International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 08 | Aug 2021 www.irjet.net p-ISSN: 2395-0072

A Study on Air Quality in Rural Areas from Laukahi to Kuriban, Madhubani (Bihar)

Md Asif Anwar[1], Mohd Shoeb Alam[2], Sapna Kumari[3]

[1]*M. Tech Student, Department of Civil Engineering, Al-Falah University, Dhauj, Faridabad*
[2]*Assistant Professor, Department of Civil Engineering, Al-Falah University, Dhauj, Faridabad*
[3]*Research Scholar, Department of Civil Engineering, Jamia Millia Islamia, New Delhi*

---***---

Abstract - *A study on air quality has been carried out using air quality monitoring, which was collected manually for the selected site at every 10 locations. Pollution from road traffic is the major environmental concern of the present day, where the effects of traffic in terms of pollution and congestion are most acutely observed. The main objective of the study is to find out the concentration of air pollutants of PM_1, $PM_{2.5}$, PM_{10}, TVOC and HCHO from Laukahi to Kuriban. At each location data were observed on the roadside(4m) also at the distance of 25 m, 50 m, 75 m, and 100 m in either direction from the center of the road. And to show how the observed concentration of air pollutants decrease with distance at a different interval. Air quality monitoring data was collected through a portable air quality pollution meter detector. The monitored value(maximum) of PM_1, $PM_{2.5}$ and PM_{10} was 35 $\mu g/m^3$, 43 $\mu g/m^3$ and 54 $\mu g/m^3$ respectively. Also observed the maximum concentration of TVOC and HCHO was 0.032 mg/m^3 and 0.183 mg/m3. A comparison of the level of these pollutants ($PM_{2.5}$ & PM_{10}) with the NAAQS was carried out and the observed level of concentration of $PM_{2.5}$ and Pm_{10} were below the NAAQS for rural areas. But if we talk about the standard limit of PM_1, the world is yet to come up with the standard limit of PM_1. Also found that the level of TVOC and HCHO were below 0.3 mg/m3.*

***Key Words*: Air quality, Air quality monitoring, Ambient air pollution, Air pollutants, Permissible limit, NAAQS, Rural areas**

1.INTRODUCTION

Air Pollution is a measure worry throughout the world in both developed and developing nations. Population and therefore the enormous volume of engine vehicles in urban and rural communities have brought about extreme air pollution which influences our environmental and human wellbeing. Vehicles are the only major source of air pollution as no significant industries are situated in that area. Today, air pollution has become more sensitive and causing serious health problems throughout the world. All researchers, policymakers and government bodies have only focused their attention on air quality in the urban areas. Air quality in rural areas is always neglected. The essential sureness is that rural areas are free from pollution. Rural areas having outdoor air pollution as well as indoor air pollution. Major sources of ambient air pollution are the impetuous use of insecticides/pesticides sprays and the burning of wheat and paddy straw. This leads to various health problems mainly affecting the respiratory and cardiovascular systems (Majra, J.P. 2011). Re-suspension of road dust because of movement of traffic and tire and brake wear are additionally a source of the ambient PM concentration. To capture the decay in air quality, it's important to evaluate the present and anticipated air pollution through nonstop air quality monitoring. Therefore, the Central Pollution Control Board had begun National Ambient Air Quality Monitoring (NAAQM). This program was afterwards renamed as National Air Quality Monitoring Program (NAMP). Ambient air levels of VOCs are required to be monitored primarily because of their role in adverse impacts on human health, as well as on ecology, and also on the adverse impact of atmospheric factors relating to other environmental changes (Ozone Layer Depletion etc.) i.e., increases in levels of troposphere (ground-level) ozone and decreases in levels of stratospheric ozone. The modelling of CO emissions was done with the use of CALINE4 model (Masood *et al.* 2017). In case of ambient air monitoring of VOC is aimed to result in knowledge of Types of VOCs, Concentrations of VOCs, Their dispersion routes, category of VOCs and VOCs in terms of their health end point (Srivastava *et al.* 2011). Dekati® PM_{10} cascade impactor were used to determine the concentrations of seven trace elements such as Cd, Cr, Mn, Ni, Pb, Sb, and Se (Anna *et al.* 2019). Transport related emissions are the major source of BC and long-range transportation from fossil fuel related sources and biomass burning could be another substantial source of BC (Begum *et al.* 2006). A system was developed by (Konnar *et al.* 2016) to detect maximum air pollutants and which is highly responsive, accurate and low cost and low power consuming. Ghanshyam (2017) have studied CO modelling in the micro environment of urban roadways along with various conditions such as surrounded by high rise buildings, forming street canyons have been reviewed and presented. It was observed that the process of air quality monitoring has been tried by researchers such as Prediction of Air Pollutants Using ISCST3 And CALINE4 Dispersion Models (Karuna *et al.* 2017), prediction of concentration of pollutants by air quality prediction model i.e., CALINE-4/2.1

