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Air Quality Monitoring in Bangalore – A Case Study

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KEYWORDS

Air quality, Particulate Matter, Bangalore and Environmental problems.

ABSTRACT

Particulate matter which includes PM_{10} (Particulate Matter) and TSPM (Total Suspended Matter) serves as an important tool to determine the ambient air quality. Bangalore is a capital of the state of Karnataka is the original "Silicon Valley" of India. The present day environment crisis demands a change in attitude, which initiatives may be taken to rescue environment from destruction in the metropolis of Bangalore. But the urban areas have a big proportion in the present day environmental troubles from the automobiles (air pollutants) throughout the world. Most of the metropolitan cities are dealing with serious air pollution problems due to concentration of motor cars and human populace within the confined urban regions. Particulate matter were analyzed the year of January (2019) to December (2019) at five different locations in Bangalore city were selected. So to improve the quality of air and water there is a need of strict enforcement and monitoring program by the Karnataka Pollution Control Board.

INTRODUCTION

Clean air is the foremost requirement to sustain healthy lives of humankind and people of the assisting ecosystems which in return affect the human health. Release of numerous gaseous emissions and particulate matter has been on the rise due to extensive industrialized increase anthropogenic emissions of various types are being pumped into the environment and lead to the formation of new pollution due to chemical reactions in the environment. These are building up the concern of ambient air pollution as a distinguished worldwide risk to human health in lots of ways.

Air pollution may be described as any atmospheric condition wherein certain substances are found in such concentrations that they able to produce unwanted effects on man and his surroundings. These substances consist of gases (SO_2, NO_2, CO, hydrocarbons), particulate matter (smoke, dust, fumes, and aerosols), radioactive materials and many others. Most of these substances are naturally present in the atmosphere in low concentrations and are commonly considered to be harmless (Rao, 1996).

Bangalore is located in the south Eastern quadrant of the state of Karnataka at 12^0 58' North latitude and 77^0 35' East longitudes at an altitude of 921m above (MSL) Mean Sea Level. The Bangalore city is to be found about 450km from the Bay of Bengal and the Arabian Sea and about 700km from the Indian Ocean. It is noticeable that different physical features such as its elevation, climate, beauty of its rolling countryside, its red earth and its granite hillocks and rock outcrops which contrast with the greenery of cultivated fields have all contributed to Bangalore city becoming a major city of modern India.

At the global level, rapid development in motor vehicle activity has severe energy security and climate change implications. The transport sector already consumes nearly half of the world's oil. But in urban areas both developing and developed countries, it is predominately mobile and vehicular pollution that contributes to air quality troubles. The sources of pollutants consist of emissions from the combustion of fossil fuels in motor vehicles and for industrial processes, domestic cooking and heating, energy production and high dust levels due

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to local construction, smoking, unpaved roads, sweeping, hotels long-range transport.

Table 1: Indian national ambient air quality standards. (All units are in µg/m³)

Pollutant	SO_2	NO_2	PM 10	PM 2.5	O_3		CO		Pb	NH_3
Averaging time (hr)	24	24	24	24	1	8	1	8	24	24
Indian Standard ($\mu g/m^3$)	80	80	100	60	180	100	4	2	1	400

MATERIALS AND METHODS

The present study is carried in Sanequrava halli (Sample 1), Peenya (Sample 2), Jayanagar (Sample 3), Hebbal (Sample 4) and Bapuji nagar (Sample 5) in Bangalore city region. The method of random sampling was adapted to collected air pollution samples at five stations in and around Bangalore city region. The high volume air sampler is used to collect the air samples at each sampling stations as standards, for each different parameters and chosen samples were analysed in the laboratory by following standard methods during the period of January 2019 to December 2019.

SUSPENDED PARTICULATE MATTER COLLECTION AND DETERMINATION

The gravimetric method (High volume air sampler APM 460 model, $PM_{2.5}$ Envirotech APM 550 model) employed for the quantification of dust fall that is a suitable method for the particles of one micron or larger size. Dust fall samples were collected at five polluted sites and control site from the emission sources during 3 times a day for every month during January 2019-December 2019.

DETERMINATION OF RESPIRABLE PARTICULATE MATTER (PM_{10})

$$\text{Concentration of } PM_{10} = \frac{W \times 106}{V \times T} \ \mu g/m^3$$

Where

V = Flow rate in cubic meter per minutes

T = Total period of sampling in minutes

W = Difference in final and initial weight of filter paper in grams.

DETERMINATION OF PARTICULATE MATTER PM 2.5

$$\text{Concentration of } PM_{2.5} = \frac{W \times 106}{V \times T} \ \mu g/m^3$$

Where

V = Flow rate in cubic meter per minutes

T = Total period of sampling in minutes

W = Difference in final and initial weight of filter paper in grams

RESULTS AND DISCUSSION

With the overall observation, it is clear that a different place of Bangalore city region describes the probability of increase of the particulate matter concentration.

