

Air Pollution and Climate Change: Case Study National Capital Territory of Delhi

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Abstract: The Ambient Air Pollution problem in National Capital Territory of Delhi is increasing at an alarming rate due to various anthropogenic activities and natural calamities; which significantly change the climatic condition and adversely influence the environmental condition. The study is conducted by statistical analysis for pollution profile of various parameters such particulate matter, nitrogen oxide, sulphur dioxide and carbon monoxide; by analyzing the these parameters particulate matter and nitrogen dioxide are not within the permissible limit due to various urban and rural activities in and around the National Capital whereas sulphur dioxide and carbon monoxide are within the permissible limits, but if the current scenario of pollution will not stop then our National Capital will be going to face many Climatic problems in future. The study also discusses the various rules and policies adopted by the Government of India, National Green Tribunal and Government of Delhi to tackle the air pollution and improve the air quality of National Capital Delhi.

Keywords: Air Pollution, Climate Change, Greenhouse Gases, Particulate Matter.

1 INTRODUCTION

IN India, pollution has become a great topic of debate at all levels and especially the "Air Pollution" because of the enhanced anthropogenic activities such as burning of fossil fuels, i.e. natural gas, coal, and oil to power, industrial processes and motor vehicles. Among the harmful chemical compounds, this burning puts into the atmosphere as carbon dioxide, carbon monoxide, nitrogen oxide, sulphur dioxide and tiny solid particles-including lead from gasoline additives called particulates. National Capital Territory of Delhi, the capital of India is sixth most polluted city in the world (World Health Organization, 2016) with approximately 25 million population and millions of people comes to Delhi every day for work and crosses Delhi every day to their work places.

2 AIR POLLUTION PROBLEM IN DELHI

Air pollution is a complex problem as it contains so many known and unknown parameters. The pollutants are added to the environment through various known and unknown natural processes as well as anthropogenic sources viz. industrial process, auto exhaust and domestic sources. According to the White paper on the pollution prepared by the Ministry of Environment and Forest and Climate Change (MOEFCC), Government of India, the ambient air quality of Delhi shows very high values of suspended solid particles which have been beyond the permissible limits from last several years continuously.

At all monitoring stations setup by the Central Pollution Control Board (CPCB), the concentration of nitrogen oxide (NO_x) and particulate matter (PM) have been found to be consistently much higher than permissible limits.

As things stand, air pollution in the city is largely due to vehicles. Delhi now has more vehicles than Mumbai, Chennai, and Kolkata put together (Goyal, 2003). Industries have also been targeted for tackling air pollution in Delhi. After tackling the issues of industries described as 'hazardous', Supreme Court of India directed the Delhi Pollution Control Committee (DPCC) to draw a list of industries that were setup in the areas categorized as 'non-conforming' and residential areas. The DPCC submitted its list of 97,600 industries before the court in 1977. The court directed Delhi government to either shift them to an alternative site or close them down. In addition to shifting of industries, a combination of setting up individual Effluent Treatment Plants (ETP), methods of control pollution at different levels of production, fiscal measure have been followed in the industrial units. The CPCB pointed out that the three main thermal power plants uses electrostatic precipitators. The emissions are controlled. There might be a bit of particulate matter and oxides of sulphur that release into the air but the problem of pollution from thermal power plants is not acute. Industrial emissions too are not alarming, CPCB claims. Delhi does have any big industry. Of course, there are about a lakh of small-scale industries. The emission levels of these industries however, are not much of a problem (Suthirto, 2002). It is the vehicular pollution both diesel and well petrol-induced which continues to be the major problem for the capital, which has the highest number of automobiles in the country (Goyal, 2003). Other major source of pollution in Delhi is burning of crops in Haryana, Punjab and Uttar Pradesh and particulate matter due to construction activities. In winters, Delhi faces Great Smog because of burning of crop in Haryana, Punjab and Haryana, which causes 12-60% of Delhi air pollution. Farmer's burns rice stubbles at the end of the Kharif season before commencing