model (Mohan *et al*. 2016), an urban air quality monitoring system based on the wireless sensor network (WSN) technology (Liu *et al*. 2011), The elemental composition, determined by energy dispersive X-ray fluorescence technique (Marcazzan *et al*. 2001), two device were used to monitor Formaldehyde detection: electrochemistry (EC) or optical (colorimetric) technology and for TVOC detection: metal oxide semi-conductor (MOS) or photo ionization detection (PID) technology (Goletto *et al*. 2020) and Box model, Gaussian plume model, Eulerian model, Lagrangian model and The KAPPAG models has described for application in both forecasting and estimation of air pollutants on the basis of considered causes and in air quality assessment and air pollution control (Uchiage *et al*. 2013). CAL3QHC, BPNN, and WNN models were applied for evaluating $PM_{2.5}$ concentrations (song *et al*. 2020). The artificial neural network (ANN) and GIS were used for monitoring and prediction of NO_2 (Ahmad *et al*. 2015). Wireless sensor network was used for air quality monitoring by Gaikwad, N. and Mistry, Y. (2015)

1.1 Objective of the study

Ambient air quality monitoring is required to determine the existing quality of air, to identify areas need of restoration and their prioritization.
The major objectives present study are as follows:

(i) Air quality monitoring of PM_1, $PM_{2.5}$ & PM_{10}, for pre-selected site from Laukahi to kuriban at every 10 location.
(ii) To identify and quantify the VOCs presence in the ambient air.
(iii) TO identify and quantify the HCHO presence in the ambient air.
(iv) To show the variation of Air quality for PM_1, $PM_{2.5}$, PM_{10}, HCHO and TVOCs at each location of pre-selected site from Laukahi to kuriban at different distance (for ex- on the road side(4m) and 25m, 50m, 75m and 100m from the centre of the road in the either side) along the road.
(v) Comparative assessment of air quality parameters.

2. MATERIALS AND METHOD

For the present study, a segment of NH 227 was selected. The research site stretches 10.4 Km longitudinally along the length and spreads 100 m laterally on either side of the road segment. The road segment extends from Laukahi (26.46889, 86.56611) to Kuriban (26.3800, 86.5344) on NH 227 further this road connects to NH 27. Some portion of selected segment was under construction, due to which many trucks, trolley and tractors run over the selected site also buses, cars, autorickshaws and motor bikes run on the road. This area was selected for study because there was a need to know the concentration of traffic emission pollutants and to know about how pollutants are decrease with distance from center of the road. the location of study area is shown in figure 1. Air pollution meter detector was used for the air quality monitoring and 1 hourly monitoring has done, starting from 20/06/2021 to 24/06/2021.

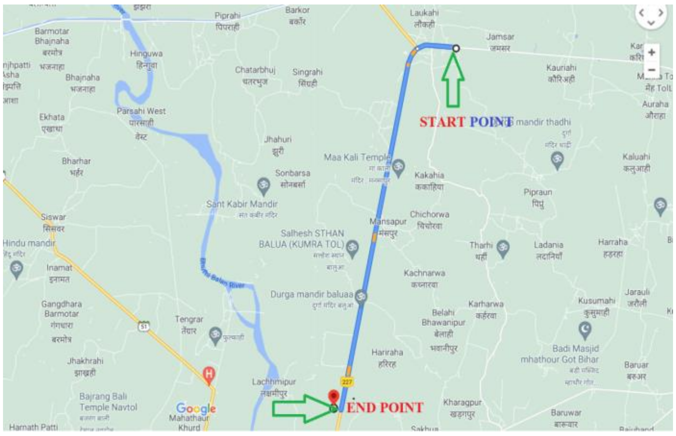

Fig -1: Google map of selected site

3. RESULTS AND DISCUSSION

Good quality of air is important for human being also for environment and vegetation. As per NATIONAL AMBIENT AIR QUALITY STANDARDS the concentration of $PM_{2.5}$ (24hrs) and PM_{10} (24 hrs) is 60 $\mu g/m^3$ and 100 $\mu g/m^3$ respectively. we found highest value of $PM_{2.5}$ and PM_{10} as 43 $\mu g/m^3$ and 54 $\mu g/m^3$ respectively, which was below the standard limit. But if we talk about standard limit of PM_1, the world is yet to come up with the standard limit of PM_1 and during the monitoring period maximum concentration of PM_1 was observed 35 $\mu g/m^3$. Also, we observed the maximum concentration of TVOC and HCHO was 0.032 mg/m^3 and 0.183 mg/m^3 respectively, which was below 0.3mg/m^3. Also observed that the concentration of pollutants was decreasing with distance. For the study, Variation of concentration of selected parameters with distance at the interval of 4 m, 25 m, 50 m, 75 m and 100 m has shown for each and every monitoring location and graphs are shown for each location below:

3.1 Air Quality at Start Point

Table -1: Concentration vs Distance for Start point

Start point	PM_1 ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	HCHO (mg/m^3)	TVOC (mg/m^3)
4m	15	20	23	0.017	0.116
25m	14	18	22	0.014	0.068
50m	14	16	22	0.010	0.036
75m	12	15	19	0.004	0.016
100m	11	15	17	0.001	0.003