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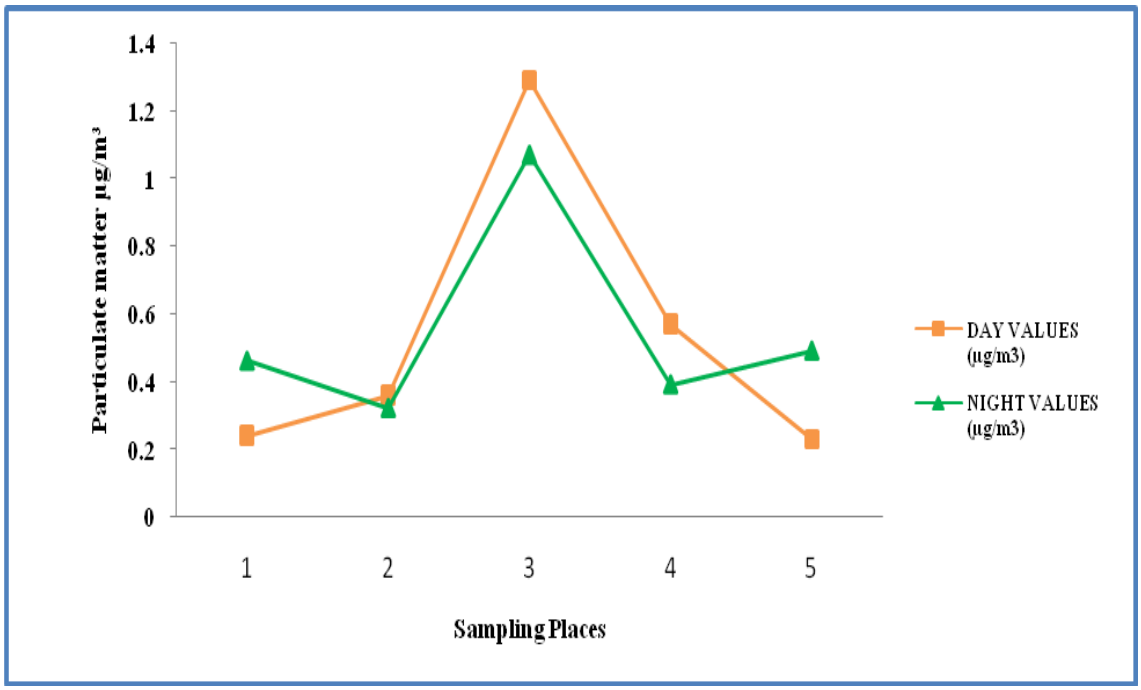

Fig 1: Particulate matter levels of different sampling stations during January 2019

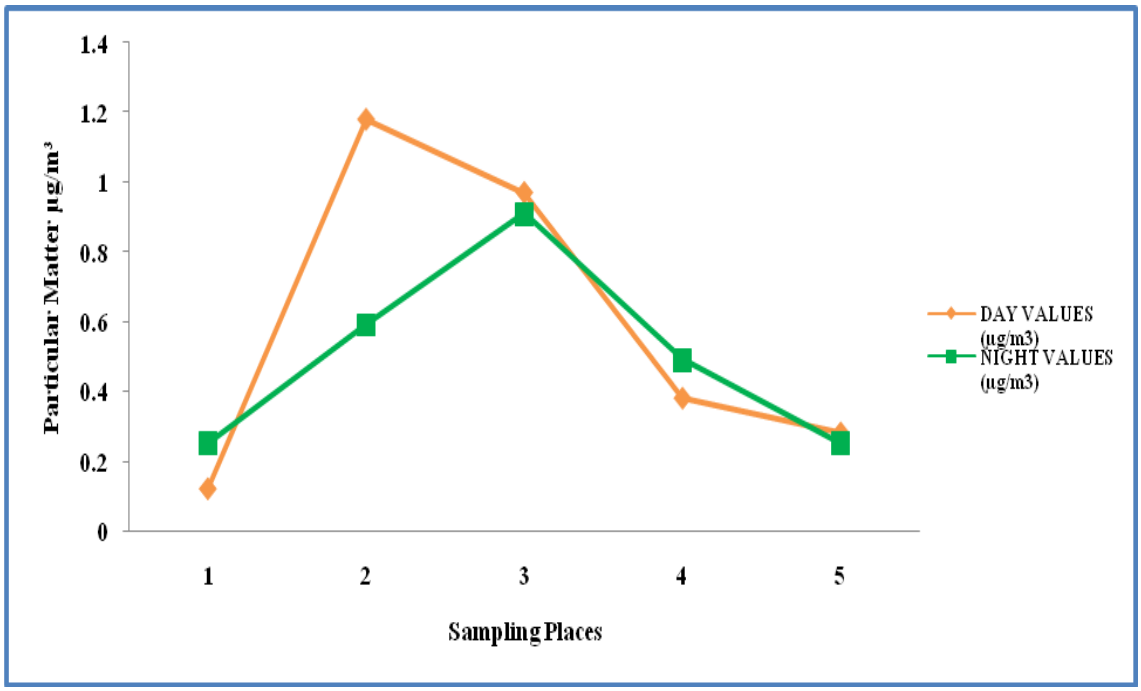

Fig 2: Particulate matter levels of different sampling stations during February 2019

