Study on Effect of Air Pollution on Health

Abstract

Air Quality Index system is used to is used to interpret air quality in standard indicator which helps public to understand the helth and environmental impacts of air pollutants and it's concentration level which are monitored on any given day. Due to rapid development and urbanisation, the enormity of air pollution is always a matt urbanisation, the enormity of air pollution is always a matt of concern. People in their studies have analysed the data till 2010 but in this a detailed analysis from 2003-2015 of air pollutants has been done. Correlation analysis have been done to study the relation between various air pollutants like SO2,NO2,PM and it's corresponding human effects.

1. Introduction

According to World Population Review, Delhi, the National Capital Territory (NCT) of India, is the densely populated metropolitan city with a large influx of population from other states of India. As per the last Census carried out in 2011, population of Delhi was 16.7 million [1] and estimated 2016 population of 18.6 million. In recent years, rapid industrialisation and urbanisation posed detrimental effect on environment. Problem of air pollution is increasingly getting more serious. Increasing levels of pollutants in air is causing extreme health disorder. It directly affects a population of millions who are suffering from shortness of breath, eye irritation to chronic respiratory disorders, pneumonia, acute asthma etc [2] [3].

[bookmark: _Toc511806192]With increase in levels of pollutants in air,health diorders are also increasing which directly affects a population of millions who are suffering from shortness of breath, eye irritation to chronic respiratory disorders, pneumonia, acute asthma etc [4]. Watery eyes, coughing and difficulty breathing are acute are common reactions of air pollution. Air pollution has both short term and long term effects on human health which affects different organs. It ranges from minor upper respiratory irritation to chronic respiratory and heart disease, lung cancer, acute respiratory infections in children and chronic bronchitis in adults, aggravating pre-existing heart and lung disease, or asthmatic attacks. In addition, short- and long-term exposures have also been linked with premature mortality and reduced life expectancy [5].

1.1 Type of pollutants

The major concentration of pollutants in the Delhi air is:-

1. Particulate Matter, RSPM and SPM (PM2.5 and PM10): The principle source of particulate matter in Delhi is vehicular emissions, particularly from heavy motor diesel vehicle, kerb-side dust, thermal power plants, industrial and residential combustion processes. Respirable suspended particulate matter (PM2.5) is considered to be more hazardous to human health than PM10. The average limit of PM2.5 pollution is 60 microgram per cubic meter but all the areas of Delhi have the level of PM 2.5 exceeding 300 microgram per cubic meter [7].

2. Nitrogen Oxide (NOx): Oxides of Nitrogen are produced during industrial combustion processes and primarily as vehicular exhaust. NOx levels are highest in urban areas as it is related to traffic. It is an important ingredient in generation of photochemical smog which envelops the urban air with haze like blanket. It has harmful effects such as wide-range of respiratory problems in adults and children.
3. Sulphur Dioxide (SO2): It is formed mostly by burning of fossil fuels particularly from thermal power plant. This pollutant is the reason for acid rain and has adverse effects on lung functions.
4. Benzene: The main sources of benzene are from vehicle exhaust and other industrial processes since it is an industrial solvent. Benzene is a component of crude oil and petrol. Apart from vehicle exhaust, evaporation from petrol filling stations can raise benzene levels [7].
5. Ozone (O3): Formed by chemical reaction of volatile organic compounds and nitrogen dioxide in the presence of sunlight, so level of ozone is generally higher in the summer. Ground level ozone also contributes in formation of photochemical smog.
6. Toluene: Toluene is another industrial volatile solvent whose short term exposure causes irritation of eyes and the respiratory tract. The substance is a known carcinogen and affects the central nervous system also.
7. Carbon Monoxide (CO): CO is a toxic air pollutant which is produced by incomplete combustion of carbon-containing fuels. Vehicle deceleration and idling vehicle engines are one of its main causes.

1.2 Effects on health

- Sulfur dioxide is also considered to cause cough shortness of breath, spasm of the larynx and acute irritation to the membranes of the eyes. It also acts an allergic agent. When it reacts with some compound, sulfuric acid is formed which may damage lungs.
- Carbon Monoxide often affects the oxygen carrying capacity of blood. Nitric oxide is reported to be a pulmonary irritant and excess concentration may cause pulmonary hemorrhage.
- Hydrogen Sulfide is also toxic. Lead emitted from automobile exhausts is a cumulative poison and is dangerous particularly to children and may cause brain damage.
- The particulate pollutants are capable of exerting a noxious local action in the interstitial areas of the lungs. Radioactive elements are also harmful to man and other living organisms.
- Smog also has killer effects which is also the result of air pollution.