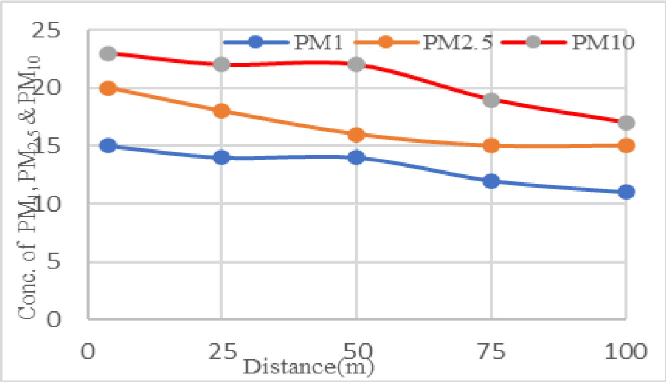

Chart -1: Variation of PM_1, $PM_{2.5}$ & PM_{10} with Distance at start point

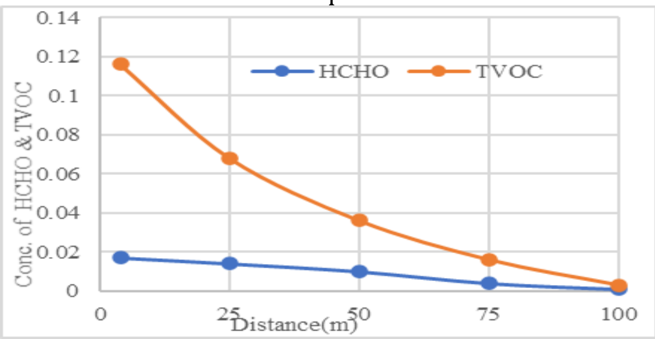

Chart -2: Variation of HCHO & TVOC with Distance at start point

3.2 Air Quality at Domra Chowk

Table -2: Concentration vs Distance for Domra Chowk

Domra Chowk	PM_1 (μg/m³)	$PM_{2.5}$ (μg/m³)	PM_{10} (μg/m³)	HCHO (mg/m³)	TVOC (mg/m³)
4m	35	43	54	0.027	0.053
25m	29	38	45	0.015	0.039
50m	25	36	40	0.009	0.026
75m	22	32	34	0.005	0.010
100m	15	24	28	0	0.002

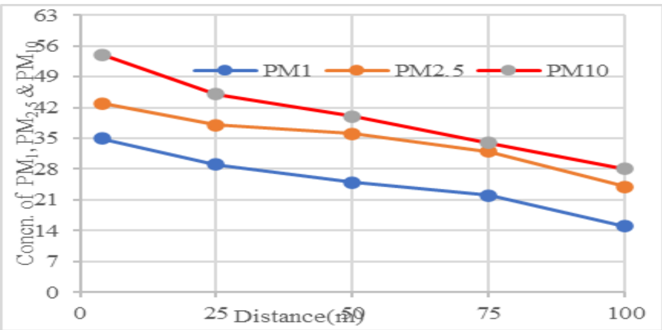

Chart -3: Variation of PM_1, $PM_{2.5}$ & PM_{10} with Distance at Domra Chowk

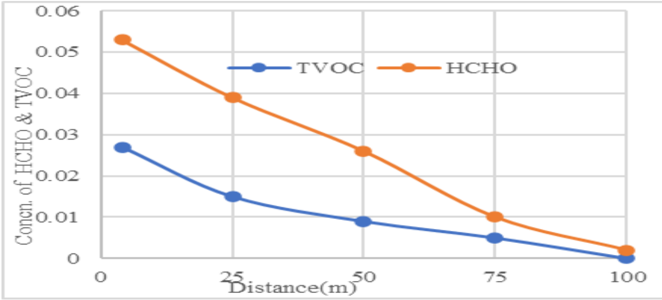

Chart -4: Variation of HCHO & TVOC with Distance at Domra Chowk

3.3 Air Quality at Location 3 (Near Hanuman Mandir on NH 227)

Table -3: Concentration vs Distance Near Hanuman Mandir

Location 3	PM_1 (μg/m³)	$PM_{2.5}$ (μg/m³)	PM_{10} (μg/m³)	HCHO (mg/m³)	TVOC (mg/m³)
4m	26	33	39	0.006	0.051
25m	20	27	36	0.004	0.029
50m	18	27	30	0.001	0.020
75m	18	25	28	0	0.010
100m	14	22	25	0	0.002

