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# Profile of Benzene and Toluene in Ambient Air of Khurja City, NCR: Sources, Seasonal Variations, and Health-Environmental Implications

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ABSTRACT

Benzene and toluene represent dangerous volatile organic compounds (VOCs) frequently found in the air of cities as a result of industries and automobiles. The paper examines the levels of concentration, spatial patterns and seasonal changes of benzene and toluene in the ambient air at Khurja City, which is part of the National Capital Region (NCR) in India. The samples of ambient air were taken at the selected sites of industry, residential, and traffic-dominated zones with the help of the standardized sampling methods, and then chemical analysis was carried out through the gas chromatography-based methods. The findings indicate that spatial and temporal differences exist, whereby the concentrations are higher in the industrial and busy regions and in the winter season. The toluene-to-benzene (T/B) ratios reveal that the major sources are anthropogenic sources, especially vehicles emission and small-scale industries. The degree of concentration was put against the national and international air quality standards to determine adherence and possible risks. The outcome of the health risk assessment shows that there is high risk of lifetime cancer due to benzene exposure and non-cancer health risks due to toluene especially its effects on the central nervous system. The paper highlights the importance of specific approaches to pollution control, the ongoing monitoring, and intervention policies to reduce the impact of VOC pollution and protect people health in newly industrialized towns like Khurja.

## Introduction

Air pollution in the cities is now a big issue of environmental and social health concern across the globe especially in the developing nations that are rapidly industrializing, urbanizing and motorizing. The growing energy consumption, transportation, and industrial activity has lead to emission of the wide variety of air pollutants, with volatile organic compounds (VOCs) being one of the most important. VOCs are also important contributors to the atmospheric chemistry as they contribute to photochemical ozone formation, secondary organic aerosol formation, and transport of air pollutants over a long range, which worsens the quality of ambient air.

The benzene and toluene are some of the VOCs that are primarily of concern because they are toxic, persistent in the atmosphere, and also because of their high sources of emission. Benzene is a proven human carcinogen which has a close relationship with leukemia, bone marrow suppression and other hematological disorders at relatively low concentrations and at long term exposures. Toluene is not the most carcinogenic but mainly a central nervous system target and it can produce headache, dizziness, respiratory irritation and cognitive impairment following prolonged exposure. The two are commonly emitted by car exhausts, fuel vaporization, the use of solvents in industries, petroleum processing, and biomass combustion and are therefore the major pollutants in cities and industries. The Khurja City is a significant ceramic City in Uttar Pradesh along with a small-scale industrial city in the National Capital Region (NCR). The city has many ceramic production units, small scale industries as well as congested traffic routes that add to the atmospheric pollution. Its closeness to the key NCR cities also subjects Khurja to pollution transportation in the area. Even with the growing level of industrial activity and road congestion, there is a lack of systematic scientific research on the ambient VOC concentration in Khurja. Lack of localized information curbs the knowledge of the sources of pollution, levels of exposure, and possible health risks to the population. The objective of the current research is to produce a baseline data on the ambient benzene and toluene levels in the Khurja City, the spatial and seasonal dynamics of the pollutants, the potential sources of emission, and the health and environmental consequences. The results will be useful in the management of air quality and offer scientific contributions to policymakers and local governments to curb VOC pollution in the new industrial towns.

### Literature Review

Healy *et al*. (2019) compared the performance of a passive air sampling technique and two online gas chromatographs in the measurement of benzene, toluene, ethylbenzene and xylene-compounds (BTEX) at a highway location. The accuracy, reliability, and time resolution of passive and active methods of monitoring were compared in the study. Their results showed that passive samplers could provide accurate results in terms of long-term mean concentrations, whereas the online gas chromatographs could capture the short-term fluctuation that could be dependent on the movement of traffic. The research was able to identify vehicular emissions as a major point of BTEXs compounds and the significance of proper monitoring methods in the quality of air in the city. Hedayatzadeh and Hassanzadeh (2020) researched the incidence, likely sources, and health hazards of BTEX compounds in Ahvaz, ambient urban environment, Iran. The analysis revealed the presence of high levels of benzene and toluene especially in places of traffic usage, which are highly contaminated by humans. The source identification analysis proposed the following as the major sources: vehicular emissions and fuel combustion. The health

risk evaluation showed that there was the potential risk of carcinogen exposures to benzene and non-carcinogen exposures to toluene which highlighted the importance of the risk of prolonged exposure to VOCs on the health of the population in urban settings.

