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Assessment of particulate pollution in Kalaburagi city

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Abstract
The main goal of PM monitoring is to provide air quality data to local, state, and national regulatory programs for determining whether an area has attained the National Ambient Air Quality Standards (standards), as many pollutants travel long distances into areas far from the emission sources and also affect human health and damage ecosystems. The goal of the current study is to quantify the concentration of air pollutants such Particulate Matter 10 (PM10) in Kalaburagi. Ten sampling sites in total were chosen, and monitoring was carried out for eight hours. According to the findings of the air quality monitoring, the quantities of pollutants varied depending on the density of mobile and stationary air pollution sources and by meteorological factors. Particulate pollutants concentrations exceeded the permissible standards of New Ambient Air Quality Standards (NAAQS) in some locations.

Keywords: Air pollution, particulate matter, PM10, public health

1. Introduction
Across the globe, air pollution poses a severe threat to public health. Since the mid-20th century London fog and the ensuing string of dramatic events in developed nations, the short-term health effects of air pollution have been intensively investigated [Bhuyan *et al*., 2010] [1]. Researchers have made an effort to explain the variation in air pollution levels, pollutants' characteristics, and potential confounders like temperature and humidity [Mamta P, at al., (2010); Balashanmugam *et al*., (2012)] [3, 5] in terms of the differences in effect estimates between regions. Air pollution has grown to be a significant environmental problem for both industrialized and developing nations after decades of development. Human health is negatively impacted by poor air quality both immediately and over time [Afroz *et al*., 2003] [6]. The cause of almost 60% of the air pollution in Indian cities is from vehicle exhaust emissions. The World Health Organization (WHO) claims that the urban air pollution brought on by the burning of solid fuels is to blame for millions of premature deaths. The WHO said in 2014 that seven million people died in 2012. One in eight of these were brought on by air pollution. To monitor and manage air quality and lessen health issues caused by air pollution, certain recommendations have been developed. According to estimates made by the Central Pollution Control Board of India in (2010) [11], particle matter (PM) levels in the air around numerous Indian cities are far higher than the safe limit established by World Health Organization standards. It is known that indoor air pollution from cooking fires and outdoor air pollution from vehicle exhaust and industrial smoke cause more fatalities in India.

2. Materials and Methods
2.1 Selection of sites for the study
The increase in air pollution, due to automobile emission in Kalaburagi city was assessed by selecting 10 fixed locations where the different environmental factors responsible for the ambient air quality. Traffic intensity is more.
Gulbarga is a historic city located in north east of Karnataka, and the city is also known as Kalaburagi which means stony land in Kannada. The city is fast growing with significant activity ongoing on the infrastructure development. Gulbarga is primarily a regional market service centre for the district and also education center and has the central university for the district and also education centre and is home town to the Jnana Ganga University and other well known educational institutions including medical engineering, Pharmacy, Dental, law, nursing and other colleges. The region is largely covered with rich black cotton soil. The climate of Gulbarga is generally dry. It covers an area of about 64 sq. Kms, surrounding the Ring road and has a population of 5, 43,147 as per the 2011 census and now it is more than 7 lakhs. The population of the city in 2001 was 430,108.

The average population growth rate over the last 3 decades 1981-11was 35.6% increase per decade. The annual average growth of population over the period 1981-2011 is 3.56% per annum. Gulbarga city is the commercial hub to neighbouring districts, it has few tourist attractions they are Sharana Basaveshwar Temple, Hazrat Khwaja Bande Nawaz Musoleum, Old Moated Fort and Buddha Vihar. Ten stations were chosen form Kalaburagi district for air sampling.