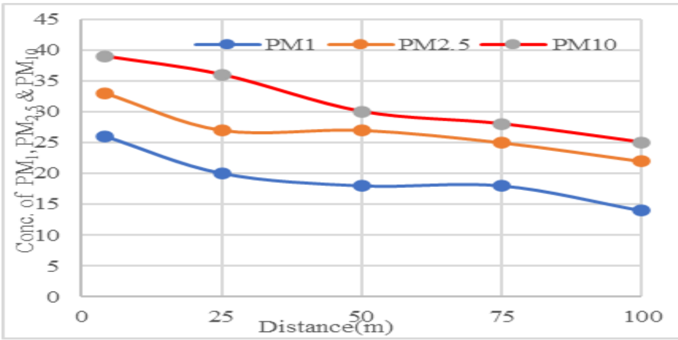

Chart-5: Variation of PM_1, $PM_{2.5}$ & PM_{10} with Distance at Location 3

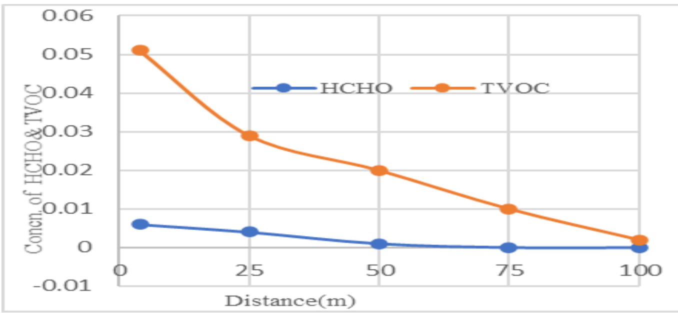

Chart -6: Variation of HCHO & TVOC with Distance at Location 3

3.4 Air Quality at Sonvarsha

Table -4: Concentration vs Distance for Sonvarsha

Sonvarsha	PM_1 (µg/m³)	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	HCHO (mg/m³)	TVOC (mg/m³)
4m	22	35	34	0.032	0.183
25m	19	29	30	0.017	0.030
50m	19	26	29	0.011	0.010
75m	18	25	25	0.002	0.007
100m	16	23	21	0	0.002

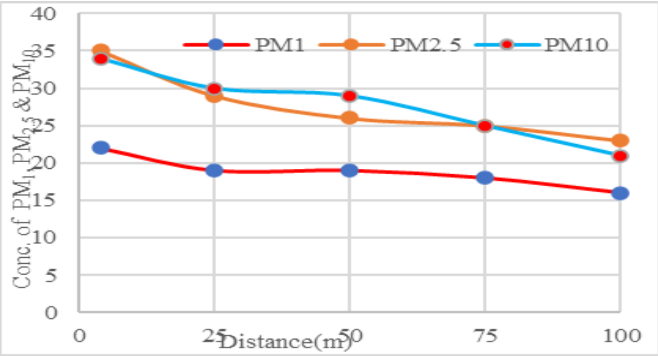

Chart-7: Variation of PM_1, $PM_{2.5}$ & PM_{10} with Distance at Sonvarsha

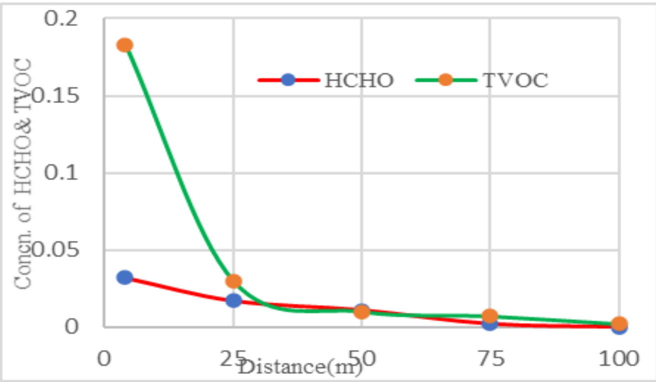

Chart -8: Variation of HCHO & TVOC with Distance at Sonvarsha

3.5 Air Quality at Dhobiyahi

Table -5: Concentration vs Distance for Dhobiyahi

Dhobiyahi	PM_1 (µg/m³)	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	HCHO (mg/m³)	TVOC (mg/m³)
4m	19	28	30	0.006	0.033
25m	19	27	29	0.004	0.020
50m	18	27	29	0.004	0.014
75m	18	26	29	0.002	0.001
100m	15	25	28	0	0