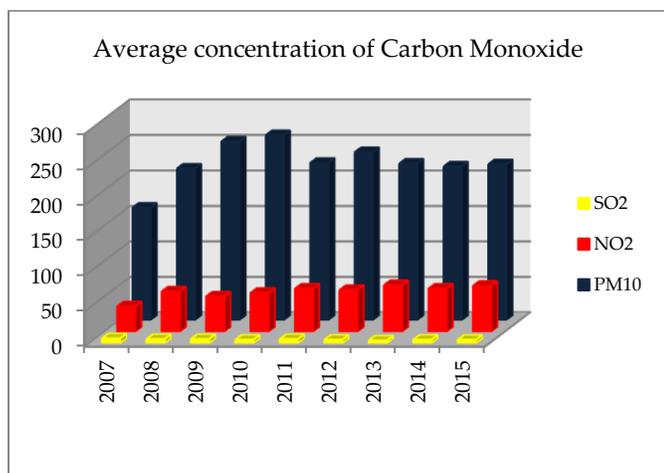
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the planting of crops for Rabi season. The wind directs the smoke towards Delhi and worsens the already polluted atmosphere air. With the number of vehicles, especially two wheelers increasing at an unprecedented rate, vehicular pollution has become major contributor to deteriorating air quality in Delhi. According to the White paper (MOEFCC), vehicular pollution contributes to 64% of the total pollution in Delhi in 1991 and 70% in 2000-2001.

In view of the above discussion, it is necessary to define the status of ambient air quality due to the presence of different pollutants in the air environment of Delhi. The different organizations e.g. Central Pollution Control Board (CPCB), National Environmental Engineering Research Institute (NEERI), The Energy Research Institute (TERI) have been monitoring the ambient air quality at various locations in Delhi measuring levels of sulphur dioxide (SO₂), nitrogen oxide (NO_x), lead (Pb), ozone (O₃), carbon monoxide (CO) and particulates matter. The atmospheric concentrations of air pollutants show a high trend. The monitoring stations of CPCB, which are monitored regularly, are located at Ashok Vihar, Mayapuri Industrial areas- Shazadabad, Siri Fort, Janakpuri, Nizamuddin and Shahdara are shown below:

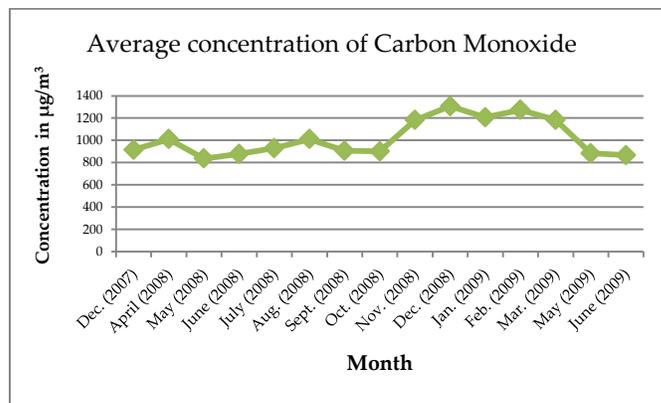


Figure1: Location of air quality monitoring stations by CPCB



Source: CPCB

Figure2: Average Concentration of SO₂, NO₂ and Particulate Matter in NCT of Delhi



Source: CPCB

Figure3: Average Concentration of Carbon Monoxide in NCT of Delhi

A detailed analysis of monitored ambient air quality data gives the status of air quality of Delhi, which as follows:

- NO₂ remain quite high near traffic intersections during peak traffic hours (morning and evening).
- SO₂ remains within the permissible limit.
- Particulate matter usually exceeds the permissible limit mainly due to natural dust, vehicular emissions, burning of crops and partly due to emissions from power plants and other industries. PM problem is more acute during summer period to natural disturbance in atmosphere.
- In general, one can see that air pollution level is high during winter month and create 'winter syndrome' due to low temperature, low mixing depth, pollution inversion and high traffic density.

Table 1: Emissions Norms for cars per kilometer

Stages	CO (gm/km)	HC+NO _x (gm/km)
1991 Norms	14.3-27.1	2.0 (onlyHC)
1996 Norms	8.68-12.40	3.00-4.36
1998 Norms	4.34-6.20	1.50-2.18
India Stage 2000 Norms	2.72	0.97
BS-II	2.2	0.5
BS-III	2.3	0.35
BS-IV	1.0	0.18

Source: CPCB

Table 2: Emissions Norms for Heavy Diesel Vehicles

Stages	CO (gm/kmhr)	HC (gm/kmhr)	NO _x (gm/kmhr)	PM (gm/kmhr)
1991 Norms	14	3.5	18	-
1996 Norms	11.2	2.4	14.4	-

India Stage 2000 Norms	4.5	1.1	8.0	0.36
BS-II	4.0	1.1	7.0	0.15
BS-III	2.1	1.6	5.0	0.10
BS-IV	1.5	0.96	3.50	0.02

