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Research Paper

Estimation of Composite Air Quality Index For Katra Town (J&K)

Environment

KEYWORDS : Ambient air, Katra, SO_2, NO_2, particulate matter

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ABSTRACT

The present study aims at assessing the ambient air quality status of Katra town (one of the important town of Jammu from economic as well as religious point of view). Data collected for a period ranging from July 2010 to June 2011 has been computed to find out Air Quality Index (AQI) on a five rating scale in quantifying air pollution, based on measuring parameters such as sulphur dioxide (SO_2), nitrogen dioxide (NO_2), Respirable Suspended Particulate Matter (PM_{10}) and Total Suspended Particulate Matter TSPM, at selected locations of residential areas, commercial areas and traffic crossings. According to air quality scale, the air quality status has been measured at each site. From the study it has been found that the traffic crossings has highest air quality index followed by commercial areas whereas residential areas have the lowest air quality index values.

Introduction

With an increased pace of industrialization especially in developing countries, environmental problems have also increased. At the same time, with growing population, economic development and increased transportation sources, there has been a rapid rise in air pollution sources. Vehicular emission is responsible for higher level of air pollutants like SPM, SO_2, NOx and other organic and inorganic pollutants and their adverse effects on human and environmental health (Kaushik, Ravindra, Yadav, Mehta and Haritash, 2006). Continuous emission of pollutants from vehicular traffic is a matter of concern because of adverse effects on ambient air quality. Air quality is a significant determinant of health. The health effects caused by air pollution may include difficulty in breathing, wheezing, coughing and aggravation of existing respiratory and cardiac conditions. Therefore measurement of Air Quality Index (AQI) of an area is important.

The AQI is a rating scale for reporting the ambient air pollution recorded at monitoring sites on a particular time scale. The overall ambient air quality of a specified area can be assessed in a better way and quantified in terms of AQI since it represents the cumulative effect of all the pollutants. The main objectives of AQI are to inform and caution the public about the risks of exposure from pollution levels and to enforce required regulatory measures. Several studies have been carried out in India to calculate the Air Quality Index in order to know the level of pollution and health concerns of the people (Mohan and Kandya, 2007; Bhaskar and Mehta, 2010; Mamta and Bassin, 2010; Srivastava and Sarkar, 2010; Panda and Panda, 2012).

In J&K also, problem of air pollution is increasing day by day. Vehicular traffic is the main source of air pollution in Jammu city as every year number of vehicles goes on increasing (Sharma and Raina, 2012). At least 9 lakh vehicles are plying on the roads in J&K, making it one of the most vehicle populated state in the country. Very few studies on ambient air pollution to calculate the AQI of different types of areas in J&K have been undertaken. However, no systematic studies have been carried out for smaller towns and particularly hilly regions such as Katra town, which is a famous pilgrimage area and act as the base camp of Shri MataVaishno Devi Shrine.

In Katra (latitude 32^0 59'N , longitude 74^0 55'E, altitude 2840 ft), religiously and economically important town of Jammu, construction and demolition for providing better infrastructure to tourists is a growing trend. Also, the number of vehicles along with other sources of pollution is constantly increasing because of continuous increase in the number of tourists. The town witnesses the influx of thousands of pilgrims everyday to the tune of ten million people annually. The number of pilgrims visiting the Shrine has risen from 1.4 million in 1986 to 10 million in 2012 that has added more number of shops, hotels, restaurants etc. to the buzzing market of Katra.

Material and methods

For the data collection and measurement of air quality index, nine sites (three residential, three commercial and three traffic crossings) have been selected after a thorough survey of the town.



Figure 1: Satellite image of study area.

The sampling was carried out for a period of one year on monthly basis i.e. from July 2010 to June 2011, by using Envirotech High Volume Respirable Dust Sampler APM 460 BL designed for particulate matter along with a gaseous sampling attachment (APM 411).

Sulphur dioxide (SO_2) has been analysed by using Modified West and Gaeke Method IS 5182, part II; Nitrogen dioxide (NO_2) by Jacob and Hochheiser method IS 5182, part VI and particulate matter (RSPM and NRSPM) by Gravimetric method, IS 5182, part IV. TSPM concentration has been calculated by summing up the two.

Air Quality Index (AQI) has been calculated using the method suggested by Tiwari and Ali, 1987. For AQI, the air quality rating of each pollutant was calculated first by the following formula:

Q= 100 x V/Vs
Where
Q = Quality rating
V = Observed value of parameter
Vs = Standard value recommended for the parameter

If 'n' numbers of parameters are considered then AQI is the Geometric mean (GM) of all the 'n' number of quality ratings.

Results and discussion

The results obtained have been presented in the following tables.

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Table 1 shows the values of Air Quality Index calculated from the data obtained for the ambient air quality of Katra town at nine sites from July 2010- June 2011. Figure 2 shows the graphical representation of the same.

The analysis of the data revealed that the concentration of SO_2 and NO_2 was within the permissible limits of National Ambient Air Quality Standards (NAAQS) stipulated by CPCB at all the selected sites whereas RSPM and TSPM concentrations exceeded the permissible limits at most of the sites.

The AQI scale was divided into five categories, each category describes the range of air quality and its associated potential health effects. The index uses health based descriptions to provide meaningful information to the public.