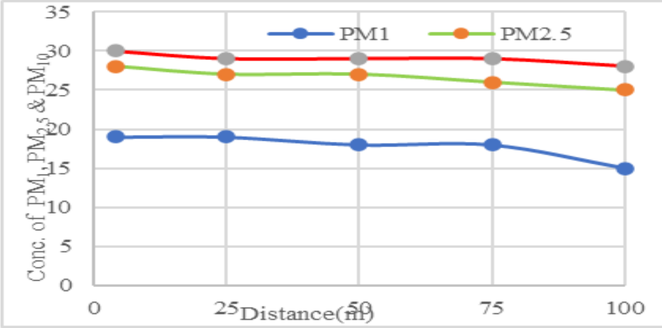

Chart-9: Variation of PM_1, $PM_{2.5}$ & PM_{10} with Distance at Dhobiyahi

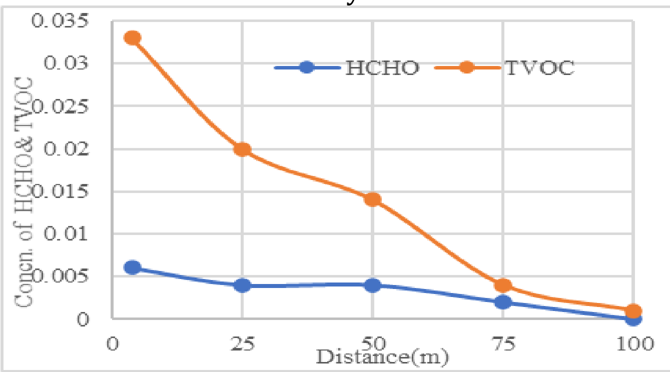

Chart -10: Variation of HCHO & TVOC with Distance at Dhobiyahi

3.6 Air Quality at Phakirna

Table -6: Concentration vs Distance for Phakirna

Phakirna	PM_1 (µg/m³)	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	HCHO (mg/m³)	TVOC (mg/m³)
4m	31	41	47	0.002	0.064
25m	25	35	38	0.002	0.024
50m	19	28	29	0.001	0.013
75m	1	26	21	0	0.010
100m	17	23	16	0	0.003

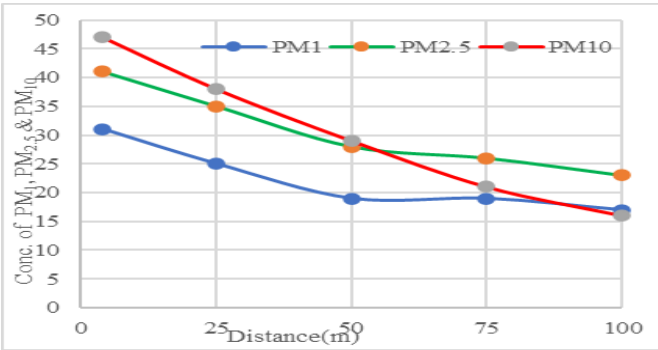

Chart-11: Variation of PM_1, $PM_{2.5}$ & PM_{10} with Distance at Phakirna

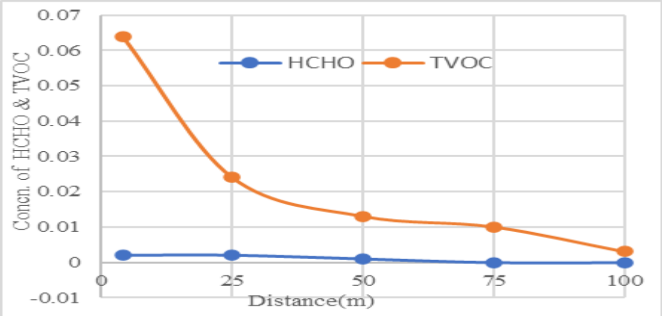

Chart -12: Variation of HCHO & TVOC with Distance at Phakirna

3.7 Air Quality at Mansapur

Table -7: Concentration vs Distance for Mansapur

Mansapur	PM_1 (µg/m³)	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	HCHO (mg/m³)	TVOC (mg/m³)
4m	30	39	48	0.010	0.077
25m	25	31	36	0.006	0.053
50m	19	24	26	0.002	0.022
75m	17	21	23	0	0.003
100m	15	20	23	0	0

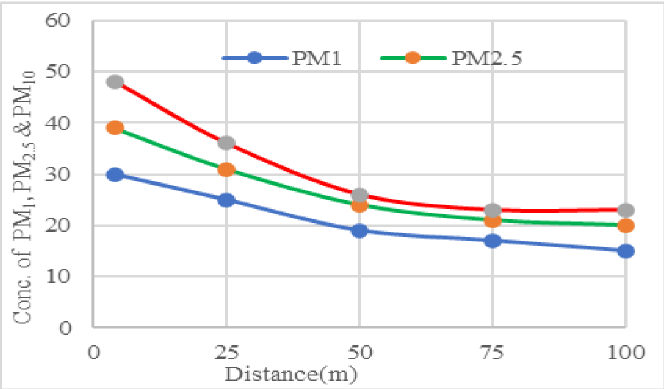

Chart-13: Variation of PM_1, $PM_{2.5}$ & PM_{10} with Distance at Mansapur

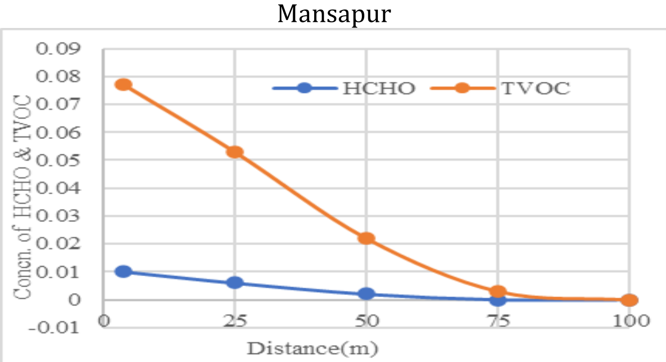

Chart -14: Variation of HCHO & TVOC with Distance at Mansapur

3.8 Air Quality at Balua

Table -8: Concentration vs Distance for Balua

Balua	PM_1 (µg/m³)	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	HCHO (mg/m³)	TVOC (mg/m³)
4m	15	22	23	0.002	0.011
25m	14	19	22	0.001	0.008
50m	14	18	20	0.001	0.005
75m	13	17	20	0	0.002
100m	12	17	19	0	0