Kaushik *et al*. (2024) stated the emissions of benzene and toluene in the National Capital Region (NCR) of India, as well as analyzed their effects on health risks and on ozone formation. The research found that there were high spatial and seasonal differences with greater concentrations during winter seasons as a result of adverse meteorological conditions. The authors pointed out motor vehicles and industry as some of the major contributors to high levels of VOCs. Their health risk evaluation revealed that benzene had a significant lifetime cancer risk with toluene being a contributor of non-cancer health effects. The paper highlighted the necessity of more stringent control over emissions and their constant monitoring in densely populated cities such as the NCR. Kumar *et al*. (2015) carried out a case study of volatile organic compounds (VOCs) in New Delhi ambient air around fuel filling stations in New Delhi, India. In the present study, it was demonstrated that VOCs, especially benzene and toluene, were increased in the area of fuel dispensing operations. The authors found that the evaporation of fuel, vehicle refueling, and the movement of the surrounding traffic were also significant factors of VOC emissions. These areas around fuel stations, that study pointed out, contained considerably larger amounts of pollutants than background areas, and this aspect highlighted the significance of localized sources of emission in urban air pollution. Kumar *et al*. (2020) evaluated cancer and non-cancer health hazards of exposure to non-methane hydrocarbons in roadside vendors in Delhi, India. The research has found that long term exposure to VOCs, such as benzene and toluene, was a significant health hazard to occupationally exposed populations. The lifetime risks of cancer with benzene were calculated and exceeded the acceptable levels, and the estimates of non-cancer risks showed the possibility of negative effects on the respiratory and nervous systems. The results highlighted the susceptibility of roadside groups and the necessity of exposure reduction measures.

## Research Methodology

The section describes the characteristics of the study area, sampling design, methods of analysis and quality control measures that will be used to determine the level of ambient benzene and toluene in Khurja City. It also explains the statistical methods of analyzing the spatial and seasonal variations and determining the significant sources of emissions.

**Study Area Description-** The current research was carried out in Khurja City which is situated in the west of Uttar Pradesh, and which forms part of the National Capital Region (NCR). The climate of the city is subtropical, with hot summers (March-June), cold winters (November-February), and moderate rainfalls (July-September). The seasonal changes of temperature and meteorological factors have a significant effect on the dispersion and concentration of air pollutants. Khurja is also known to have ceramic and pottery industries, and other small scale manufacturing facilities. Besides that, the city has been experiencing gradual growth in vehicular movement owing to urban growth and linkages with other adjacent cities in the NCR. All these factors will add up to the release of volatile organic compounds (VOCs), and Khurja is a significant site to evaluate the ambient air quality.

**Selection of Sampling Locations-**There used to be ambient air sample checking at selected places, which were the representation of various land-use patterns in the city. These sites were generally grouped into industrial regions, residential districts and locations where there is traffic to achieve a spatial variation in the amount of pollutants. Industrial locations were selected close to ceramic and small manufacturing facilities, traffic locations were selected at busy road intersections and highways, and residential locations were selected at locations where industrial influence could not be directly experienced.

**Sampling Strategy and Schedule-**Sampling was done seasonally in order to measure the changes in benzene and toluene concentration with time. The two big seasons were taken into account; summer and winter. The reason behind this seasonal method was to determine how meteorological factors like climate, wind velocity and mixing height of the atmosphere affected the VOC concentrations. Several samples were taken at every location to be representative and reliable on the data.