2. Related Work

Considerable research has been carried out in the subject area of air pollution and health data analysis along with its interpretation. Researchers Maureen L. Cropper, Nathalie B. Simon, Anna Alberini, and P.K. Sharma, have compared the impact of particulate matter of India and US and also death by age groups of India and US [7]. Other researchers working in the field of air quality and health effects studies are Sanjoy Maji, Sirajuddin Ahmed and Weqar Ahmad Siddiqui, have studied daily averaged concentration data of air pollutants of monitoring sites under the National Ambient Air Quality Monitoring Programme of Delhi were analysed for the period 2001–2010 (10 years) using the AQI system [8]. Keiko Hirota , Shogo Sakamoto , Satoshi Shibuya and Shigeru Kashima discussed methods of estimating the health effects of air

pollution in large Asian cities [9]. Thereafter C. Arden Pope, Michael J. Thun, Mohan M. Namboodiri, Douglas W. Dockery, John S. Evans, Frak E. Speizer and Clark W. Heath linked ambient air pollution data from 151 U.S. metropolitan areas in 1980 with individual risk factor [10].

Akindayo Olanrewaju Ogunbayo studied the relationship between exposure to environmental air pollution and hypertensive disease[11]. A comprehensive emission inventory for Delhi, India, for 1990–2000(10 years) has been developed in support of air quality by B.R. Gurjar, J.A. van Aardenne, J. Lelieveld, M. Mohan[12]. Ping-Wei Soh, Kai-Hsiang Chen, Jen-Wei Huang and Hone-Jay Chu explored the spatial-temporal patterns of particulate matter (PM) in Taiwan[13].

However, there is a scope for further studies due to the susceptibility of the population towards increasing air pollution and to find ways to monitor and control it in an effective manner.

In the presented work, correlation analysis for analyzing the trends of air pollution with health in Delhi has been used.

3. Proposed Work

3.1 Data set used

The data has been collected from KAGGLE [15].Three datasets are used. A snapshot of the dataset used figure1 contains six attributes: Year, SO2, NO2, RSPM, SPM and PM2.5. The ‘Year’ attribute describes the sampling year and other parameters give their individual centration in air. The data has been collected from 2003 to 2015.

Fig.1. Snapshot of the dataset

A snapshot of the dataset used figure 2 contains five attributes: Year, Cause, Gender, Age group and mortality. The ‘Year’ attribute describes the sampling year and other parameters give their individual information. The data has been collected from 2012 to 2015.

Fig.2. Snapshot of the dataset

A snapshot of the dataset used figure 3 contains five attributes: Year, Cause, Gender, Age group and mortality. The ‘Year’ attribute describes the sampling year and other parameters give their individual information. The data has been collected from 2004 to 2015.

Fig.3. Snapshot of the dataset

A snapshot of the dataset used figure 4 contains eleven attributes: Season, NO, NO2, TOULENE, O3 etc. The ‘Season’ attribute describes the season of the year i.e. summer and other parameters give their individual values in different days of summer.

Fig.4. Snapshot of the dataset

A snapshot of the dataset used figure 5 contains eleven attributes: Season, NO, NO2, TOULENE, O3 etc. The ‘Season’ attribute describes the season of the year i.e. winter and

other parameters give their individual values in different days of winter.

Fig.5. Snapshot of the dataset

A snapshot of the dataset used figure 6 contains eleven attributes: Season, NO, NO2, TOULENE, O3 etc. The ‘Season’ attribute describes the season of the year and other parameters give their individual values in different days of summer & winter.

Fig.6. Snapshot of the dataset

3.2 Proposed approach

A systematic approach has been followed in this analysis which is depicted in figure 4.4. The approach starts with the collection of dataset from Kaggle [15]. Collected data has been pre processed to remove the redundancy. Pre processing of data includes steps like parsing of years, cleaning and training. Further, Correlation analysis has been carried out using python libraries and then the data is analyzed.

(Collection of data)

(Data Pre Processing)

(Data Analysis)

(Correlation Analysis)

(Scatter Plot) (Correlation Matrix)

(Result)

Fig 7: Flowchart of proposed approach

[bookmark: _Toc511806198]3.3 Methods and Techniques involved

1. Correlation analysis has been used in the study to correlate the basic characteristics of data. We have used Pearson-type correlation.