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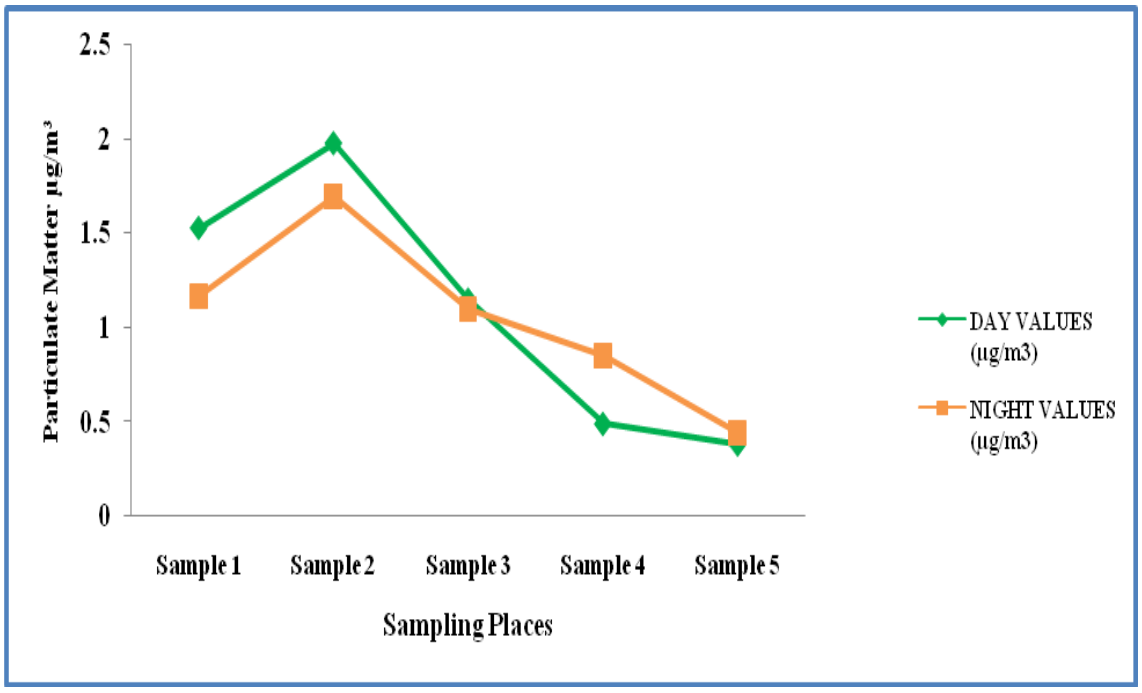

Fig 3: Particulate matter levels of different sampling stations during March 2019

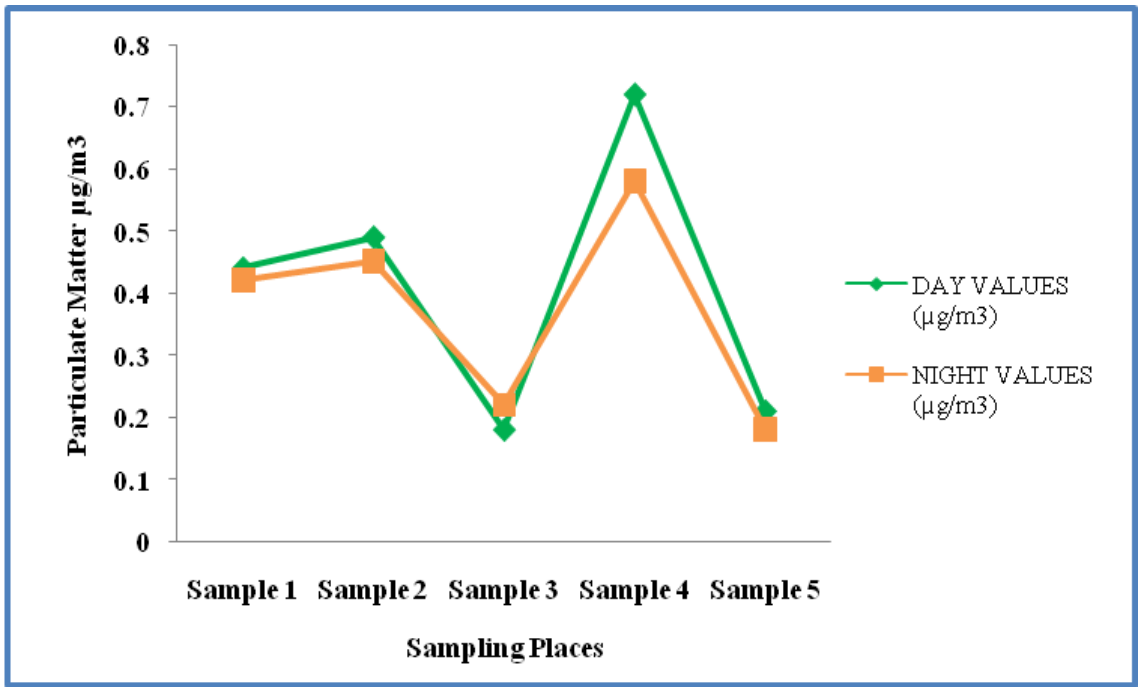

Fig 4: Particulate matter levels of different sampling stations during April 2019