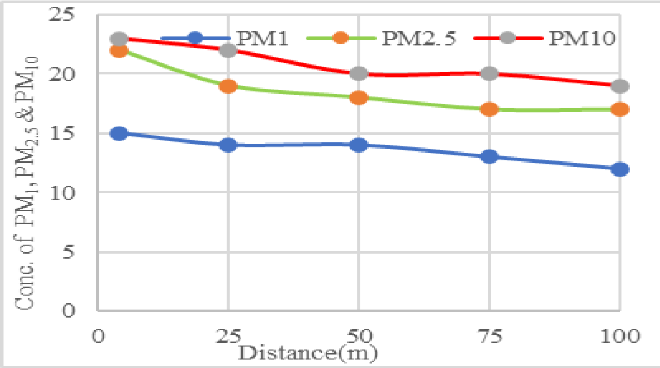

Chart-15: Variation of PM_1, $PM_{2.5}$ & PM_{10} with Distance at Balua

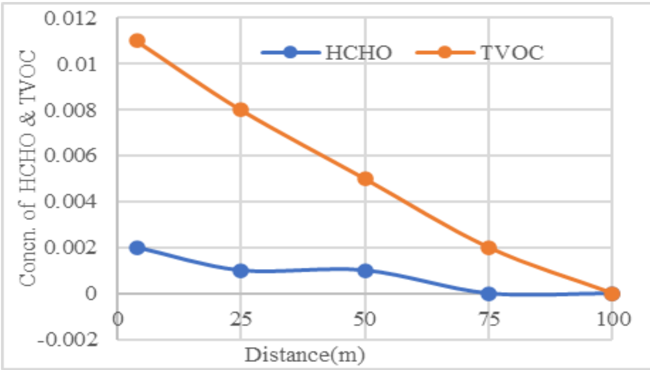

Chart -16: Variation of HCHO & TVOC with Distance at Balua

3.9 Air Quality at Dhabhi

Table -9: Concentration vs Distance for Dhabhi

Dhabhi	PM_1 (µg/m³)	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	HCHO (mg/m³)	TVOC (mg/m³)
4m	31	43	49	0.019	0.151
25m	29	38	42	0.013	0.103
50m	27	36	37	0.006	0.053
75m	25	31	36	0.001	0.022
100m	22	25	30	0	0.007

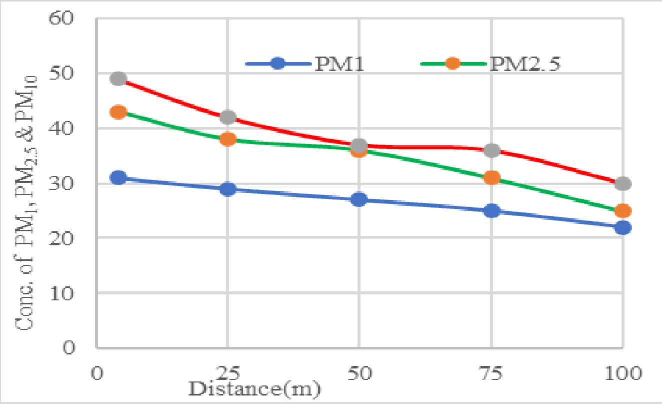

Chart-17: Variation of PM_1, $PM_{2.5}$ & PM_{10} with Distance at Dhabhi

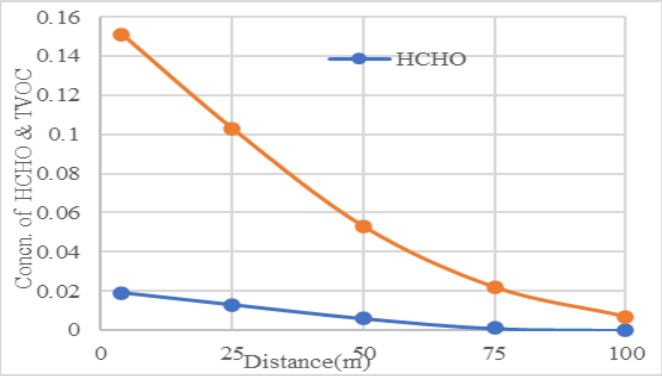

Chart -18: Variation of HCHO & TVOC with Distance at Dhabhi

3.10 Air Quality at Kuriban

Table -10: Concentration vs Distance for Kuriban

Kuriban	PM_1 (μg/m^3)	$PM_{2.5}$ (μg/m^3)	PM_{10} (μg/m^3)	HCHO (mg/m^3)	TVOC (mg/m^3)
4m	30	43	45	0.026	0.140
25m	29	39	39	0.017	0.077
50m	27	36	35	0.012	0.053
75m	21	29	30	0.005	0.020
100m	19	29	22	0.001	0.009