**Sampling and Analytical Methods-**Active air sampling methods were utilized in the form of adsorbent tubes that had been specifically made to collect VOC. The tubes were filled with ambient air at a constant flow rate over a short period of time to obtain an adequate sample volume. The tubes with the adsorbent were sampled and then sealed properly and taken to the laboratory.

The analysis of laboratories was performed through gas chromatographic methods, which permit us to identify and determine the amount of benzene and toluene in the laboratory. To achieve the accuracy of the analysis, calibration was done on the standard reference compounds.

**Quality Assurance and Quality Control-**Quality assurance and quality control (QA/QC) procedures were strongly adhered to during the study in order to ensure that the data remained of good quality and reliability. These were routine instrument calibration, field blank in order to determine contamination, duplicate sample testing to determine reproducibility and standard operating procedures in the sampling and analysis.

**Data Analysis and Source Identification-**To investigate the spatial and seasonal difference in benzene and toluene level, statistical analysis was applied to assess the difference in directly sampled concentration of benzene and toluene in various sampling sites. Concentration levels were summarized using descriptive statistics and comparative analysis was used to help identify the differences in site categories and seasons. Toluenebenzene (T/B) ratio was determined and it was employed as a diagnostic measure to estimate the prevailing sources of emissions like vehicular sources, industrial sources and fuel sources.

## Results

The section shows the concentrations of benzene and toluene measured in the ambient air of Khurja City and indicates their spatial and seasonal distribution in the various land-use categories. These findings are addressed in the areas of concentration distribution, seasonality and source identification using diagnostic ratios.

**Concentration Levels of Benzene and Toluene-**The results of ambient air monitoring have shown that both benzene and toluene were observed in all the chosen sampling points although there was evident difference between industrial, traffic dominated, and residential regions. All in all, toluene levels were greater than benzene levels at most sites, which is due to its higher emission levels in the vehicular exhaust and the use of solvents in industries. The comparatively higher concentrations were observed at industrial and traffic locations, and the relatively low concentrations were observed at residential locations.

**Spatial Distribution of Benzene and Toluene-**The spatial analysis demonstrated that the largest concentration of high levels of benzene and toluene was found in industrial zones and then in those of traffic. It was found that residential areas had lower levels of concentration which implied a relatively lower exposure. The spatial pattern indicates the contribution of the ceramic industries, small manufacturing units and automobile emissions towards the ambient VOC levels in the city.

**Table 1: Distribution of Benzene Concentrations Across Different Land-Use Categories**

| Concentration Range (µg/m³) | Industrial (%) | Traffic (%) | Residential (%) |
|---|---|---|---|
| < 1.0 | 12 | 10 | 38 |
| 1.0 – 2.0 | 30 | 34 | 42 |
| 2.0 – 3.0 | 35 | 33 | 15 |
| > 3.0 | 23 | 23 | 5 |

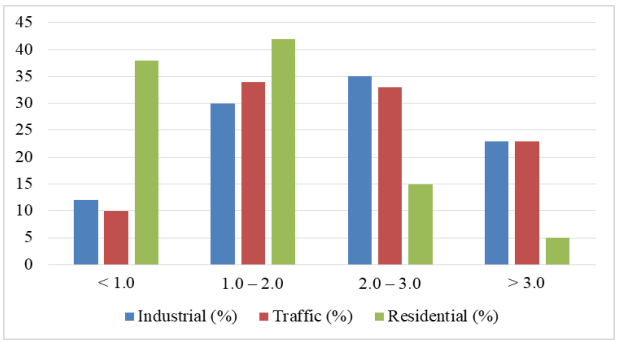


**Figure 1: Graphical Representation of Distribution of Benzene Concentrations Across Different Land-Use Categories**

As observed in the analysis of the distribution of benzene concentrations, there is a noticeable spatial difference in the distribution of benzene concentrations across various land-use categories in Khurja City. The high percentage of samples in the moderate to high concentration ranges (≥ 2.0 µg/m 3 ) in industrial and traffic dominated areas demonstrated that industrial activity and automobile emissions had a strong impact on that area. Conversely, residential locations were mostly characterized by the regions of low concentration implying relatively low levels of exposure. This spatial pattern emphasizes the importance of localized sources of emissions and land-use pattern in the management of ambient distribution of benzene in the city.