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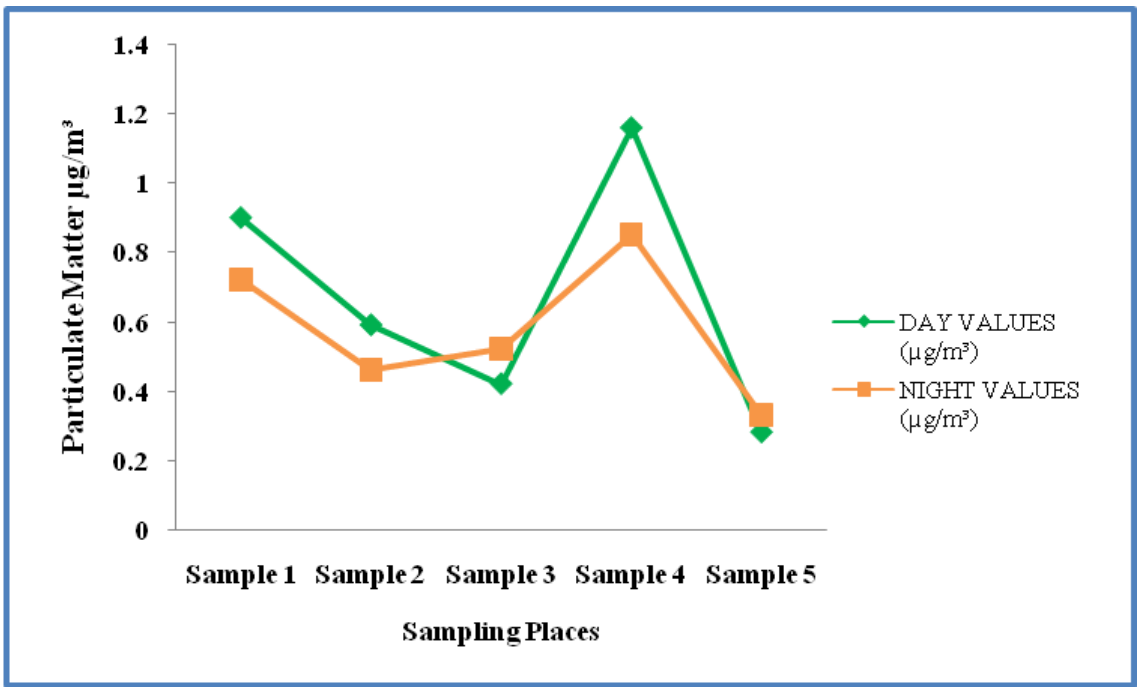