2.2 Selected ambient air quality assessment sites

The ambient air quality assessment sites were chosen on the basis of maximum vehicular usage. In order to assess the impact of automobile emissions on the ambient air quality of Kalaburagi City, the following ambient air quality assessment sites were selected:

A1: Zoology Dept, GUK
A2: Gulbarga University main Gate
A3: Sedum ring road (Khrge) Circle
A4: Jagat Circle
A5: Sardhar Patel (Timmapuri) Circle
A6: Ram Mandir circle
A7: Godutai Nagar
A8: Chowk Police Station
A9: Shanti Nagar
A10: Central Bus stand

2.3 Ambient air quality samplers

Respirable Dust Sampler

The APM 460 sampler uses an improved cyclone with sharper cutoff (D50 at 10 microns) to separate the coarser particulates from the air stream before filtering it on the glass microfibre filter. By using the APM 460, measurement of Respirable Particulate Matter can be done accurately and TSPM can also be assessed by collection of dust retained in the cyclone cup.

Special features

- Brushless blower reduces equipment downtime and maintenance effort.
- Provision of light for flow and time reading during night.
- Toolbox within the instrument.
- Lockable casters, top cover and gaseous attachment.
- Improved cabinet design which is more sturdy and durable with SS hardware.
- Electromagnetic Interference (EMI) to TVs totally eliminated.

APM 460 BL comes with an in-built voltage stabilizer to compensate for voltage fluctuations. This model has been made more userfriendly by providing a lighting arrangement for night operation, tool box within the instrument, softer handles, lockable top-cover and wheels for easy transportation. The cabinet design has also been improved to prevent entry of rain water and dust into the machine. Owing to its modular design, APM 460 BL can be easily paired with a gaseous sampling attachment (for monitoring SO_2, NO_X, NH_3, Ozone etc) as gaseous sampling requires only a few LPM of air flow.

Blower

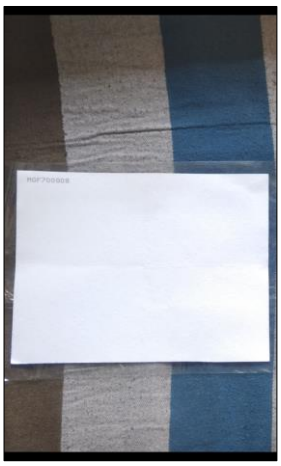
The blower provides a monitoring flow rate in the range of 0.9 to 1.4 m^3/min. The monitoring flow rate can be quantified using the manometer.

Cyclone Separator

The cyclone separator collects the coarser particles by settling. The settled particles are collected by placing a pre-weighed cup at the bottom of the cyclone separator.

Table 1: Filter Specification – PM_{10}

Property	Unit	Value
Filter media	n/a	Glass Micro F F(GF/ A)
Filter thickness	Cm	0.45
Filter dimension	Inches	8 x 10
Particle retention	%	99.95



Normal Filter Paper Before Sampling

Filter paper After Sampling

Table 2: Technical Specification of RDS APM - 460 BL

Flow Rate	**11.505 m^3/min**
Particulate Size	10 microns to 0.5 micron collected on Filter paper. Filter holder designed to accept any standard filter sheet of 20.3 cm × 25.4 cm size. SPM bigger than 10 microns collected in a separate sampling cone
Recommended Filter	Whatman GF/ A
Sampling Time	8 hours (maximum)
Sampling Time Record	21 to 99.96 hours
Automatic Sampling Control	A Programmable digital timer is used to shut off the sampler after a present sampling interval
Power Requirement	Nominal 220 V, Single Phase, 50 Hz AC mains supply
Overall Size	Approximately 400 × 300 × 650 mm

3. Results and Discussions

The present study is aimed at measuring air pollution in Kalaburagi and estimates the concentration of air pollutants such as Particulate Matter 10 (PM10). Total of Ten sampling locations were selected and monitoring was done for 8 hours duration. The samples are collected; monitoring was carried on as per Central Pollution Control Board guidelines [Bhuyan PK *et al*., (2010)] [1].

The results of air quality monitoring showed that the pollution concentrations were variable at different sampling locations depending on the density of mobile and stationary air pollution sources and by meteorological factors. Particulate pollutants concentrations exceeded the permissible standards of New Ambient Air Quality Standards (NAAQS) in locations A1 A3 A4 A5 A6 A8 and A10 periphery our observation and survey find heavy pollution in Gulbarga city, it needs continuous research.

