

Case Study on Impact on Pollution by Airborne Particles in a Semi Arid Zone of Rajasthan

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ABSTRACT

Across the world Air pollution is the crucial environment issue. In Rajasthan, particularly in western region, which include the part of the Thar Desert, the situation becomes inexorable due to sandy storms, and the level of pollutants undergo many changes due to climatic conditions. In this case study the deterioration in the quality of air due to the Particulate matter in the hot and semi-arid zone of Rajasthan has been observed by seasonal periodic sampling of different regions throughout the year 2015. Pollution due to particulates size less than 10 μm has been found to be maximum in the month of April and May with the temperature range of 43°C to 31.5°C (max) and 21°C-23°C (min) in the residential area Whereas, in the commercial traffic zone amount of particulate with the size less than 10 μm were maximum in the month of February with the temperature range of 28°C-30°C(max) to 14-16°C (min). Weather plays a vital role with respect to the amount of air borne particulate matter..

Keywords: *Air Pollution, Air borne Particulate, Particulate pollution..*

I. INTRODUCTION

Air pollution is a challenging aspect of environment due to its impact on human health. According to World Health Organization air pollution leads to 8,00,000 premature deaths from lung cancer, cardiovascular and respiratory diseases worldwide, Impact of air pollution and its Magnitude remained largely unknown due to lack of studies on the problem. Therefore, the present study was carried out to assess the problem of air pollution in addition to increased incidence of chronic bronchitis, acute respiratory illness, exacerbation of asthma and coronary disease, and impairment of lung function. Jodhpur is second largest city in the state. In Jodhpur it has high number of registered vehicles and more than 10000 industrial units, which are likely to contribute to air pollution.

II. SOURCES AND CHEMICAL COMPOSITION OF AIRBORNE PARTICULATE MATTER

Airborne Particulate Matter (PM) can be generated from both anthropogenic (burning of fossil fuels in vehicles, power plants and various industrial processes) and natural (dust storms, forest and grassland fires, living vegetation) sources, they consists of a mixture of solid particles and liquid droplets that are suspended in the air for long periods of time, varying microscopic in size, composition, and origin (1,2). The United State Environmental Protection Agency (3) classifies particulate matter into eight categories, or source sectors,

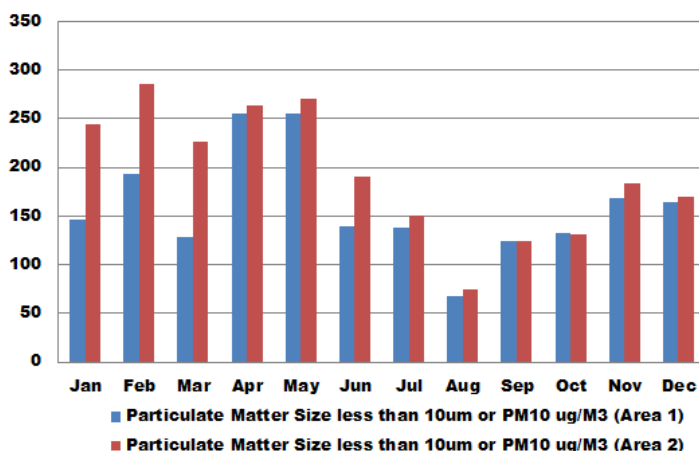


including: agriculture, dust, fires, fuel combustion, industrial processes, solvent, mobile, and miscellaneous sources. The combustion of fuel in automobiles, trucks, and jet airplanes produces several primary pollutants: Nitrogen oxides, Gaseous hydrocarbons, and Carbon monoxide, as well as large quantities of particulates, chiefly lead. The fine particles (PM_{2.5}) composed of elemental carbon, transition metals, complex organic molecules, sulphate, and nitrate. The trace elements like Ba, Sr, Ni, Cr, Cu, V, Zn was also found in aerosols(4). In the presence of sunlight, nitrogen oxides combine with hydrocarbons to form a secondary class of pollutants, the photochemical oxidants, among them ozone and the eye-stinging peroxyacetyl nitrate (PAN). Variety of sources produce particulates with different size and composition they are often classified into three groups according to their mass concentration: Coarse particles (diameter, 10 and ≥ 2.5 μ m), fine particles (diameter, 2.5 and ≥ 0.1 μ m), and ultrafine particles (<0.1 μ m) and represented as PM_{2.5} and PM₁₀. Compared to engine exhaust, non-exhaust particles are enriched in metals, metal oxides and mineral elements and contain less carbonaceous material (5).