Fig5: Particulate matter levels of different sampling stations during May 2019

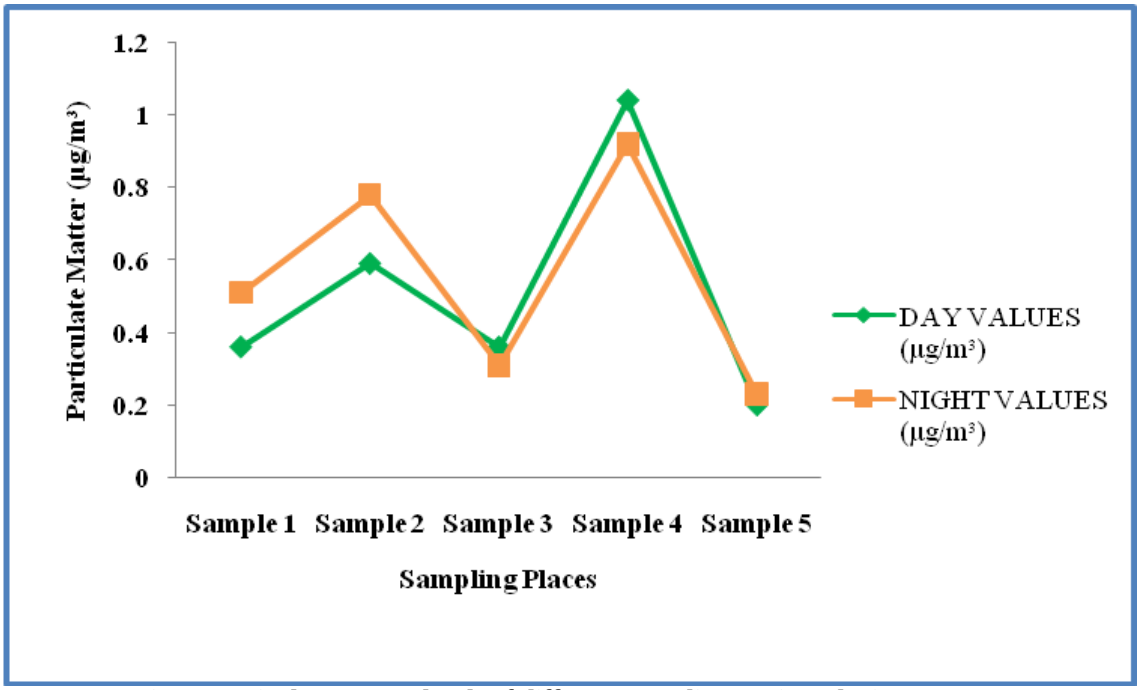

Fig 6: Particulate matter levels of different sampling stations during June 2019

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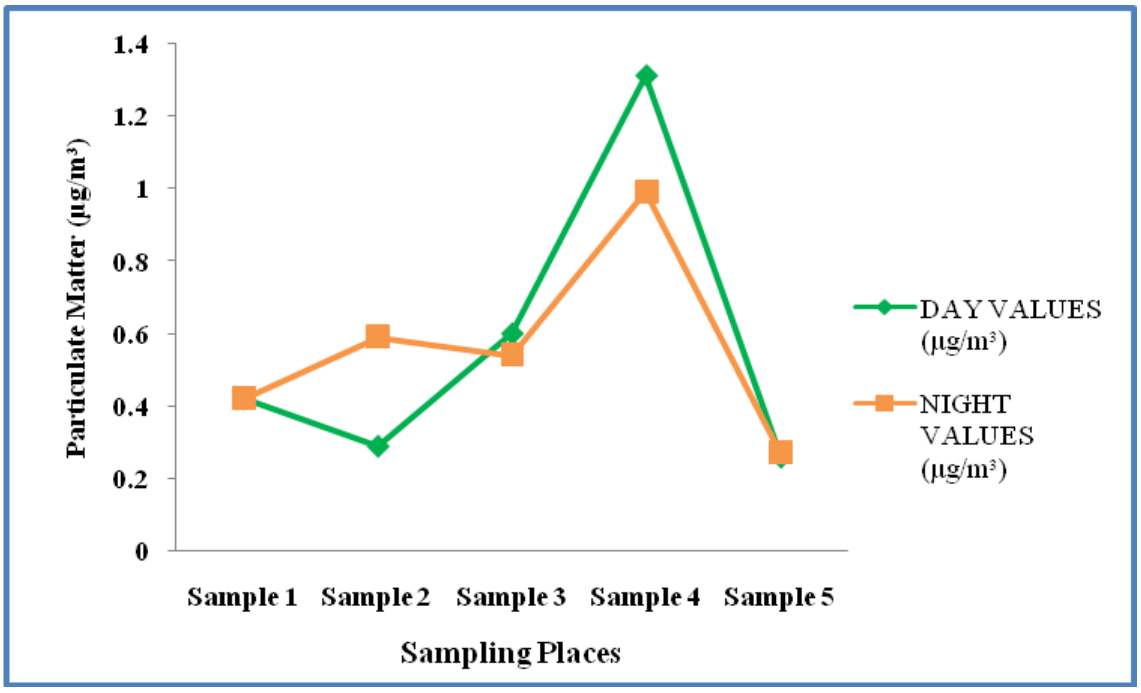

Fig 7 : Particulate matter levels of different sampling stations during July 2019

