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# A Study on Air Quality Analysis and the Impact of Pollutants and Climatic Factors

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**Abstract:** *The study analyses how pollutants such as Particulate Matter, Sulphur dioxide, Nitrogen Oxides, Ozone, Benzene, Carbon Monoxide, Ammonia and weather conditions impact the Air Quality Index (AQI).Methods like Multiple Regression and Logistic Regression are used to examine the effects of pollutants (PM2.5, NO2, SO2) and weather factors (temperature, humidity) on AQI. The data type to be collected here will be secondary data from Kaggle.The sample size collected was 8000+, methodology used is descriptive research. The findings show that pollutants and climate factors significantly affect air quality, with recommendations for real-time monitoring, predictive modeling, and stricter regulations to improve air quality.*

**Keywords:** Pollutants, Particulate Matter, Sulphur dioxide, Nitrogen Oxides, Ozone, Benzene, Carbon Monoxide, Ammonia, Temperature, Humidity, Air Quality Index, Logistic Regression, Multiple regression analysis

## I. INTRODUCTION

Air quality analysis is essential for monitoring pollutants like carbon monoxide, particulate matter, and sulphur dioxide, which are linked to respiratory diseases and climate change. Techniques such as direct sampling, remote sensing, and air quality monitoring stations are used to gather data, with advanced methods like chemical analysis and computer modeling providing real-time insights. Rapid urbanization and industrial growth have escalated air pollution levels, necessitating continuous monitoring to protect public health and the environment. Air quality data plays a key role in shaping regulatory policies, enforcing standards, and guiding pollution control strategies to reduce emissions. The air quality analysis industry is growing, driven by advancements in monitoring technologies and increasing global efforts to combat air pollution.

## II. OBJECTIVES

- To examine the relevance and implications of Air Quality Index.
- To identify the factors influencing Air Quality Index.
- To analyse the effect of temperature and Humidity aspects on Air Quality Index.
- To analyse the effect of Particulate Matter2.5, Particulate Matter10, Nitrogen oxide, Nitrogen dioxide, Ammonia, Carbon monoxide, Sulphur dioxide, Ozone, Benzene, Toluene and Xylene.

## III. LITERATURE REVIEW

Amrita Thakur (2017), India. “Study of Ambient Air Quality Trends and Analysis of Contributing Factors in Bengaluru, India”. This study aims to analyse the air pollution trends in Bangalore and investigate the contributing factors. The findings of the study reveal that RSPM levels have increased in certain locations. While RSPM levels have risen, the absorption of SO2 and NO2 remain under control.

Greta Gustafsson (2022), London. “Urban Planning for Better Air Quality”. This study aims to enhance greenery and evaluate the effects of Low-Traffic Neighbourhoods (LTNs), with special attention to PM10 and NOx levels. The findings reveal a decrease in NOx and PM10 levels after the implementation of Low-Traffic Neighbourhoods and the COVID-19 lockdowns.

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Natalia Dzhevaga, Darya Borisova (2021), St. Petersburg, Russia. "Analysis of Air Monitoring system in Megacity on the Example of St. Petersburg". The goal of is to measure the environmental conditions in St. Petersburg through gravimetric, electrochemical, and chromatographic methods.The outcomes display that Gas Chromatography analysis of the samples revealed the existence of highly toxic hydrocarbons.

## IV. RESEARCH METHODOLOGY

The research employed a descriptive methodology, using multiple regression and logistic regression analysis to assess how factors like Pollutants (PM2.5, NO2, SO2) and weather factors (temperature, humidity) impact the Air Quality Index. Data was collected via secondary sources, including Kaggle datasets, 8000+ sample size.

### SAMPLING

The study utilized simple random sampling to ensure a representative subset of the Pollutants and Weather Conditions, selecting a sample size of 8000+.

### STATISTICAL TOOLS

- **Microsoft Excel:** data organization, visualization, and basic statistical analysis, such as creating charts and calculating descriptive statistics.
- **SPSS software:** multiple regression analysis to examine the relationships between independent and dependent variables. Logistic regression analysis to predict the categorical dependent variable

### HYPOTHESIS TEST

**Null Hypothesis($H_0$)**

Ho – Temperature and Humidity aspects do not influence Air Quality Index Bucket.

**Alternative Hypothesis($H_1$)**

H1 - Temperature and Humidity aspects influence Air Quality Index Bucket.

| Model | | Sum of Squares | df | Mean Square | F | Sig |
|---|---|---|---|---|---|---|
| 1 | Regression | 5447.314 | 2 | 2723.657 | 4694.839 | 0.000b |
| | Residual | 5148.729 | 8875 | 0.580 | | |
| | Total | 10596.044 | 8877 | | | |

**ANOVA**[a]

**Dependent Variable**: Air Quality Index

**Predictors:** Temperature and Humidity

Inference, as sig. value of 0.000 is less than the standard P value of 0.05, we reject Ho and Conclude that both Temperature and Humidity together does influence Air Quality Index.

**Coefficients**[a]

| Model | | Unstandardized B | Coefficients Std. Error | Standardized Coefficients Beta | t | Sig | Result |
|---|---|---|---|---|---|---|---|
| 1 | (Constant) | 6.825 | .032 | - | 210.0772 | .000 | - |
| | X2 | -2.357 | .027 | -.681 | -86.378 | .000 | Significant |
| | X3 | -2.57 | .023 | -.089 | -11.254 | .000 | Significant |

**Dependent Variable:** Air Quality Index

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## V. DISCUSSION AND RESULTS

The study on Air Quality Analysis demonstrates that Pollutants and Weather conditions have significant impact on Air Quality Index. Analysing the distribution of pollutants across various categories or AQI buckets to reveal patterns and trends in air quality over a period of time and across different locations. This insight aids in understanding how factors such as weather, industrial activities and traffic influence air quality.

### KEY FINDINGS

- The majority of the sample areas show minimal exposure to particulate matter (PM2.5 and PM10), contributing to lower pollution levels.
- Nitrogen dioxide concentrations are significantly high in certain locations and times, heavily impacting air quality in those areas.
- Moderate levels of ammonia, carbon monoxide, and ozone are present in most areas, indicating a moderate effect on overall air quality.
- Temperature has a strong influence on the Air Quality Index (AQI), with higher temperatures correlating with poorer air quality, while humidity has a lesser impact.
- Twelve pollutants, including PM2.5, PM10, nitrogen compounds, ammonia, and volatile organic compounds, together significantly influence the AQI, requiring comprehensive management strategies

## VI. CONCLUSION

This study concludes that Pollutants and weather conditions have been identified as key predictors of air quality, significantly influencing pollution levels. Targeted interventions are necessary, especially in urban areas, to address key pollutants like particulate matter, nitrogen dioxide, ammonia, carbon monoxide, ozone, and sulphur dioxide. Visualizations, such as charts, are effective tools for analysing data and presenting findings to stakeholders in a clear and accessible manner. Continuous monitoring and data-informed policy decisions are essential for reducing the negative effects of air pollution on health and the environment. Future research should focus on incorporating real-time sensor data and machine learning techniques for more precise air quality predictions and management.

## VII. LIMITATIONS

- The study may face challenges due to inconsistencies and gaps in air quality data, particularly in regions with limited monitoring infrastructure.
- Merging information from diverse sources, involving satellite images, ground-based sensors, and IoT devices, can be technically demanding.
- Variations in air quality standards and regulations across different regions and countries make it challenging to compare data and assess policy effectiveness.
- The study's emphasis on air pollution that occurs outside might neglect the significant health risks posed by indoor air quality.

## REFERENCES

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