,jkm}$ = Emission of pollutant (i) from vehicle type (j)

per driven kilometre.

III. RESULT AND DISCUSSION

In the wake of urbanization and industrialization in Coimbatore, the number of automobiles is rising particularly after economic liberalization. Sources from the Regional Transport Office of Coimbatore are as follows:

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Coimbatore City comprising Coimbatore South, Coimbatore North, Coimbatore west and Coimbatore Central alone witnessed a total registration of 81,431 where as the same offices during the previous year witnessed a registration of only 75,024 new vehicles. In addition to these, there are RTOs in Tirupur and Mettupalayam in the district of which Tirupur witnessed an increase of 3,000 new vehicles while Mettupalayam witnessed an increase of 1,000 vehicles. The vehicles registered in the other two RTO offices, i.e., Tirupur and Mettupalayam, will also come into Coimbatore city adding to the pressure on roads. The spurt in registration of new vehicles in the district is closer to 7,000 vehicles. In 2015, the district had 1,48,757 new vehicles registered while it has shot up to 1,96,757 vehicles in 2016. The estimated on-road population of two wheelers in the city is about 10,96,057 and the estimated on-road population of motor cars is about 264183 till December 2016.

A. ESTIMATION OF TWO WHEELER POPULATION

TABLE 1: New two wheeler registrations annually

YEAR	Two Wheelers registered
2016	81431
2015	75084
2014	73810

The graph showing the declining trend in the case of two wheelers is shown in the following graph.

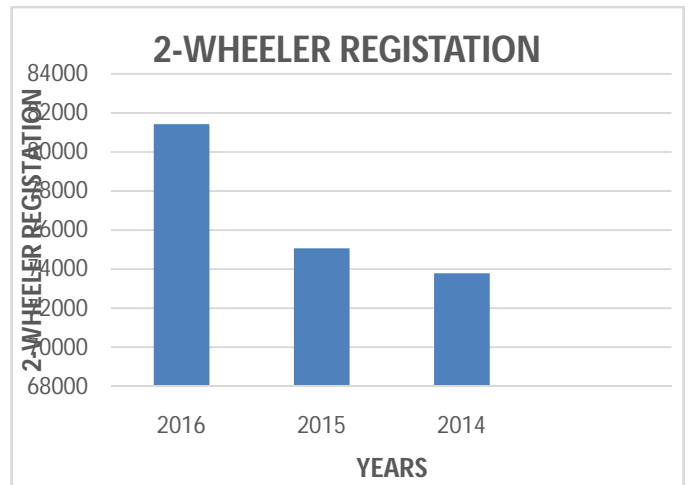


FIGURE 1: Annual growth of two wheelers
 Increase in percentage 2014- 2015 = 1.62%
 Increase in percentage 2015-2016 = 7.91%

B. ESTIMATION OF FOUR WHEELER POPULATION:

TABLE 2: New four wheeler registrations annually

YEAR	Four Wheelers registered
2016	22850
2015	16804
2014	14756

Increase in percentage 2014- 2015 = 12.19%
 Increase in percentage 2015-2016 = 27.75%
 The graph showing the declining trend in the case of four wheelers is shown in the following graph.

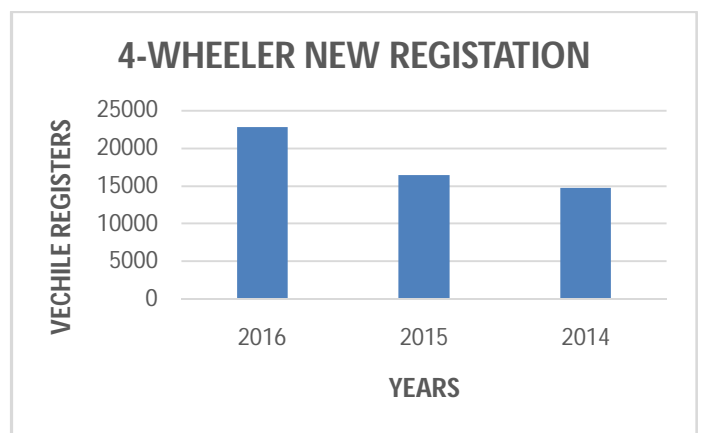


FIGURE 2: Annual growth of four wheelers

IV. CONCLUSION

An emission inventory of several air pollutants including criteria pollutants, ozone precursors, and greenhouse gases emitted from transport sector has been estimated for Coimbatore city. It is known that the emission loads for almost all the pollutants showed increasing trend over the years. This

indicates that increase in the emission loads will be much greater in the absence of the pollution control measures.

An attempt is made to explain the various limitations of the inventory model and difficulties faced during its implementation in Coimbatore city. The estimation of the inventory is made with the available data and the limitations of the data and the assumptions made in the absence of required data is also clearly explained.

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