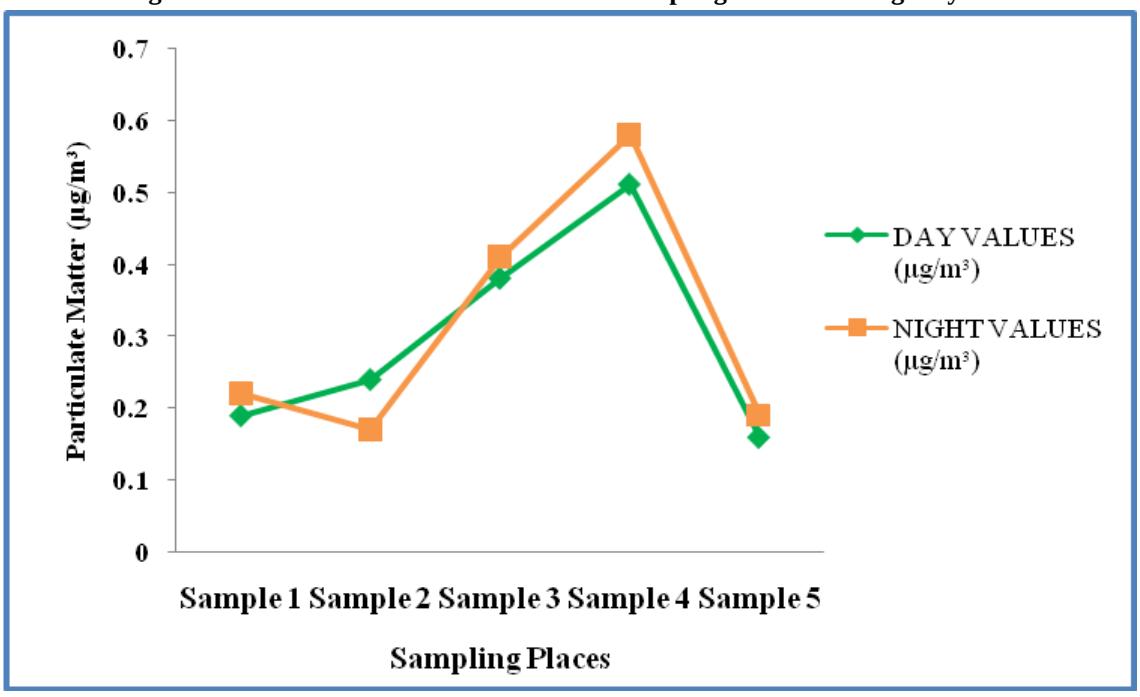

Fig 8 : Particulate matter levels of different sampling stations during August 2019

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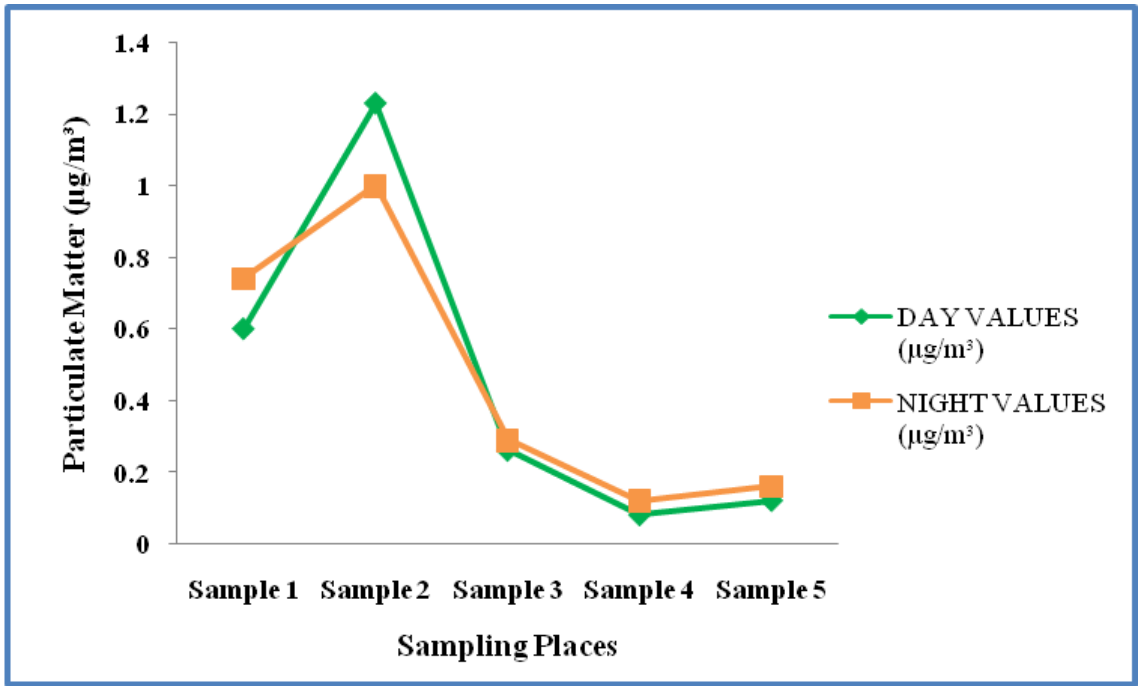

Fig 9 : Particulate matter levels of different sampling stations during September 2019