In order to assess the impact of automobile emissions on the ambient air quality of Kalaburagi City, the following Ambient Air Quality Monitoring Stations (AAQMS) were selected:

A1: Zoology Dept, GUK
A2: Gulbarga University main Gate
A3: Sedum ring road (Khrge) Circle
A4: Jagat Circle
A5: Sardhar Patel (Timmapuri) Circle
A6: Ram Mandir circle
A7: Godutai Nagar
A8: Chowk Police Station
A9: Shanti Nagar
A10: Central Bus stand

Particulate Matter (PM10): The ambient air quality data with respect to PM_{10} obtained from different monitoring locations in Kalaburagi are discussed below for each station separately. The concentration distribution of PM10 shown in Table 5 indicates the measured data in the range of 63.7(µg/m^3) to 307.20(µg/m^3) NAAQS permissible limit of PM10 is 100 µg/m^3

3.1 Formula and Calculation

$$RSPM = \frac{(W2-W1)x\,(1000x1000)}{v}$$

W1=Initial weight of filter before sampling.
W2= Final weight of filter after sampling.
V = Volume of air sampled.

$$V = \frac{(Q1+Q2)}{2} x\ Time$$

Q1= Initial air flow rate m^3/min.
Q2=final air flow rate m^3/min.
Time=Total time in hr.

$$NRSPM = \frac{(W2-W1)x\,(1000x1000)}{v}$$

W1=Initial weight of conical hopper
W2=Final weight of conical hopper

TSPM=RSPM+NRSPM = ---------- µg/m^3

Table 3: Concentration of Respirable Suspended Particulate matter (RSPM)

SI No	**Sampling Locations**	**DATE**	**RSPM(PM_{10} in µg/m^3)**
1	A1	5/24/2018	93.0558
2	A2	5/28/2018	162.6369
3	A3	5/30/2018	227.2443
4	A4	5/31/2018	230.8796
5	A5	6/01/2018	202.1764
6	A6	6/03/2018	236.536
7	A7	6/04/2018	63.7836
8	A8	6/05/2018	219.9148
9	A9	6/08/2018	96.9292
10	A10	6/09/2018	193.5846

The lowest value of 63.78µg/m^3 was observed at godutai nagar an extension area however at our University campus it was 93.05 µg/m^3 and in another extension area it was 96.92 µg/m^3 at shanti nagar

At the tropic places and circles it was more than 200 µg/m^3 the highest was observed at Ram mandir circle (236.53 µg/m^3) followed by jagat circle (230.87 µg/m^3) kharge circle (227.24 µg/m^3) chowk police station super market (219.91 µg/m^3)

Extension area: A7, A9 less than 100 µg/m^3
Tropic area: A3, A4, A5, A6, A8, A10 more than 200 µg/m^3
University area: A1, A2 less than 200 µg/m^3

Table 4: Non-Respirable Suspended Particulate matter (NRSPM)

SI No	**Sampling Locations**	**DATE**	**NRSPM**
1	A1	5/24/2018	74.4446
2	A2	5/28/2018	126.4954
3	A3	5/30/2018	511.2997
4	A4	5/31/2018	408.4793
5	A5	6/01/2018	640.2254
6	A6	6/03/2018	1030.621
7	A7	6/04/2018	95.6754
8	A8	6/05/2018	592.0783
9	A9	6/08/2018	193.8586
10	A10	6/09/2018	1129.244

The lowest value of 74.44 µg/m^3 was observed at our University campus godutai nagar an extension area it was 95.67 µg/m^3 and in another extension area it was 193.85 µg/m^{3}at shanti nagar
At the tropic places and circles it was more than 400 µg/m^3 the highest was observed at central bus stand (1129.24 µg/m^3) followed by Ram mandir circle (1030.62 µg/m^3) Timmapuri Circle (640.22 µg/m^3) chowk police station super market (592.07 µg/m^3) Kharge Circle(511.22 µg/m^3)

Extension area: A7, A9 less than 200 µg/m^3

Tropic area: A3, A4, A5, A6, A8, A10 more than 400 µg/m^3

University area: A1, A2 less than 150 µg/m^3

Table 5: Total Suspended Particulate Matter (TSPM)