2. Classification analysis is a supervised learning approach in which the computer program learns from the data input given to it and then uses this learning to classify new observation. We have used KNeighborsClassifier

4. Results

Fig 8: Correlation Matrix of various diseases vs. pollution

Fig. 9: Correlation Matrix of Circulatory & Respiratory vs. pollution

Fig. 10: Correlation Matrix of Age specific, Probability of dying and Expectation of life vs.

pollution

Fig. 11: Prediction of season (summer) based on test values given

Fig. 12: Prediction of season(winter) based on test values given

5. Conclusion and Future Scope

The agenda of this study is to use technology for creating awareness to decrease pollution by adopting proper measures. New Delhi, which has already been ranked among the world's most polluted city, is considered in the study. This study focused on the implementation of correlation analysis, data mining techniques to fathom the different patterns in various types of particles in air. Python Libraries have been used for analyzing using Python language.

From correlation matrix of different diseases vs. pollution and circulatory & respiratory vs. pollution it can be concluded that there is a negative relationship of SPM with mortality rate i.e. with increase in SPM in air, mortality rate also increases. Also RSPM, NO2 & PM2.5 also had negative relationship on mortality i.e. with increase in value of RSPM, NO2 & PM2.5 the mortality of children between age groups 0 & 5 also increases.

From correlation matrix of probability of dying, expectation of life and age specific death rate vs. pollution it can be concluded that there is positive linear relationship between SPM, RSPM, NO2 and PM2.5 and mortality rate.

Future Work will be the study of morbidity. In this report we have studied the morality of infants. Further we will study the morality rate in adults.

Increase in PM10, PM2.5 can be attributed to kerb-side dust and construction work. The aggrandisement in the pollutants composition contributes much in delhi's pollution during the winters due to the burning of the crop stubble in the adjacent states. More stringent pollution control measures are required with public-policymakers participation. Emphasis to explore clean energy fuels and gradually phasing out fossil fuels, employing zero waste technology with integrated waste management will curb air pollution menace in due course.

References

1. Statistical Abstract (2016) Delhi Govt Portal, www.delhi.gov.in.
2. Cohen, Aaron J, Brauer, Michael et al. (2017) "Estimates and 25-year trends of the global burden of disease attributable to ambient air pollution: an analysis of data from the Global Burden of Diseases Study", The Lancet389 (10082): 1907-1908.
3. Rizwan SA, Nongkynrih B, Gupta SK. (2013) "Air pollution in Delhi: Its Magnitude and effects on health." Indian J Community Med38 (1):4-8.
4. Dr. Nidhi Sharma, Shweta Taneja ,Vaishali Sagar, Arshita Bhatt"Forecasting air pollution load in Delhi using data analysis tools" July 2018
5. Marilena Kampa, Elias Castanas "Human health effects of air pollution" 10 June 2007.
6. Realtime ambient air quality data of delhi, DPCC link:http://dpccairdata.com/dpccairdata/display.
7. Maureen L. Cropper, Nathalie B. Simon, Anna Alberini, and P.K. Sharma "The Health

Effects of Air Pollution in Delhi, India”
8. Sanjoy Maji, Sirajuddin Ahmed and Weqar Ahmad Siddiqui “Air quality assessment and its relation to potential health impacts in Delhi, India”.
9. Keiko Hirota, Shogo Sakamoto, Satoshi Shibuya and Shigeru Kashima, “A Methodology of Health Effects Estimation from Air Pollution in Large Asian Cities”
10. C.Arden Pope, Michael J. Thun, Mohan M. Namboodiri, Douglas E. Dockery, John S. Evans, Frank E. Speizer and Clark W. Heath “Particulate Air Pollution as a Predirtor of Mortality in a Prospertive Study of u.S. Adults”.
11. Akindato Olanrewaju Ogubayo “ Retrospective Study of Effects of Air Pollution in Human Health.” , May 2016
12. B.R. Gurjar, J.A. van Aardenne, J. Lelieveld, M. Mohan, “Emission estimates and trends (1990–2000) for megacity Delhi and implications”
13. Ping-Wei Soh, Kai-Hsiang Chen, Jen-Wei Huang, Hone-Jay Chu, “Spatial-temporal Pattern Analysis and Prediction of Air Quality in Taiwan”
14. Python (2017) [Online] Available at: https://www.python.org/
15. Data for pollution available from link: https://www.kaggle.com/
16. Data for pollution available from link: https://www.cpcb.com/