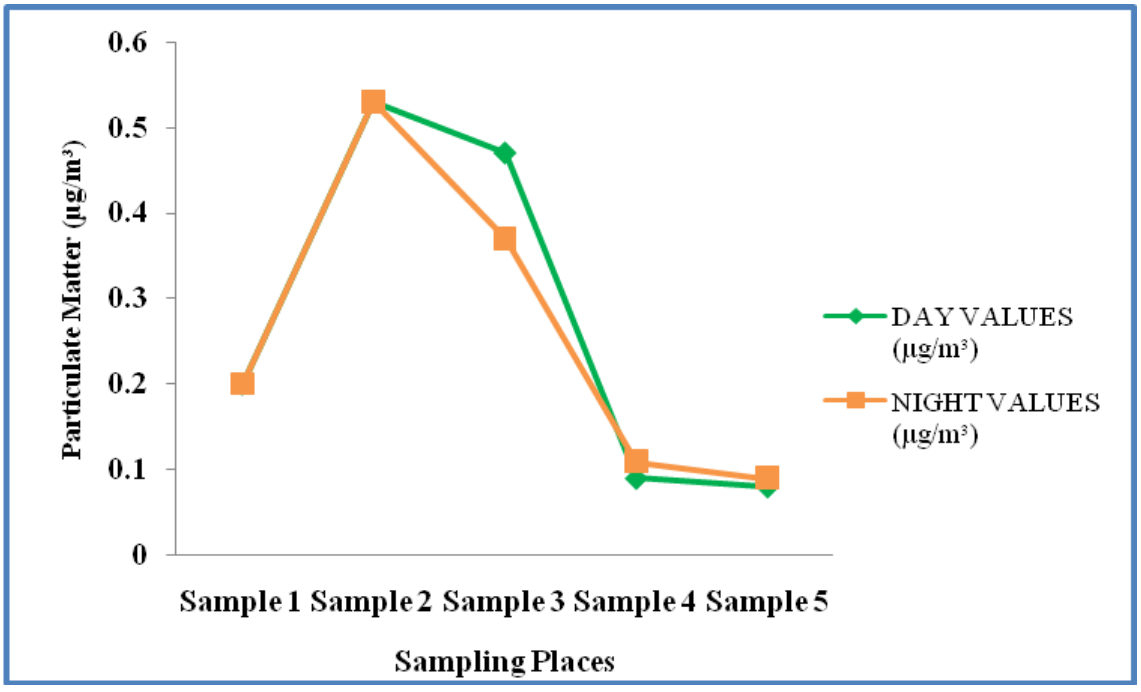

Fig 10 : Particulate matter levels of different sampling stations during October 2019

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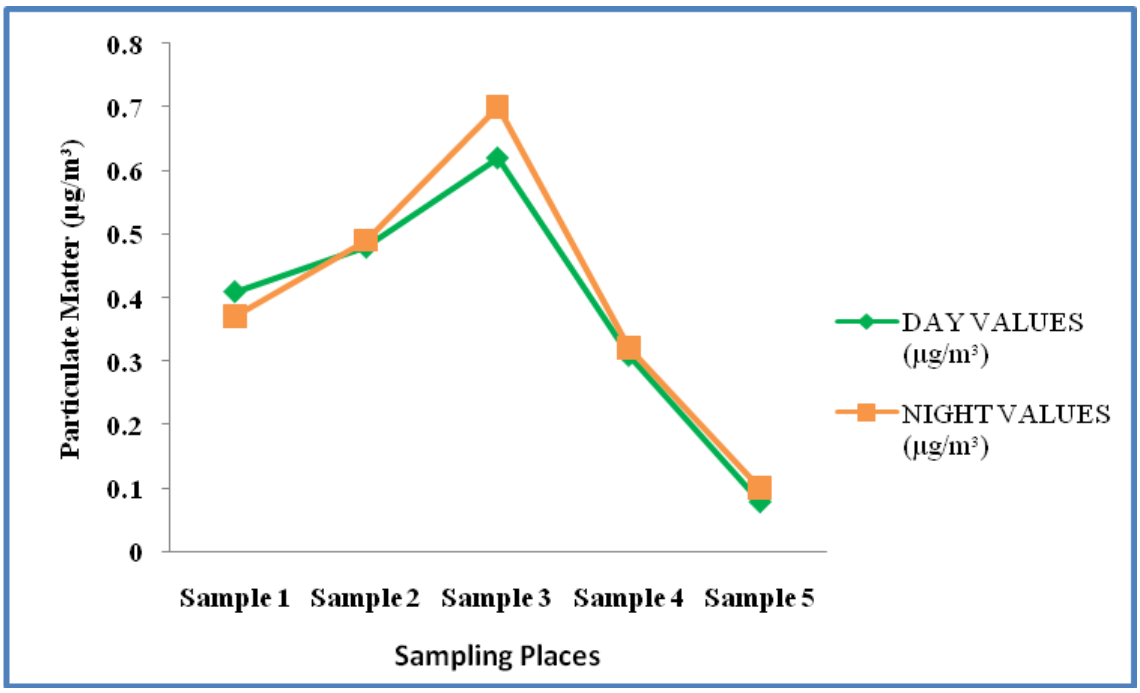

Fig 11 : Particulate matter levels of different sampling stations during November 2019