SI No	Sampling Locations	DATE	TSPM
1	A1	5/24/2018	167.5004
2	A2	5/28/2018	289.1322
3	A3	5/30/2018	738.5441
4	A4	5/31/2018	639.3589
5	A5	6/01/2018	832.4017
6	A6	6/03/2018	1267.1573
7	A7	6/04/2018	159.4591
8	A8	6/05/2018	811.9931
9	A9	6/08/2018	290.7878
10	A1O	6/09/2018	1322.8281

The lowest value of 159.45 µg/m^3 was observed at godutai nagar an extension area however at our university campus it was (167.50 µg/m^3) and in another extension area it was 290.78µg/m^{3}at shanti nagar.
At the tropic places and circles it was more than 600 µg/m^3 the highest was observed at central bus stand (1322.82 µg/m^3) followed by Ram mandir circle (1267.15 µg/m^3) Timmapuri Circle (842.40 µg/m^3) chowk police station super market (811.99 µg/m^3) Kharge Circle (738.54 µg/m^3)
Extension area: A7, A9 less than 300 µg/m^3
Tropic area: A3, A4, A5, A6, A8, A10 more than 600 µg/m^3
University area: A1, A2 less than 300 µg/m^3

Table 6: Particulate matter at University Area of Kalaburagi city

Sampling locations	place	TSPM (µg/m^3)	NRSPM >PM$_{10}$ (µg/m^3)	RSPM <PM$_{10}$ (µg/m^3)
A1	Zoology Dept, GUK	167.5004	74.4446	93.0558
A2	GUK Gate	280.1322	126.4954	162.6369

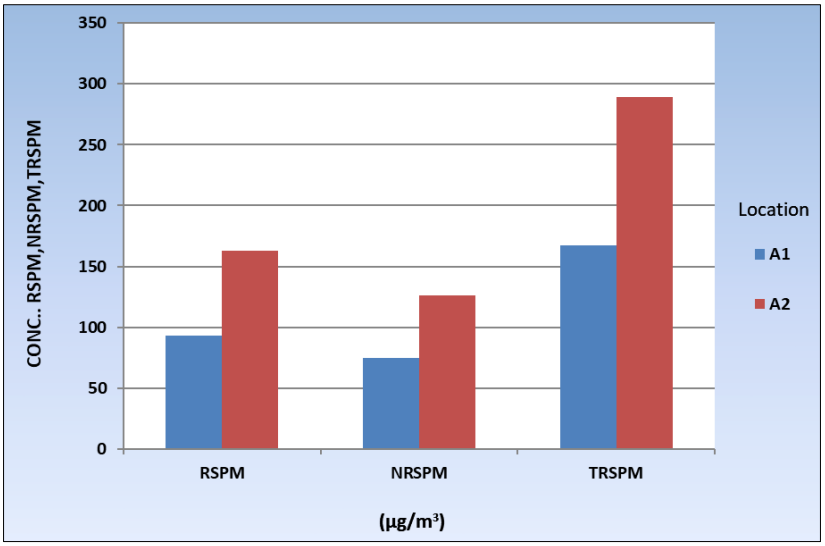


Fig 1: Particulate matter at University Area of Kalaburagi city

Table 7: Particulate matter at Tropic area of kalaburagi city

Sampling Locations	place	TSPM (µg/m^3)	NRSPM >PM$_{10}$ (µg/m^3)	RSPM <PM$_{10}$ (µg/m^3)
A3	Kharge Circle	738.5440	511.2997	227.2443
A4	Jagat Circle	639.3589	408.4793	230.8796
A5	Timmapuri Circle	842.4017	640.2254	202.1764
A6	Ram Mandir	1267.1573	1030.621	236.5360
A8	Chowk Police Station	811.9931	592.0783	219.9148
A10	Central Bustand	1322.8281	1129.244	193.5846

