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REPORT

Geographical Survey of Air Pollution of Patna Urban Town

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Interannual variation of air pollutions in Patna urban have been analyzed from different places and the two primary pollutants SO_2, NO_2 and suspended particulate matter. The methodology involves obtaining the ambient quality data for the study period April 1997 to March 2001.

Key Words: Geographical Survey, Air pollution, Patna.

INTRODUCTION

Air pollution is usually regarded as consisting of particulate and liquid matter in the atmosphere together with various noxious gases that are emitted by certain industrial processes. There are many sources of pollution, industrial, agriculture, domestic and transport. The area of study is Patna urban area. The city typifies a backward economy, primarily agriculture with practically no industrial development, with a growing urban population in which migration is fuelled more by the "push factor" opening in rural areas of the state of Bihar than by any other cause. Patna is an administrative-commercial-educational centre of the state. The south-western part of the city is the administrative area consisting of government offices and residences. East of Gandhi Maidan is the old city, while western Patna consists of haphazard growth of urban settlements merging with the town of Danapur. The purpose of the study is to analyze the interannual variations of air pollutants in Patna, the primary pollutants being sulphur dioxide, nitrogen dioxide and suspended particulate matter.

RESULTS AND DISCUSSION

The methodology involves obtaining the ambient air quality data for the study period April 1997 to March 2001, from the Bihar State Pollution Control Board. The level of pollutants has been analyzed[1, 2] by using basic statistical calculations and deviations from the mean levels have been calculated. The primary data were obtained from the two stations, Gandhi Maidan in north-central Patna and Beltron

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Bhawan located mid-way between the lush government area and the crowded western colonies.

Sulphur Dioxide (SO_2)

Minimum annual averages at Gandhi Maidan declined from 7.3 $\mu g/m^3$ to 5.1 $\mu g/m^3$ whereas the instrumental readings at Beltron Bhawan stabilized around 3 $\mu g/m^3$. However, the maximum averages are high in Gandhi Maidan (over 35 $\mu g/m^3$) and below 25 $\mu g/m^3$ at Beltron Bhawan. The major explanation for this variation is attributed to the fact that Gandhi Maidan despite being the major "Green Lung" of Patna also serves as a transport node in its north-eastern corner. The second site is located on a major arterial road, having swifter traffic and less crowding. The Gandhi Maidan area registered higher averages in winter months and early spring, between November and March (above 20 $\mu g/m^3$). However, this benchmark registered a decrease from a maximum of 30.7 $\mu g/m^3$ in March 1998 to a minimum of 20.8 $\mu g/m^3$ in December 2001. The lowest monthly averages occurring in July-August also fell from 18.6 $\mu g/m^3$ in August 1997 to 13.4 $\mu g/m^3$ in August 2000. This time period coincides with the outbreak of the monsoon rain. Increase in annual averages in the winter period can be attributed not only to automobile emissions, that also to burning of wood and fossil fuels, standard deviation values reveal a gradual lowering from 3.75 $\mu g/m^3$ through 3.26 $\mu g/m^3$ to 2.47 $\mu g/m^3$ (Table-2). Readings at Beltron Bhawan showed higher values in the drier months, and lower in the monsoon periods during the years 1997–98 and 1998–99, but there was a shift in the highest SO_2 content of 12.3 $\mu g/m^3$ in April 1997 and 1998 to 12.5 $\mu g/m^3$ and 13.0 $\mu g/m^3$ in January of 2000 and 2001 respectively. Standard deviation of annual readings showed a reverse trend of an increase from 1.60 $\mu g/m^3$ in 1997–98 to 2.00 $\mu g/m^3$ in 2000–2001, when compared to that of Gandhi Maidan area.

