ASSESSMENT OF AIR QUALITY AND VEHICULAR POLLUTION IN THE CITY OF SHILLONG, MEGHALAYA

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ABSTRACT

In the absence of industries, vehicular emission is the only source of harmful gases in Shillong. The paper will focus to highlight air quality in the city by taking support of assessment of vehicular pollution for a period of ten years. Government published records were used extensively for addressing city's air quality in the paper. The study of vehicular emission in the paper was established with the help of Traffic count method to highlight the source of emissions of air pollutants and it also provided immense traffic volume in the city. The level of concentration of air pollutants are within permissible range of the National Ambient Air Quality Standards therefore rendering the air quality in the city as good to satisfactory. Precautionary measures should be taken to retain the air quality as urbanization and development is approaching the city of Shillong.

Keywords**:** *Air Quality Index; Vehicular Growth; Vehicular emission; air pollutant; air pollution*

Introduction

Human welfare, whether individual or of the community, is inseparable from the totality of the environmental conditions. For a comfortable life and with better purchasing capacity, man aims to upgrade his standard of living for which one way of doing so is by owning a vehicle. Alongside in the same community, man owns vehicles for increasing his own income capacity. A vehicle serves as a luxury commodity for some part of the world's population and as necessary commodity for others. Regardless of any purpose that it is being purchased, a vehicle surely comes in contact with the natural environment directly and indirectly. It is the direct involvement of the vehicle with nature that has caused great concern in the world today. Every corner of the world has become familiar with the use of vehicular transportation. All these corners have also experienced the involvement of transportation with the environment. Tucked in the northeastern most part of India, Shillong city has also witnessed the importance of vehicles over the years. Residents realises the comfort that vehicles provide in their daily life. Man's daily activities, personal or professional, could be easily accomplished with the service of vehicles. Hence, number of vehicles shows increasing trend from one year to another in the city. Least was the residents aware of the consolation service that comes with the use of vehicles in the city. The pleasant climate and natural surroundings of Shillong is now an issue of great concern with the increase in the vehicle population. Vehicles have become issue of great concern in the city because of the fuels used in the engines that propels them to move from one point to another. The invention of internal combustion engine breakthrough the use of petrol and diesel fuels to operate engine in vehicles. vehicles runs smoothly and swiftly with the use of these fuels which provide speedier transport and timely completion of work. These fuels have the finest utility in the world but it is the by-product of these fuels that interfere with the mechanism of nature. Vehicles exhaust harmful gases with the use of petrol and diesel fuels.The vehicles exhaust releases mixture of harmful gases which are then absorbed by the atmospheric layer in the city. These harmful gases intervene with the atmospheric system of the place and ultimately change the healthy condition of the layer of air in that location. Changing air quality is the consolation service that has been received in the city along with the massive use of vehicles. The issue of changing air quality due to vehicular emission has been brought forward in many literature related to the field of study. Combustion of fossil fuels such as coal, oil and petrol can produce coarse particles from the release of non-combustible materials (fly ash); fine particles from the condensation of materials vaporized during combustion; and secondary particles through the atmospheric reactions of sulfur oxides and

nitrogen oxides initially released as gases (Nisanth et al., 2012). The main sources of total anthropogenic emissions of primary PM10 are road traffic (10–25%), stationary combustion (40–55%) and industrial processes (15–30%). However, the contribution of road traffic to ground-level urban concentrations and to human exposure would be considerably larger than the contribution of road traffic to emission. The other major contributor to PM10 concentration (26–34%) was estimated to be long-range pollution from sources other than transport. Transport-related CO2 emissions are expected to rise 57 per cent over the 25 years to 2030 (ADB, 2009). Globally, light duty vehicle numbers are predicted to increase ten-fold from 2008-2050 (de Jong, 2008). Along with aviation, "motor cars are increasingly the favoured modes for passenger transport but are also significantly the most damaging" (Chapman 2007, p. 357).

Long-term exposure to high concentrations of SO2 can contribute to respiratory illness, particularly for children and the elderly, and aggravate existing heart and lung diseases (USEPA 2008).

The concept of an Air Quality Index (AQI) has been developed and used effectively in many developed countries for over last three decades (USEPA 1976, 2014; Ontario, 2013; Shenfeld, 1970). An AQI is defined as an overall scheme that transforms weighted values of individual air pollution related parameters (SO2, CO, visibility, etc.) into a single number or set of numbers. Briefly, an AQI is useful for: (i) general public to know air quality in a simplified way, (ii) a politician to invoke quick actions, (iii) a decision maker to know the trend of events and to chalk out corrective pollution control strategies, (iv) a government official to study the impact of regulatory actions, and (v) a scientist who engages in scientific research using air quality data.