III. CASE STUDY OF SEMI ARID ZONE OF WESTERN RAJASTHAN

In Rajasthan Jodhpur is the second metropolitan city with population near about 1,300,000 it is very hot and semi-arid climate at Jodhpur. It lies between 26 degree 0 minute and 27 degree 37 minutes north latitude and 72 degrees 55 minutes and 73 degrees and 52 minutes longitude. It covers 22850 sq km geographical area. Assessment of air pollution of different selected site for commercial /vehicular and residentially sensitive area. The parameter particulate matter size less than 10 μ m, PM₁₀(RSPM) was analyzed at monthly average basis throughout the year 2015. The data was taken from the Website of Rajasthan State Pollution Control Board and the acceptable limit for PM₁₀ for given by National Ambient Air Quality Standard (NAAQS)(6) as per CPCB notification dated 18/11/2009. The temperature of the city at the same time was also viewed as an important component effects the concentration of particulate matter. The data are given in the Table-1 and graphically represented in Figure -1

Table				
Monthly Average (year 2015)	Particulate Matter Size less than 10 μ m or PM ₁₀ ug/M ³ (Area 1)	Particulate Matter Size less than 10 μ m or PM ₁₀ ug/M ³ (Area 2)	Temperature Maximum (°C)	Temperature Minimum (°C)
Jan	146	244	26.5	8
Feb	193	286	30.5	16
Mar	128	226	30.5	16
Apr	256	264	31.5	21.5
May	256	270	43	22.5
Jun	139	190	41.5	29
Jul	138	150	37.5	29
Aug	68	75	33	26
Sep	125	125	39	25
Oct	133	132	38	23
Nov	169	184	31	17.5
Dec	164	170	25	9.5



IV. RESULTS AND DISCUSSIONS

The climate of Jodhpur is hot and semi arid. The heat during summer makes it hottest region in India. The aridity of west Rajasthan is due to vast anticyclone circulation cell in the middle of troposphere extending from Arabia to West Rajasthan. The source of particulates in jodhpur are the industries, which are related to dyes textiles, timber and furniture, handicraft, metal and chemical some rolling meals, guar gum pulses and oil meal are also there. According to statics there are 802210 total registered vehicles in Jodhpur and the wind storms also responsible for increase in particulates in air. The weather here is cold from month of November to March; the summer starts in April and extends up to June and monsoon season from July to mid-September. The amount of particulates in air in the residential area (area-1) is low during rainy season with temperature 38oC higher and 26oC is lower. The amount of particulates started increase during winters. The highest PM was found in month of April and May with the temperature 45oC higher and 17oC lower.

On the other area which is highly traffic area(area-2) low PM was observed in the same season as area -1 that is in rainy and started increasing in the month of Nov with the temperature 33oC higher and 17oC lower. Here we can see that the amount of particulates remain high for around five months with highest in the month of February, where the temperature was ranges from 33oC higher and 15oC lower.

From the above observations we can see that the amount of PM is dependent on weather and temperature. The quality of air is sensitive to climate change (7) Effect of climate change on air quality. High concentration of PM at the residential area (area-1) is may be due to combustion of fuel in houses and public places, Incineration of municipal waste and biomass combustion by slum in the area. The higher concentration of PM in during summer which is very hot with temperature reaches 43oC maximum, in this period the strong winds blowing with the sand and fine particles often in the speed 10-15 kmph and occasionally as sand storm at the speed 60-80 kmph. In the traffic area the road dust resuspended through mechanical and thermal turbulence in this period. The high value in winter at area-2 is may be due to low humidity, low temperature and low wind speed so the particulates will accumulate in low height of planetary boundary layer. This high concentration may leads to respiratory problems such as cough, shortness of breath, wheezing, common cold, and throat congestion(8,9).Meister et al. also shows the toxicological evidence for negative health effects of non-exhaust

particles(10).

The downfall in PM concentration for both the area is the monsoon season availability of water vapour or humidity is quite low upto middle of month of June after this the rainfall act as scavenger for PM and a decrease in PM level was found. Very fine particles were not removed still and remain in the air. Increased levels of fine particles in the air are linked to health hazards such as heart disease, altered lung function and lung cancer.