Table 2 depict the five levels of AQI.
The Air Quality Index values varied between a minimum of 19.52 to a maximum of 56.58 during the study period. On the basis of AQI, it was observed that traffic crossings have shown higher pollution level followed by commercial areas whereas residential areas have shown lower AQI values. The higher AQI were observed at site VII and VIII and lowest at site II.

Site VII (Bus Stand) and site VIII (Railway Road) were found to be moderately polluted, all the three commercial sites (site IV, V and VI) and one traffic crossing (site IX) have shown light air pollution whereas all the residential sites (site I, II and III) fall under clean category as shown in table 1 . Thus, among all the nine sites, two traffic crossings have shown comparatively higher pollution level as compared to other sites. This may be attributed to the fact that these two sites represent the busy traffic junctions of the town.

Table 1: AQI and AAQ class at selected sites during the study period

Sites	AQI (Air Quality Index)	AAQ (Ambient Air quality) Class
A.Residential Areas		
1. Paharganj	23.29	CA (Clean Air)
2. Gopal Nagar	19.52	CA (Clean Air)
3. Keshav Nagar	22.29	CA (Clean Air)
B. Commercial Areas		
4. Main Bazaar	37.05	LAP (Light Air Pollution)
5. Chintamani	34.70	LAP (Light Air Pollution)
6. Hospital Road	30.12	LAP (Light Air Pollution)
C. Traffic Crossings		
7. Bus Stand	42.24	LAP (light Air Pollution)
8. Railway Road	56.58	MAP (Moderate Air Pollution)
9. Serli	39.01	LAP (light Air Pollution)

Table 2: Rating scale of AQI values

S.NO.	Index Value	Remarks
1.	0-25	Clean air (CA)
2.	26-50	Light air pollution (LAP)
3.	51-75	Moderate air pollution (MAP)
4.	76-100	Heavy air pollution (HAP)
5.	Above 100	Severe air pollution (SAP)

Source: Senthilnathan, (2007)

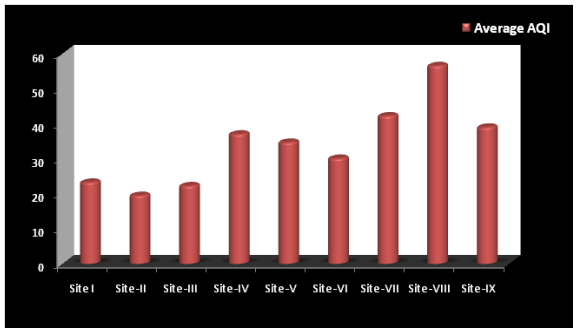

Figure 2: Average AQI of selected sites from July 2010 to June 2011

Seasonal variation of AQI
Table 3 shows the AQI trends in the four seasons (winter, summer, monsoon and post-monsoon) from July 2010-June 2011.

Table 3: Seasonal average AQI of pollutants in different types of areas

Sites	Seasons			
	Winter	Summer	Monsoon	Post-Monsoon
A. Residential Areas				
1. Paharganj	28.66	22.60	18.37	26.49
2. Gopal Nagar	23.27	17.02	14.34	25.45
3. Keshav Nagar	25.54	20.26	17.31	28.09
B. Commercial Areas				
4. Main Bazaar	41.41	37.51	31.79	39.72
5. Chintamani	40.24	34.48	27.81	40.04
6. Hospital Road	37.97	27.53	24.96	33.52
C. Traffic Crossings				
7. Bus Stand	44.08	39.72	33.52	54.48
8. Railway Road	67.07	57.98	45.10	60.66
9. Serli	48.89	34.04	29.94	48.69

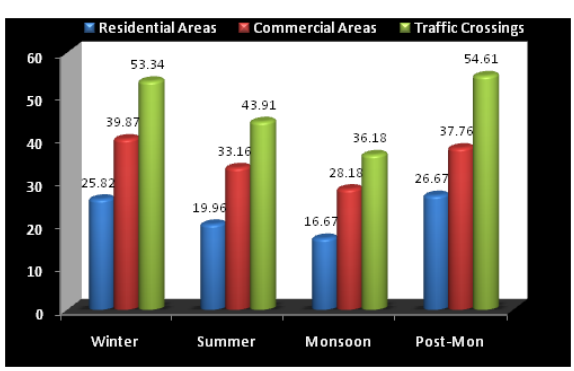

Figure 3: Seasonal average of AQI in different areas during the study period.

Monsoon season showed the best air quality at all the sites and winter season showed the worst air quality at six sites whereas three sites showed worst air quality in post-monsoon season. Monsoon season exhibited best air quality because of large amounts of precipitation, resulting in washing out of the pollutants and hence cleaning of the atmosphere. The worst air quality in winter season may be attributed to calm meteorological conditions and hence less dispersion of pollutants. Moreover, winter season in this area received much less rainfall as compared to other seasons. Mohan and Kandya (2007) also pointed out that monsoon season is the best season and winter season is the worst in terms of air quality.

Conclusion

From the study, it has been concluded the concentration of SO_2 and NO_2 has been observed to be well within the prescribed limits whereas the concentration of both RSPM (PM_{10}) and TSPM has crossed the limits most of the times. The observed AQI values in study area correspond to clean air in residential areas to light air pollution in commercial areas and moderate pollution at one of the traffic crossings. Seasonally, best air quality has been observed in monsoon season and worst in winter season followed by post-monsoon.

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