**Spatial Distribution of Toluene-**The concentration of toluene was always higher than benzene in all categories of sites. The contribution of anthropogenic sources like fuel combustion and industrial solvent emissions had a stronger effect on the industrial and traffic locations, which had a greater percentage of samples in higher concentration ranges.

**Table 2: Distribution of Toluene Concentrations Across Different Land-Use Categories**

| Concentration Range (µg/m³) | Industrial (%) | Traffic (%) | Residential (%) |
|---|---|---|---|
| < 5.0 | 15 | 12 | 40 |
| 5.0 – 10.0 | 32 | 36 | 45 |
| 10.0 – 15.0 | 34 | 30 | 10 |
| > 15.0 | 19 | 22 | 5 |

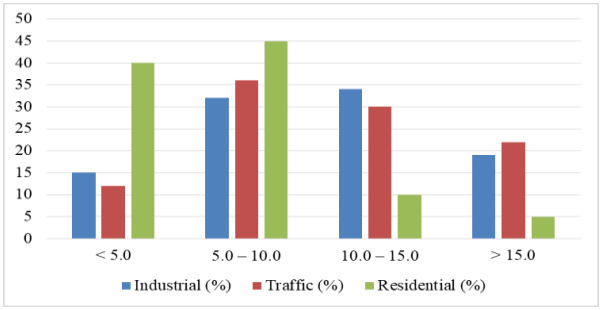


**Figure 2: Graphical Representation of Distribution of Toluene Concentrations Across Different Land-Use Categories**

Spatial distribution of toluene concentrations shows that there is a strong impact of anthropogenic activities all over Khurja City. Areas that had a high level of industrial and traffic showed a greater number of samples in the higher concentration levels ( 10.0 µg/m 3 and above), indicative of the effect of automobile emissions, fuel combustion, and solvent usage in industries. Lower to moderate ranges of concentration were prevalent in residential areas, which implied relatively low exposures. The general trend proves the fact that the concentration of toluene is highly influenced by the land-use features and severity of human activities in the city.

**Seasonal Variation of Benzene and Toluene-**Seasonal analysis shows that the concentration of benzene and toluene was high in the winter season than in summer. This is due to the fact that there is low mixing height in the atmosphere, inversion of temperatures, and less dispersion of pollutants in winter seasons.

**Table 3: Seasonal Percentage Variation of Benzene and Toluene Concentrations**

| Season | Benzene (%) | Toluene (%) |
|---|---|---|
| Winter | 60 | 57 |
| Summer | 40 | 43 |

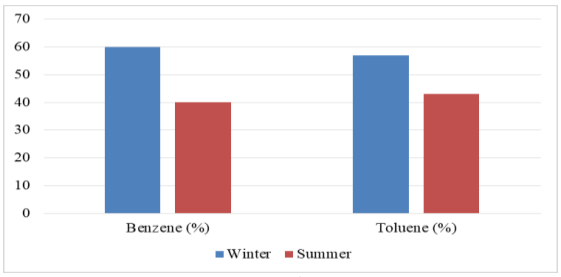


**Figure 3: Graphical Representation of Seasonal Percentage Variation of Benzene and Toluene Concentrations**

The analysis of seasonal variation shows that the concentration of the benzene and toluene was very high in winter as compared to the summer. The higher winter percentages indicate the effect of the poor weather conditions like the reduced mixing height of the atmosphere and temperature inversion that limit the spread of pollutants. Conversely, when the atmosphere is better mixed in summer, the concentrations become relatively lower, hence the influence of seasonal meteorology on the regulation of ambient levels of VOCs is very significant.

**Source Identification Using Toluene/Benzene Ratio-**The determined toluene-to-benzene (T/B) ratios were usually higher than one in most of the locations, which showed that the sources of anthropogenic emissions are dominant. The existence of higher T/B ratios in traffic and industrial regions is indicative of a heavy contribution by vehicle emissions, fuel outgassing, and industry.