A recent study to define Air Quality Index in India has been taken up by Beig et al (2010) which includes air quality forecasting and named the system as SAFAR (System of Air Quality-Weather Forecasting and Research). This study considered correlation analysis of long term air quality data of different pollutants and health data for two cities, Chennai and Delhi. CPCB notified (http:// www.cpcb.nic.in) a new set of Indian National Air Quality Standards (INAQS) for 12 parameters [carbon monoxide (CO) nitrogen dioxide (NO2), sulphur dioxide (SO2), particulate matter (PM) of less than 2.5 microns size (PM2.5), PM of less than 10 microns size (PM10), Ozone (O3), Lead (Pb), Ammonia (NH3), Benzo(a)Pyrene (BaP), Benzene (C6 H6), Arsenic (As), and Nickel (Ni)] .

With support of the given literatures, the paper will proceed with the following objectives:

1. To examine the pattern of vehicular traffic in the city and analysing vehicular pollution.
2. to elaborate on the trend of the air quality of Shillong

Methodology

Secondary data for vehicular growth and Air Quality in the city were obtained from Government Published Annual Reports. Daily traffic count was initiated to study the movement of vehicular traffic in the city at different road junctions. For the prepared paper, Shillong proves to be a satisfactory location as it engulfs maximum traffic volume since it is the centre for educational, administration, tourism and distribution services. This also leads to increasing population growth which makes a fair argument to attach to it that number of vehicles is also increasing in the city.

Study area: Located at 25°57" N and 91°88"E, Shillong is blessed with a pleasant natural environment which has managed to compel the British to change their headquarters in the colonial era. The sole medium of transportation in the city is the road which defines automobile to be of great value. Being the hub of prosperous development, it registers huge movement of daily commuters for diverse purposes which are carried out by vehicles. It leads to vehicular emission of harmful gases in the city. But emissions of harmful gases are from vehicles owned by the residents and from vehicles plying throughout the city continuously for delivering goods and passengers from one point to another.

Results and Discussion

Vehicular traffic in the city: In recent years, traffic congestion has become especially acute in cities worldwide: too many vehicles on narrow roads. Traffic jams and congested roads are a daily problem. The increasing demand for mobility is also a major challenge. Rising levels of traffic bring increased safety, health, environmental and economic concerns. The resulting costs can be measured as incremental delay, vehicle operating costs (fuel and wear), accidents, pollution emissions and stress of the drivers.

Shillong witness the largest number of cars plying on its road to and fro the area daily. The number of vehicles recorded at traffic junctions. Sardar traffic branch records the highest number of vehicles plying in its area which include seven main junctions. One of the main factors that explain huge volume of traffic in this area is the highest density of population as the area falls within the Municipal area of Shillong. Various other factors also come into picture to describe the maximum number of vehicles seen moving in this area. Firstly, the location of two main commercial centres - The Iewduh and Police Bazaar- in this site acts as a strong magnet for promoting heavy traffic flow towards the city. Secondly, it hosts numerous reputed schools, colleges and vocational training institutions .Thirdly, almost all Government departments and corporation are also located within this jurisdiction. Fourthly, hospitals and medical centres and facilities are found in the city. These services compel vehicles to transport goods and people from different parts of the state to the city. Hence, creates a condition of traffic congestion where the stop and go and slow pace of driving cause lots of energy resulting in air pollution. This condition validates the fact that transport is the mechanism that moves pollution from source to receptor. One notable point associated with the Mawlai Traffic branch is that it welcomes huge volume of traffic from outside the states via Guwahati-Shillong Road. This creates a busy atmosphere along this roads which contributes more to vehicle exhaustion in the city. Rich variety of commercial, administrative, educational and health services attracts huge volume of vehicular traffic which will highly aggravates the concern of air quality in the region.

The city of Shillong is a collection of many localities which are all interconnected by roads. The slope of the city limits the construction of roads to narrow and winding ones. Practically, only small size vehicles can be driven through the different parts of the city. Cars and two wheelers are the appreciable size to drive through the city comfortably. Hence, it can be affiliated that cars are one of the leading causes of deteriorating the air quality as they have the maximum share in the world of traffic in the city .On the basis of services, passenger vehicles are a major pollution contributor, producing significant amounts of nitrogen oxides, carbon monoxide. More than one lakh vehicles are registered every year in the city (Table-1) and in addition, 34% increase is noticed in the sale of pre-owned cars which add to the already depressed traffic congestion in the city to accentuate vehicular emissions.