V. CONCLUSION

The present study shows that concentration of particulates in air is sensitive to climate change and it is dependent on weather. Particulate matter concentration is higher than the limits given by NAAQS throughout the year and it is harmful for both climate and health(13,14). The high concentration of Particulates also affects crops (11,12) by depositing on leaves. So it is necessary for government to apply strict implementation of abatement measures and environmental regulations related to traffic and industries. The seriousness of the pollution due to particulate matter leads to the future research for the quantification and identification of the compounds present as particles in air so the health effects are better understood to reduce the risk.

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REFERENCES

- [1] Dockery D.W., Pope III A.P., Xu X., Spengler J.D., Ware J.H., Fay M.E., Ferris B.G., and Speizer F.E., (1993), An association between air pollution and mortality in six U.S. cities, *The New England Journal of Medicine*, 329(24), pp 1753-1759.
- [2] Bascom R. et al., (1996), Health effects of outdoor air pollution, *American journal of respiratory and critical care medicine*, 153, pp 3-50.
- [3] The United State Environmental Protection Agency (USEPA, 2014).
- [4] Yadav S. and Rajamani V., (2006), Air quality and trace metal chemistry of different size fractions of aerosols in N-NW India-Implications for source diversity, *Atmospheric Environment*, 40, pp 698-712.
- [5] Visser, S., Slowik, J. G., Furger, M., Zotter, P., Bukowiecki, N., Dressler, R., Flechsig, U., Appel, K., Green, D. C., Tremper, A. H., Young, D. E., Williams, P. I., Allan, J. D., Herndon, S. C., Williams, L. R., Mohr, C., Xu, L., Ng, N. L., Detournay, A., Barlow, J. F., Halios, C. H., Fleming, Z. L., Baltensperger, U., and Prévôt, A. S. H.: Kerb and urban increment of highly time resolved trace elements in PM₁₀, PM_{2.5} and PM_{1.0} winter aerosol in London during ClearfLo 2012, *Atmos. Chem. Phys.*, 15, 2367–2386, doi:10.5194/acp-15-2367-2015, 2015.
- [6] National Ambient Air Quality Standard (NAAQS).

- [7] Daniel J. Jacob , Darrell A. Winner “Effect of climate change on air quality” Atmospheric Environment 43 (2009) 51–63.
- [8] Rajkumar, Nagar J. K., Kumar H., Kushwah A. S., Meena M., Kumar P., Raj N., Singhal M. K. and Gaur S. N., (2007), Association of Indoor and Outdoor Air Pollutant Level with Respiratory Problems Among Children in an Industrial Area of Delhi, India, Archives of Environmental and Occupational Health, 62 (2), pp 75-80.
- [9] Rajkumar, Nagar J. K., Kumar H., Kushwah A.S., Meena M., Kumar P., Raj N., Singhal M. K. and Gaur, S. N., (2008), Indoor Air Pollution and Respiratory Function of Children in Ashok Vihar, Delhi: An Exposure - Response Study, Asia-Pacific Journal of Public Health, 20 (1), pp 36-48.
- [10] Meister, K., Johansson, C., and Forsberg, B.: Estimated short term effects of coarse particles on daily mortality in Stockholm, Sweden, Environ. Health Perspect., 2012 March, 120, 431–436, doi:10.1289/ehp.1103995, 2012.
- [11] Khem Singh, Zahid H. Khan, Prabhat K. Gupta “Temporal Changes in Particulate Matter and Trace Gas Concentrations: A Case Study of Delhi” OPEN JOURNAL OF ATMOSPHERIC AND CLIMATE CHANGE ISSN(Print): 2374-3794 ISSN(Online): 2374-3808 Vol.1, Number 2, Aug.2014.
- [12] Huixia Wang, Hui Shi, and Yanhui Wang “Effects of Weather, Time, and Pollution Level on the Amount of Particulate Matter Deposited on Leaves of Ligustrum lucidum” The Scientific World Journal Volume 2015 (2015), Article ID 935942, 8 pages.
- [13] Martins P., Valente J., Papoila A.L., Caires I., Araújo-Martins J., Mata P., Lopes M., Torres S., Rosado-Pinto J., Borrego C., Annesi-Maesano, I., and Neuparth N. (2012). Airways Changes Related to Air Pollution Exposure in Wheezing Children. European Respiratory Journal., 39(2): 246-253.
- [14] Miranda A.I., Martins V., Cascão P., Amorim J.H., Valente J., Tavares R., Borrego C., Tchepel O., Ferreira A.J., Cordeiro C.R., Viegas D.X., Ribeiro L.M., and Pita L.P. (2010). Monitoring of firefighters exposure to smoke during fire experiments in Portugal. Environment International, 36(7): 736-745