**Table 4: Contribution of Identified VOC Sources Based on T/B Ratio**

| Source Category | Contribution (%) |
|---|---|
| Vehicular Emissions | 45 |
| Industrial Activities | 35 |
| Fuel Evaporation | 12 |
| Biomass Burning | 8 |

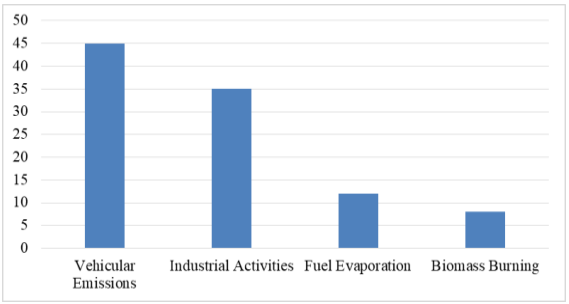


**Figure 4: Graphical Representation of Contribution of Identified VOC Sources Based on T/B Ratio**

The analysis of toluene-to-benzene ratio shows that the sources of anthropogenic origin take the leading role in determining the ambient VOC levels in Khurja City. The impact of vehicles is the highest percentage with the next impact being industrial operations which represents the combination of traffic density and the small-scale industries. The relatively smaller role of fuel evaporation and biomass burning indicates that the factor of combustion and industrial sources will have a greater influence on the regulation of benzene and toluene levels in the study area.

## Discussion

The analysis provides a clear spatial and seasonal differences in the ambient benzene and toluene concentration throughout Khurja City that is mainly dependent on human-related events and weather conditions. The concentration of these is greater in industrial and traffic-dominated neighborhoods implying the importance of ceramic industries, small-scale manufacturing facilities, and automobile emissions and lesser in residential neighborhoods indicating relatively lower exposure. The levels of toluene were always higher than that of benzene, indicating the large number of applications in industrial and fuel related work. Seasonal analysis indicates a high concentration in the winter season because of a decrease in dispersion and temperature inversion in the atmosphere.

The ratio of toluene to benzene rate is also an indication that vehicular and industrial sources are predominant, and the rising influence of urbanization and industrialization on the quality of air in such emerging towns as Khurja is evident.

## Conclusions

The current research offers an extensive evaluation of the ambient benzene and toluene levels in Khurja City, NCR, showing that there are substantial spatial and seasonal differences, which are primarily determined by human interventions. The presence of higher levels in industrial and traffic dominated regions underscores the significant role of ceramic industries, small scale manufacturing, and vehicular emissions whereas the relatively lower levels seen in residential areas reflect the lack of exposure. The high concentrations of toluene relative to benzene are a constant due to its extensive application in industries and combustion of fuels. Seasonal analysis shows that high concentrations occur during the winter season because of poor meteorological conditions that includes less atmospheric mixing and temperature inversion. The analysis of the ratio of toluene and benzene confirms that vehicles and industries are the main sources of VOC pollution in the study area. In general, these results emphasize that persistent monitoring, practical methods of emission control, and policy interventions can be used to reduce VOC pollution and preserve human health in quick developing industrial cities such as Khurja.

## References


Healy, R. M., Wang, J. M., Karellas, N. S., Todd, A., Sofowote, U., Su, Y., & Munoz, A. (2019). Assessment of a passive sampling method and two on-line gas chromatographs for the measurement of benzene, toluene, ethylbenzene and xylenes in ambient air at a highway site. Atmospheric Pollution Research, 10(4), 1123-1127

Hedayatzadeh, F., & Hassanzadeh, N. (2020). Occurrence, probable source, and health risk assessment of benzene, toluene, ethylbenzene, and xylene compounds in ambient urban atmosphere in Ahvaz, Iran.

Kaushik, N., Mishra, A. K., & Das, R. M. (2024). Assessment of benzene and toluene emissions in National Capital Region (NCR): Implications for health risks and ozone formation. Air Quality, Atmosphere & Health, 17(12), 3015-3029.