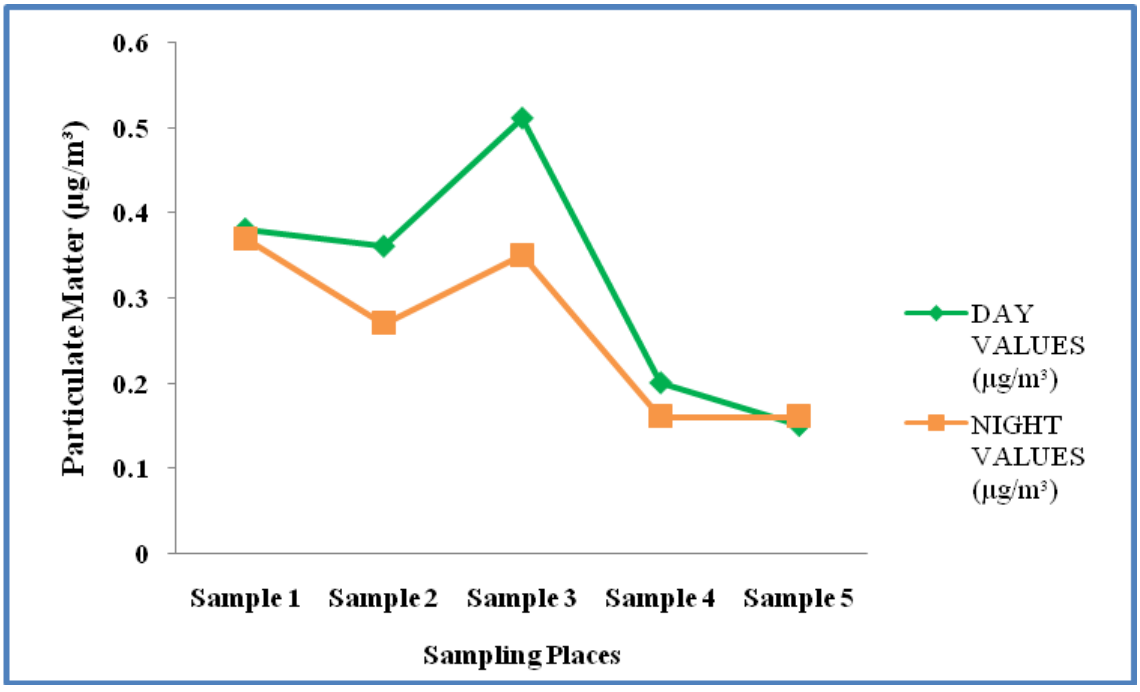

Fig 12 : Particulate matter levels of different sampling stations during December 2019

Air pollution caused by automobiles has been described as the 'disease of wealth'. Sulphur dioxide, nitrogen dioxide and particulate matter (PM) are regarded as major air pollutants in India (Agarwal and Bhatnagar, 1991). In the developing countries, air quality crisis in cities is attributed to vehicular emission which contributes to 40-80% of total air pollution (Ghose *et al.*, 2005). A major part of Particulate matter existing in

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the air also comes from natural sources, including ground, oceans and volcanoes (Limaye and Salvi, 2010). Furthermore, Particulate matter can travel over long distances and even remain suspended in the atmosphere over time (Londahl *et al.*, 2007).

Pandey *et al.* (1999) has studied the ambient air quality of Lucknow city in India, in terms of SPM which ranges from 583 μg/m^3 to 3450μg/m^3, the authors have mentioned the vehicular pollution also acts as a source of pollution.

Agarwal and khanam (1997) have monitored the air quality near by Dala cement factory in Uttarpradesh in India. They have reported that the SPM concentration has exceeded within 2km from the source, and also higher values have been recorded during summer periods that is about 752μg/m^3, where the sampling site is 0.5km from the source.

Similar results have been cited by Mohanty, (1999), Joshi and Jain (2000), Jayanthi and Krishnamoorthy (2006), Gupta and Sunita (1997), Agarwal and Khanam (1997) further discuss the effect of transportation of cement bags and raw materials as source for SPM. So we can justify the mere pollution of this region may be influenced by not only from the source but also the meteorological condition along with the stack height, plume behavior could contribute to the severity of pollution. (Rao and Rao, 1989).

This study reveals the concentration of PM_{10} and $PM_{2.5}$ at all the sampling stations to be dangerous to plants, animals and human beings. The sampling stations fall under the category of industrial, residential and sensitive zones. As the industries happen to be the main establishment of this area it is highly important to understand about the ambient air quality. In the residential zones such as Sample 2, Sample 5 PM noticed was 210 μg/m^3 for the period of January 2018. This value slightly exceeds the standards and the air quality index is calculated to be heavily polluted during day and night. That may be a reason for the severe pollution of this region where as the monsoon brings rain to the region during June to July. But these months have not recorded higher number of rainy days, where as the wind speed is higher during these days. Not only these factors are associated with pollution, the other factors such as the plume behavior must also be considered. Pandey *et al.* (1999) has studied the ambient air quality of Lucknow city in India, in terms of SPM which ranges from 583 μg/m^3 to 3450μg/m^3, the authors have mentioned the vehicular pollution also acts as a source of pollution. The sampling station namely Sample 3 is severely polluted during January, February, and November and the area seems to be fairly clean during, April and during most of the months namely June, August, September, October and December it is moderately polluted. And in this area not much variation is seen during the day and night values.

CONCLUSION

Air pollution is a global issue, therefore, can't be addressed only locally, moreover local actions are irreplaceable and crucially necessary. The main cause of air pollution is mainly due to fast growing population of automobiles and poor traffic control, congested roads. To overcome this development and planning of city and public awareness play very important role to reduce the ambient air pollution. From the study, it is clear that the anthropogenic activities especially industrial, mining activities and vehicular pollution are responsible for the higher concentration of particulate matter in Bangalore region. Increased monitoring can play an important role as a health advisory system and as a means of increasing pressure on polluters to comply with existing regulations. There is an urgent need of development of a sustainability index to bench mark using these components strong environmental governance guidelines/ violators.

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