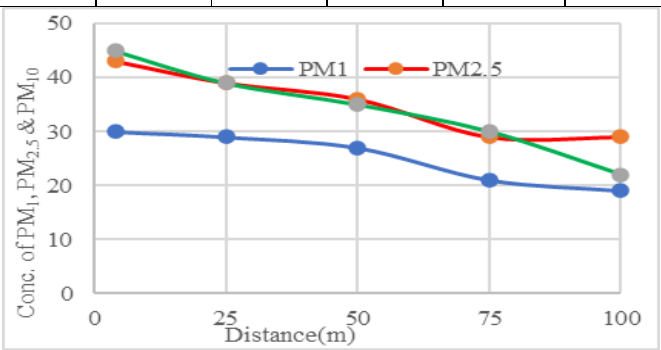

Chart-19: Variation of PM_1, $PM_{2.5}$ & PM_{10} with Distance at Kuriban

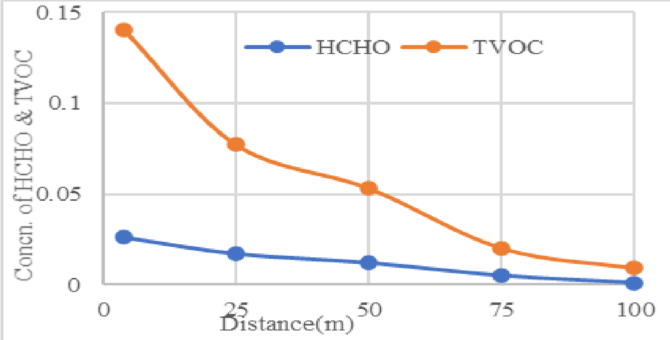

Chart -20: Variation of HCHO & TVOC with Distance at Kuriban

4. CONCLUSIONS

PM_1, in comparison to PM_{10} and $PM_{2.5}$, isn't subject to air quality standards, nor WHO recommendations, thus it's not routinely measured. Although PM1 features a higher potential to cause harmful health effects than coarse particles. This particulate is more likely to succeed deeper into the respiratory system carrying more toxins from anthropogenic emissions. VOC of both primary and secondary origin in ambient air has immense importance as they have direct and indirect effects on global climate change, ecology and human health. Formaldehyde could be a crucial industrial chemical consumed to produce a good array of materials, but it is also generated naturally by the physical body. When inhaled, it's absorbed primarily at the placement of the primary contact, where it's metabolized and reacts with cellular components. Thus, inhaled formaldehyde remains predominantly within the tissue that lines the airways.

In this paper, PM_1, $PM_{2.5}$, PM_{10}, TVOC and HCHO were collected for the segment of NH227 from Laukahi to Kuriban. The readings were taken in peak hours. The observed reading of air pollutant concentrations was below the NAAQS for $PM_{2.5}$ & PM_{10}, but for PM_1 there is no standard limit. Also, the concentration of TVOC and HCHO were under superb condition because it was below 0.3 mg/m3.

In our result, it has been observed that the monitored data of air pollutants decreasing with the distance at the interval of 4 m, 25 m, 50 m, 75 m and 100 m from the center of the road in either direction. And with the help of monitored data scatter graphs are shown (concentration vs distance) for all selected air pollutants.

REFERENCES

[1] Ahmad, S.S., Urooj, R. and Nawaz, M., "Air Pollution Monitoring and Prediction," Current Air Quality Issues, Farhad Nejadkoorki, IntechOpen, 2015
doi: 10.5772/59678.

[2] Anna, M. and Zajusz-Zubek, E., "PM1 in Ambient and Indoor Air—Urban and Rural Areas in the Upper Silesian Region, Poland" Atmosphere, 2019, 10(11), 1-16. https://doi.org/10.3390/atmos10110662.

[3] Arya, S., "Air Quality Monitoring at Some Selected Traffic Junction of Jhansi, Central India," Elixir Pollution, 2016, 92, 38697-38701.

[4] Begum, B.A., Biswas, S.K. and Hopke, P.K., "Temporal variations and spatial distribution of ambient PM2.5 and PM10 concentrations in Dhaka, Bangladesh," Sci Total Environ, 2006, 358(1-3), 36-45.

[5] Bulto, T.W., "Influence of particulate matter on human health in selected African provinces: mini-review", Reviews on Environmental Health, 2021, 36(1), 9-14. https://doi.org/10.1515/reveh-2020-0013.

[6] Central Pollution Control Board (CPCB), New Delhi, India (2006), Report on Air Quality Trends and Action Plan for Control of Air Pollution from Seventeen Cities.