Assessment of vehicular pollution: As per arrangement with the Office of the Commissioner of Transport, Meghalaya, the periodical renewals of permits of taxis are subject to submission of “Green Certificates” issued from the Office of the Board. Large number of vehicles have been tested for over ten years (Table-2)

Most of the vehicles driven in vehicles comply with the emission standard set up by the Meghalaya Pollution Control Board. Yet not all vehicles have been checked and not all vehicles running on the roads in the city are subjected to this test.

Air Quality: The Meghalaya State Pollution Control Board is monitoring the Ambient Air Quality at 7 (seven) stations in the state under National Air Monitoring Programme (NAMP) sponsored by CPCB the frequency of monitoring is twice a week. Particulate Matter (PM_{10}),Sulphur Dioxide(SO_2), Oxides of Nitrogen (NO_2) and meteorological parameters viz. wind speed, wind direction,ambient air temperature, humidity, etc. were monitored at these stations and the observations are presented below:-

1. Board's Office Premises, Lumpyngngad, Shillong (Station – I):

Ambient air quality monitoring data(Table -3) during 2013 monitored at the Board's Office Premises, Lumpyngngad, Shillong, revealed that the Annual Average concentrations of Sulphur Dioxide(SO_2), Oxides of Nitrogen (NO_2) and Particulate Matter (PM_{10}) are within the prescribed standards of National Ambient Air Quality standards.

2. **MUDA Complex, Police Bazar, Shillong (Station – II):**

Ambient air quality monitoring data(Table-4)during 2013 monitored at MUDA Complex, Police Bazar, Shillong, revealed that the Annual Average concentrations of Sulphur Dioxide (SO_2), and Oxides of Nitrogen (NO_2) are within the prescribed standards of National Ambient Air Quality standards. Particulate Matter (PM_{10}) levels are above the National Ambient Air Quality standards

It can be observed that concentration of Particulate Matter recorded in both the station is higher during the winter months. The size distribution of particles is strongly affected by prevailing weather conditions. During summer season the wind speeds are relatively higher thereby increasing the re-suspension of coarse fraction of particles. Winter concentrations of ambient PM10 were observed to be higher irrespective of the monitoring sites and duration of sampling, suggesting longer residence times of these pollutants in the atmosphere during winter due to stagnant conditions and low mixing heights.(Gupta,et.al 2008)

Concentration of SO_2, as noticed in both the station, remains within the range of permissible limits framed by Central Pollution Control Board India. Concentration of SO_2 is higher in Station-II than in station –i because of large volume of traffic coming and going through this station daily. The WBEG (World Bank Emission Guidelines) for SO2 are concentration based, whereas, Indian standards are based on the stack height. The Indian coal has low sulphur contents (0.2–0.3%) compared to imported coal, where the sulphur content is in the range of 0.6– 1.5% (NTPC, 1995).

NO_2 is witnessed to be having a high level of concentration in Station –II in the city. Heavy vehicle exhaustion due to wide number of traffic volume in this area is the main explanation for high level of NO_2 concentration .Winter dry months are suggested to be a favourable time span for higher concentration of NO_2 in station –II.

Station – II is located in the densely vehicular traffic spot of the city. This reason is sufficient to explain high concentration of all the three parameters to define ambient air quality in the city. Readings in both the station suggests a decreasing trend in the concentration of Particulate Matter in the air over the years (Table – 5).

Tables, figures and illustrations:

Table - I: Type and number of registered vehicles in Shillong

Type of vehicles	Numbers of vehicles
Trucks	11925
Buses	2696
Jeeps	13629
Cars	51344
Taxi	14116
Two wheelers	37017
Three wheelers	17 42
Others	5283
Total	86408

(source: District Level Statistics Meghalaya,2018)

Table-II: Number of vehicles tested for emission standard

Period	Type of vehicles	Total no. of vehicles tested	Percentage of vehicles complying to emission standard	Percentage of vehicles non-complying to emissions standard
2004-2005	Petrol-driven LMV	1820	76.5%	23.5%
2005-2006	Petrol-driven LMV	1681	92.9%	7%
2006-2007	Petrol-driven LMV	1460	94.2%	5.8%
2007-2008	Petrol-driven LMV	1483	95.8%	4.2%

2008-2009	Petrol-driven LMV	1378	99.3%	0.7%
2009-2010	Petrol-driven LMV	1287	95%	4.1%
2010-2011	Petrol-driven LMV	1154	99.8%	0.2%
	Diesel-Driven LMV	9	100%	0%
2011-2012	Petrol-driven LMV	2524	97.7%	2.3%
	Diesel-Driven LMV	722	96.2%	3.7%
2012-2013	Petrol-driven LMV	223	93.1%	6.9%
	Diesel-Driven LMV	1497	91.6%	8.4%
2013-2014	Petrol-driven LMV	3725	95%	5%
	Diesel-Driven LMV	1473	93%	7%

*Diesel driven LMV were tested only after 2010.