Kumar, N., Kumar, P., Sithananthan, M., Mathai, R., Sehgal, A. K., Suresh, R., & Das, B. P. (2015). Volatile organic compounds (VOCs) in ambient air-A case study at the vicinity of fuel filling stations in New Delhi, India (No. 2015-01-0055). SAE Technical Paper.

Kumar, R. P., Kashyap, P., Kumar, R., Pandey, A. K., Kumar, A., & Kumar, K. (2020). Cancer and non-cancer health risk assessment associated with exposure to non-methane hydrocarbons among roadside vendors in Delhi, India. Human and Ecological Risk Assessment: An International Journal, 26(5), 1285-1299.

Kumar, R. P., Pandey, A. K., Kumar, R., Kashyap, P., & Kumar, K. (2017). Assessment of source profile of nonmethane hydrocarbon in the ambient air of metro city Delhi, India. Current World Environment, 12(2), 326

Kumari, P., Garg, G., Soni, D., & Aggarwal, S. G. (2023). Measurement of benzene and other volatile organic compounds: implications for its inhalation health risk associated with the workers at a fuel station in Delhi. Asian Journal of Atmospheric Environment, 17(1), 7.

Lalrinzuali, R. K. (2018). Assessment of ambient air quality in the campus of university of horticulture and forestry Nauni-Solan Himachal Pradesh (Doctoral dissertation, Dr. Yashwant Singh Parmar University of Horticulture And Forestry).

Liu, T., Yang, T., Yuan, X., Su, Q., Feng, J., & Jiang, J. (2025). Determination of eight benzene homologues in airport ambient air and aircraft cabin air by two-stage thermal desorption-gas chromatography. RSC advances, 15(29), 23772-23782.

Montero-Montoya, R., López-Vargas, R., & Arellano-Aguilar, O. (2018). Volatile organic compounds in air: sources, distribution, exposure and associated illnesses in children. Annals of global health, 84(2), 225.

Sekar, A., Varghese, G. K., & Varma, M. R. (2019). Analysis of benzene air quality standards, monitoring methods and concentrations in indoor and outdoor environment. Heliyon, 5(11).

Sharma, S., Giri, B., & Patel, K. S. (2016). Ambient volatile organic compounds in the atmosphere of industrial central India. Journal of Atmospheric Chemistry, 73(4), 381-395.

Shin, S. S., Yang, E. H., Lee, H. C., Moon, S. H., & Ryoo, J. H. (2022). Association of metabolites of benzene and toluene with lipid profiles in Korean adults: Korean National Environmental Health Survey (2015–2017). BMC Public Health, 22(1), 1917.

Singh, R., Gaur, M., & Shukla, A. (2016). Seasonal and spatial variation of BTEX in ambient air of Delhi. Journal of Environmental Protection, 7(5), 670-688.

Soltanpour, Z., Mohammadian, Y., & Fakhri, Y. (2021). The concentration of benzene, toluene, ethylbenzene, and xylene in ambient air of the gas stations in Iran: A systematic review and probabilistic health risk assessment. Toxicology and industrial health, 37(3), 134-141.

Chaudhary, S. and Kumar, A. (2012). Monitoring of Benzene, Toluene, Ethyl benzene and Xylene (BTEX) Concentration In ambient Air of Firozabad, India. International Archive of Applied Science & Technology, Vol. 3(2), 92-96.

Chaudhary, S. and Kumar, A. (2012). Study on Refuelling pump stations caused by BTEX Compounds in Firozabad city. International Archive of Applied Science & Technology, Vol. 3(2),75-79.

Chaudhary, S. and Sisodia, N. (2015). Analysis of Ketoconazole and Piribedil using Ion Selective Electrodes. IOSR Journal of Applied Chemistry, Vol. 8(1), Ver.II, 1-4.

Chaudhary, S. (2016). Effect of benzene and Xylene concentration on Public health in Ambient Air In City of Firozabad, India. PARIPEX – Indian Journal of Research,Vol. 5(11), 504-505.