TABLE-1
AVERAGE READINGS OF AIR POLLUTANTS TAKEN IN THE MONTH OF MARCH
(Units are in $\mu g/m^3$)

Years	Sulphur Dioxide				Nitrogen oxide				Suspended particulate matter			
	Gandhi Maidan		Beltron Bhawan		Gandhi Maidan		Beltron Bhawan		Gandhi Maidan		Beltron Bhawan	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	max
1997–1998	7.3	48.9	3.0	24.4	8.4	61.5	3.8	28.8	11.1	1578	32	527
1998–1999	6.6	49.0	3.0	24.4	7.7	115.0	3.8	28.8	55	1802	32	527
1999–2000	6.1	37.0	3.2	19.3	7.7	47.5	5.1	33.0	65	1856	42	477
2000–2001	5.1	35.5	3.0	18.0	7.0	39.2	3.8	21.5	43	2644	38	327

TABLE-2
DATA OF STANDARD DEVIATION OF SO_2, NO_2, SPM
TAKEN IN THE MONTH OF MARCH

Years	Sulphur dioxide		Nitrogen oxide		Suspended particulate matter	
	Beltron Bhawan	Gandhi Maidan	Beltron Bhawan	Gandhi Maidan	Beltron Bhawan	Gandhi Maidan
1997–1998	1.60	3.75	1.95	4.68	81.97	153.32
1998–1999	1.60	3.40	1.95	4.05	81.97	195.31
1999–2000	1.85	3.26	2.07	3.72	62.22	190.98
2000–2001	2.00	2.47	2.16	2.45	50.01	260.62

Nitrogen Dioxide (NO_2)

Minimum average showed a decline from 8.4 $\mu g/m^3$ in 1997–98 to 7.0 $\mu g/m^3$ in 2001–01 in Gandhi Maidan. The Beltron Bhawan site registered a rise in the minimum mean from 3.8 $\mu g/m^3$ to 5.1 $\mu g/m^3$ in 1999–2000. The high annual maximum readings were also recorded in Gandhi Maidan in 1997–98 (32.1 $\mu g/m^3$) which gradually lowered to 20 $\mu g/m^3$ by 2001; constant lowering around 11 $\mu g/m^3$ was recorded at Beltron Bhawan. Seasonal variations in NO_2 levels were at higher level in 1997–98 at Gandhi Maidan (between 21.2–35.7 $\mu g/m^3$), but fell between 14.9 to 26 $\mu g/m^3$ in 1999–2000. The first four months averages were highest for all the years in the rainy months. Deviation values also decreased from 4.68 to 2.45 $\mu g/m^3$ by 2001. At Beltron Bhawan, NO_2 levels show a general rise from October to April every year, but the general level of NO_2 is lower than the Gandhi Maidan area. Deviations, however, show increase in values from 1.95 to 2.16 $\mu g/m^3$.

Suspended Particulate Matter (SPMs)

SPM concentration was highest in Gandhi Maidan with rapid increase from 1578 $\mu g/m^3$ to 2644 $\mu g/m^3$ maximum levels. Maximum levels, minimum levels, average level, however, showed decline by over 50%, the range between minimum and maximum averages being most in 2000–2001. Deviation from the annual mean also increased from 153.32 to 260.62 $\mu g/m^3$. Conversely, Beltron Bhawan readings showed a decline in deviation values. Here the SPM level peaked to 201 $\mu g/m^3$ in 1997–98, and both the minimum and maximum figures were fluctuating at lower levels (3 to 5 times lower than the Gandhi Maidan site). Maximum concentrations of SPMs occurred in October-April period at Gandhi Maidan, the monthly range also being high during this period. Beltron Bhawan yielded less variation between maximum and minimum monthly averages throughout the study period. Decline in deviation values was also observed.

Conclusion

The analysis reveals higher levels of air pollutions in Gandhi Maidan area. The ambient air quality at Beltron Bhawan shows positive signs of improvement due to pollution control methods adopted by the administration in the form of

restrictions on movement of heavy vehicular traffic within the city limits. Automobile emissions, mainly from three-wheeled vehicles, as well as the bus stand of Gandhi Maidan, proved to be the major cause of higher concentration of primary air pollutants there. The heavy concentration of SPMs in the air may be partly attributed to the wind blown sands originating from the dry river-bed of the Ganga, a few yards north of the Gandhi Maidan area. The study also reveals that weather and climate controls influence the concentration and dispersal of the pollutants; however values in the summer and drier months prove that high wind velocities and atmospheric temperature increase the buoyancy of the gaseous pollutants, thereby dispersing them effectively. Although, the two primary pollutants are well within the permissible limits, the excessive concentration of SPMs is a challenge to both environmentalists and policy-makers.

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REFERENCES

1. Wald, A Statistical Decision Function, Wiley-Interscience, New York (1950).
2. Anderson Sellers and P.J. Robinson, Climatology, Longman Group, U.K., 318 (1986).

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