[7] Colbeck, I., Nasir, Z.A. and Ali, Z., "The state of ambient air quality in Pakistan-a review," Environmental Science and Pollution Research, 2009, 17(1), 49-63. DOI:10.1007/s11356-009-0217-2.

[8] Gaikwad, N. and Mistry, Y., "Review on Environment Monitoring System and Energy Efficiency," Int. Journal of Engineering Research and Applications, 2015, 5(7), (Part - 1), 90-92.

[9] Ghanshyam, "Urban Air Quality Monitoring and Modelling-A Review" International Journal of Engineering and Manufacturing Science, 2017, (2), 181-202.

[10] Goletto, V., Mialon, G., Faivre, T., Wang, Y., Lesieur, I., Petigny, N. and Vijapurapu, S.S., "Formaldehyde and Total VOC (TVOC) Commercial Low-Cost Monitoring Devices: From an Evaluation in Controlled Conditions to a Use Case Application in a Real Building," Chemosensors,2020, 8(1), 8, https://doi.org/10.3390/chemosensors8010008.

[11] Karuna, M. S., Upadhyay, O. P., Saxena, D.K., Mahadeva Swamy, M. and Majumder, S., "Ambient Air Quality Monitoring and Prediction of Air Pollutants," Journal of Environmental Science, Toxicology and Food Technology, 2017, 11(12), 14-29.

[12] Konnur, D.A. and Ragha, Dr. L.K., "Review Paper on Smart Sensor Network for Air Quality Monitoring," International Journal of Innovative Research in Advanced Engineering (IJIRAE), 2016, 3(7), 31-35. doi:10.17632/j2y6xtr3dp.1.

[13] Kularatna, N. and Sudantha, B.H., "An environmental air pollution monitoring system based on the IEEE 1451 standard for low-cost requirements," IEEE Sensors J., 2008, 8(4), 415–422. doi: 10.1109/JSEN.2008.917477.

[14] Liu, J., Chen, Y., Lin, T., Lai, D., Wen, t., SUN, C., Juang, J. and Jiang, J. (2011), "Developed Urban Air Quality Monitoring System Based on Wireless Sensor Networks," 2011 Fifth International Conference on Sensing Technology, 2011, doi:10.1109/ICSENST.2011.6137040.

[15] Majra, J.P., "Air Quality in Rural Areas", Chemistry, Emission Control, Radioactive Pollution and Indoor Air Quality," Dr. Nicolas Mazzeo (Ed.), 2011.

[16] Marcazzan, G.M., Vaccaro, S., Valli, G. and Vecchi, R., "Characterisation of PM10 and PM2.5 particulate matter in the ambient air of Milan (Italy)," Science Direct, 2001, 35(27), 4639-4650, https://doi.org/10.1016/S1352-2310(01)00124-8.

[17] Masood, A., Ahmad, K. and Ahmad, S., "Urban Roadside Monitoring, Modelling and Mapping of Air Pollution: A case study of New Delhi, India," Appl. J. Envir. Eng. Sci., 2017, 3(2), 179-194, https://doi.org/10.48422/IMIST.PRSM/ajees-v3i2.8593.

[18] Mohan, B., Ahmed, K. and Afsar, S., "Study on Air Quality in the near field of MMA," international Journal of Advance Research and Innovation, 2016, 3(2), 238-243.

[19] Pope, C. A. and Dockery, D.W., "Health Effects of Fine Particulate Air Pollution: Lines that Connect," J Air Waste Manag Assoc., 2006, 56(6), 709-42. DOI: 10.1080/10473289.2006.10464485.

[20] Samaras Z.C. and Zierock K.H., "Evolution of road traffic emissions in urban areas of the European Community," Science of the Total Environment, 1994, 146(7), 253-261.

[21] Sindhwani, R. and Goyal, P., "Assessment of traffic–generated gaseous and particulate matter emissions and trends over Delhi," Atmospheric Pollution Research, 2014, 5(3), 438-446. https://doi.org/10.5094/APR.2014.051.

[22] Song J, Qiu Z, Ren G, Li X, "Prediction of pedestrian exposure to traffic particulate matters (PMs) at urban signalized intersection," Sustainable Cities and Society, 2020, 60, 102153. https://doi.org/10.1016/j.scs.2020.102153.

[23] Srivastava, A. and Mazumdar, D., Monitoring and Reporting VOCs in Ambient Air, Chapters in Air Quality Monitoring, Assessment and Management by Nicolás A. Mazzeo, IntechOpen, India, 2011.

[24] Streets, D.G., Fu, J.s., Jang, C.j., Hao, J., He, k., Tang, X., Zhang, Y., Wang, Z., Li, Z., Zhang, Q., Wang, L., Wang, B. and Yu, C., "Air quality during the 2008 Beijing Olympic Games," Science Direct, 2007, 41(3), 480-492. https://doi.org/10.1016/j.atmosenv.2006.08.046.

[25] Ukaigwe, Sandra A., Osoka, Emmanuel C., "Air Quality Monitoring Using Model: A Review," International Journal of Science and Research (IJSR), India, 2013, 2(9).