Singh, V. and Chaudhary, S. (2019). Study of groundwater quality in Khurja city and adjoining areas of Khurja Borewell And hand-pump water. International Journal of Geography, Geology and Environment, 1(1), 95-9 9.

Chaudhary, S. and Singh, V. (2021). Toluene concentration at commercial site in ambient air of Firozabad and its Impact on human health, International,IJDDT, Volume 16 Issue 1, 2026 journal of humanities, Law and Social Sciences, Vol. 8(1), 71-76.

Chaudhary, S. (2022). Benzene and Toluene concentration at different Traffic intersection during Pre-mid-post winter season, in ambient air of Aligarh and its impact on Human Health, PARIPEX - Indian Journal of Research, vol.11(8), 42-45.

Chaudhary, S. (2022). Effect of BTEX Concentrations on human health, in ambient air at different refuelling pump stations in Firozabad, Journal of Socio Economic Review, Vol. 9(2), 34-41.

Chaudhary, S. (2023). Photo electrochemical (PEC) Study of The Dye Sensitized High Band Gap Structure of ZnO Semiconductor electrodes Prepared by the SOL-Gel Method, PARIPEX- Indian journal of Research, Vol. 12(9), 94-96.

Chaudhary, S. (2024). An Assessment of released Industrial Effluent and its impact on Water Quality, PARIPEX- Indian journal of Research, Vol. 13(8), 55-58.

Chaudhary, S. (2024). Role of Native plant Species in Phytoremediation of Heavy Metals from Contaminated Soil at Atrauli and Panethi, PARIPEX- Indian journal of Research, Vol. 13(8), 59-62.

Singh, Y., Chaudhary, S., Ravikant (2024). An Exhaustive examination of the models, methods, histories and viewpoints related to water quality Indexes (WQIs). AIRO journals, Vol. 3(1), 210-226.

Geeta, Chaudhary, S., Ravikant (2024). Heavy metals in Aligarg's urban soil: An overview of health risks and pollution assessment, AIRO journals, Vol. 3(1), 228-244.

Chaudhary, S., Singh, V., Singh, S. K. (2024). A Stud.y of New Approachesto Statistical Analysis of research data,JSIANE,Vol. 4(4), 24-29.

Chaudhary, S. (2024) Role of Nano Catalysts in Green Chemistry, JSIANE,Vol. 4(4), 08-11.

Geeta, Chaudhary, S. (2024). A Comprehensive Study on Native Plant Species for Phytoremediation of Heavy Metals Contaminated in Soil, JSIANE,Vol. 4(4), 15-19.

Kumar, Y., Chaudhary, S. (2024).AStudy of Innovative Approaches to Water Pollution Control: EmergingStrategies and Technologies, JSIANE,Vol. 4(4), 47-51.

Chaudhary, S. (2025). AStudy of Toxic Heavy MetalsIn Released Treated/Untreated Waste water from Slaughterhouses of Khurja, Uttar Predesh. JSIANE, 5(1), ISSN:2583-2093, 5(1). 9-11.

Singh, Y., Chaudhary, S. (2025). Heavy Metal Concentration in Contaminated Water Caused by a Release of Industrial pollutants and City Waste. JSIANE, 5(1), ISSN:2583-2093, 5(1), 38-40.

Geeta, Chaudhary, S. (2025). Soil Quality Degradation Due to Heavy Metal Concentration in Contaminated Soil and its Remediation. JSIANE, 5(1), ISSN:2583-2093, 5(1), 43-45.

Geeta, Chaudhary, S. Kant, R. (2024). Assessment of human health risks from the distribution and concentration of heavy metals in soil, ground water amd vegetables in Aligarh, Uttar Pradesh, Frontiers in Health Informatics, ISSN:2676-7104, Vo;. 13(5), 1104-1116.

Singh, Y., Chaudhary, S. Kant, R. (2024). Physiochemical indicators of emerging pollutants in Aligarh's urban water system.Frontiers in Health Informatics, ISSN:2676-7104, Vo;. 13(5), 1117-1131.