(Source: Annual Report, Meghalaya State Pollution Control Broad)

The monitoring results during the period are shown in Table –III:
Ambient Air Quality data at Board's Office Premises, Lumpyngngad, Shillong,

(Stn – I), 2013

Months → Parameters	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual average
PM10 (µg/m3)	49.1	45.9	48.9	36.8	40	39.7	37.7	37.6	36.1	32.1	39.5	39.2	40.2
SO2 (µg/m3)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
NOx (µg/m3)	4.7	4.5	4.7	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5

Permissible Limits: PM_{10}(µg/m3) – 60, SO2(µg /m3) – 50, NO_2(µg/m3) – 40

(Source: Annual Report, Meghalaya State Pollution Control Broad)

Table – IV: Ambient Air Quality data at MUDA Complex, Police Bazar, Shillong, (Stn – II),

Months → Parameters	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual average
PM10 (µg/m3)	92.3	93.2	94.7	93.2	87.5	89.2	88.6	85.3	86.7	85.3	85.8	82.9	88.7
SO2 (µg/m3)	2.1	2.7	2.3	2.4	4.9	3.8	3.7	3.2	2.8	2.3	2.2	2.5	2.9
NOx (µg/m3)	18.0	17.6	18.1	18.6	18.1	16.9	16.1	17	16.9	16.6	13.8	13.8	16.7

Permissible Limits: PM_{10}(µg/m3) – 60, SO2(µg /m3) – 50, NO_2(µg/m3) – 40

(Source: Annual Report, Meghalaya State Pollution Control Broad)

Table-V: Average Annual Ambient Air Quality Data, Shillong

YEAR	Board's Premises,Lumpyngngad PARAMETERS			MUDA,Police Bazar PARAMETERS		
	PM_{10}	SO_2	NO_2	PM_{10}	SO_2	NO_2
2004	47.1	0.3	0.4	90.0	0.3	0.4
2005	56.3	0.3	0.6	100.1	0.5	5.4
2006	63.9	2.0	4.5	116.5	4.2	19.3
2007	57.8	2.0	4.5	101.5	3.4	18.1
2008	63.6	2.0	4.7	122.0	2.0	16.0
2009	65.3	2.0	4.7	128.9	2.0	10.6
2010	56.7	2.0	4.7	109.7	2.5	15.6
2011	49.1	2.0	4.7	90.3	3.3	14.9
2012	40.5	2.0	4.9	87.4	2.5	15.3
2013	40.2	2.0	4.5	88.7	2.9	16.7

Permissible Limits: PM $_{10}$(µg/m3) – 60, SO_2 (µg /m3) – 50, NO $_2$(µg/m3) – 40

(Source: Annual Report, Meghalaya State Pollution Control Broad)

Conclusion

The roads in the city of Shillong are heavily crowded by heavy number of (a) vehicles which are owned by the residents (b) vehicles driving from the fringe of the city (c) vehicles from the other districts in the state (d) vehicles from the other states of India(private and passengers). These are the sources of vehicular emissions with cars contributing the largest contributor of vehicle exhaustion in the city. Harmful gases exhausted from all these sources are recorded at two stations in the city. Recordings from the two stations, expresses a visible level of air pollutants for PM_{10}, SO_2 and NO_2. The Annual Average concentrations of Sulphur Dioxide (SO_2), and Oxides of Nitrogen (NO_2) are within the prescribed standards of National Ambient Air Quality standards. Particulate Matter (PM_{10}) levels are above the National Ambient Air Quality standards. Air Quality Index calculated for these sites in the city shows a pleasant response with air quality marked to be 'Good to satisfactory'. During this time duration, it can be stated that the air quality in the city is favourable and is not an issue of concern. Preserving and retaining the air quality is utmost important as urbanization and development is rapidly approaching which can hamper the pleasant atmospheric layer in the city.

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