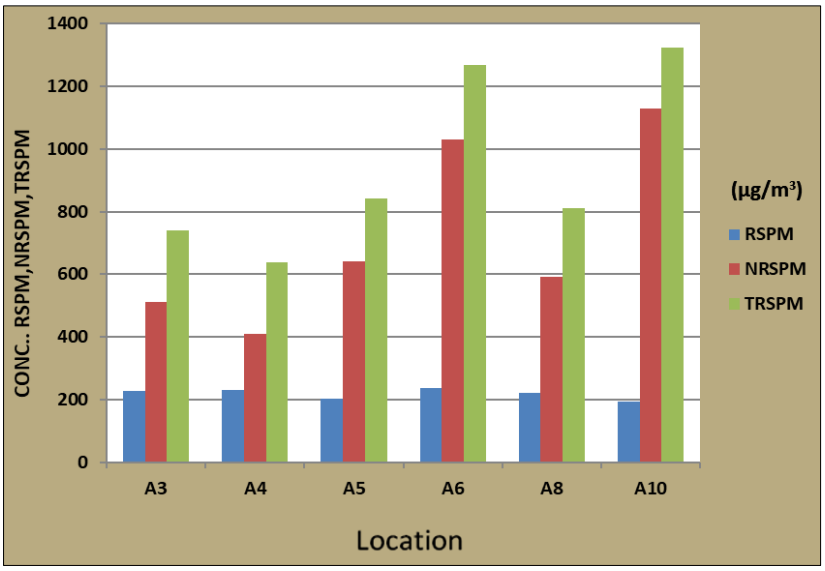


Fig 2: Particulate matter at Tropic area of Kalaburagi city

Table 8: Particulate matter at residential area of Kalaburagi city

Sampling locations	place	TSPM (µg/m^3)	NRSPM >PM$_{10}$ (µg/m^3)	RSPM <PM$_{10}$ (µg/m^3)
A7	Godutai Nagar	159.4591	95.6754	63.7836
A9	Shanti Nagar	290.7878	193.8586	96.9292

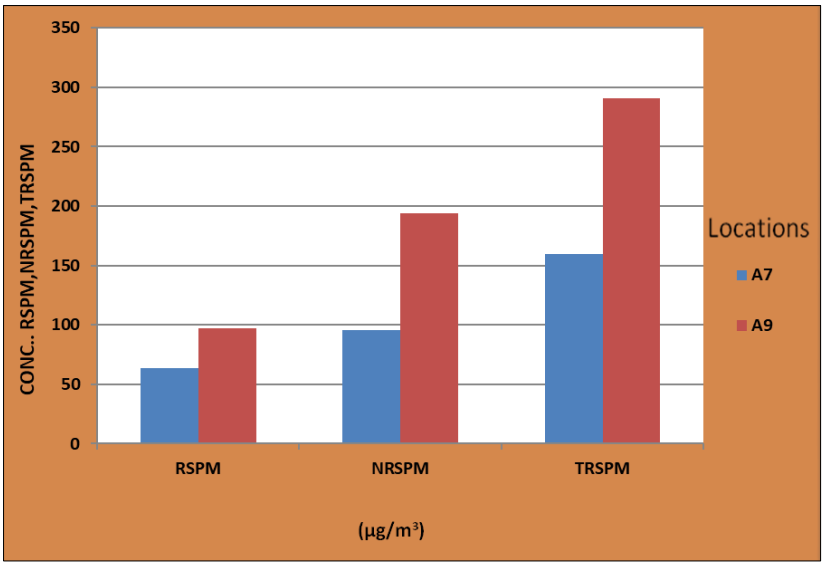


Fig 3: Particulate matter at residential area of Kalaburagi city

4. Conclusion

There is great need to control the air pollution as it is affecting the environment and human health seriously. Detailed background information on urban air quality status is very much essential for local control agencies to implement the air quality management programme. Urban air pollution is a severe environmental problem, which requires immediate attention on the part of researchers. Kalaburagi city has a high potential for air pollution due to its exponential population and traffic. The concentrations of air pollutants like have to be controlled to save the environment. To control air pollution, proper rules and regulations should be implemented by the government, awareness among the people, control the growth of population, number of vehicles, industries and energy consumption. We need to take pollution issue seriously because ignorance is certainly not the proper way to go. The stakes are really high and world needs to wake up and start acting right now because environmental issues are constantly growing in number and size. The conclusion of the study as follows:

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