Source: CPCB

Table 3: BS-VI Norms for Diesel and Petrol Vehicles

Pollutants	Diesel	Petrol
CO	0.50	1.00
NOx	0.080	0.060
PM	0.005	0.005

Source: CPCB

In view of seriousness of air pollution, many rules and policies are implemented like pollution certificate; polluter pays principle, no-entry of commercial vehicles during peak hours and odd- even rules; all these are described below:

- First, the “Pollution Certificate” which is applicable in all over the India. The main reason to implement this is to check whether the vehicle emissions are within the permissible limit or not. However, the point is that is it really works? Actually, this policy does not work properly because from where we get the pollution certificate they give the certificate without checking the vehicles. Therefore, people take the certificate to avoid the penalty, which is Rs. 5000 in Delhi.
- Second, to improve the air quality of Delhi is “converting all the DTC, private buses and three-wheelers to CNG” (Hindustan Time, 29 July, 1998). The Supreme Court of India passed a rule on 1998 that all the DTC, private buses and three-wheelers which run on diesel should be converted to CNG. The reason behind that is ‘CNG is cleaner fuel than diesel’.
- Third policy adopted is “No-entry of commercial vehicles during the peak hours” under this all the vehicles within the Delhi or coming to Delhi or going from Delhi should not run on roads during the peak hours (in morning from 8:00 am to 11:00 am and in evening 5:00 pm to 9:00 pm) to decrease the traffic load so that there is no traffic congestion and consequently traffic will move gradually.
- Fifth, is “Banning of 10 years-old diesel vehicles”, by the order of Supreme Court of India in 2015, all the diesel vehicles which are older than 2006 should not be allowed in Delhi. As diesel vehicles emits more particulate matter emissions than any other fuels.
- Sixth, is “Odd-Even rule” which was applied to limited number of cars on the roads to avoid the road congestion and air pollution in National Capital, this

rule is not effective as there is many loop holes in this like vehicles which are driving by women and senior citizen are exempted from this rule and if school children are sitting in the vehicles then that vehicles are exempted and last CNG vehicles are also exempted from this rule.

- Seventh, is “Ban on new registration of diesel vehicles of 2000cc and above till March 31, 2016”. This order is given by the Supreme Court of India in 2015, the reason behind this is to improve the air quality of Delhi because SUVs are generally used by more affluent sections of our society and because of the higher engine capacity, they are more prone to cause higher levels of pollution.
- Last one is introduction of BS-VI fuel in Delhi with a leap of BS-V to control the emissions from vehicular exhaust. As the emission from BS-VI is much better than BS-V.

3 CLIMATE CHANGE AND AIR POLLUTION

Climate change and air pollution are closely coupled. Just as air pollution, having adverse effects on human health and ecosystems, it can also influence the Earth’s climate. When energy from the sun reaches the Earth, the planet absorbs some energy and radiates rest back to space as heat. The Earth’s surface temperature depends on this balance between incoming and outgoing energy. Atmospheric greenhouse gases like carbon dioxide and methane can trap this energy and prevent the heat from escaping.

4 CLIMATE IMPACTS OF AIR POLLUTION

Conventional air pollutants such as ozone and particle pollution can also contribute to climate change as ozone and particle pollution stay in the atmosphere for only few days or weeks which reducing these emissions and help reduce climate impact in the near term.

Ozone is a significant contributor to climate warming. The climate impact of ozone are greatest when the ozone is located in the upper part of the atmosphere and its concentration in this part, sometimes referred to as “Global Background Ozone” which is determined by worldwide emissions of methane (CH₄), CO, NO_x, and VOCs as well as by natural processes like lightning and transport from the stratosphere.

Particle pollution can also have significant impacts on climate, both directly and indirectly. The direct effects come from particle ability to absorb and scatter light. Different types of particles have different impacts on climate: some warm (e.g. black carbon); others cool (e.g. sulphate and nitrates). Black carbon, a component of soot particles contributes to global warming by absorbing sunlight, there by heating the atmosphere. Particle pollution can also have important indirect effects on climate for example; particles

can change the reflectivity of clouds, which is an indirect influence of cloud lifetime and precipitation.

The net effect for all particles in the atmosphere is cooling because scattering generally dominates though effects can vary dramatically by region (Forster et.al, 2007). While the health benefits of reducing all types of emissions that contributing to particle pollution are relatively clear. The net impact of emissions reduction strategies will depend on the relative reduction in particles of different types.

In general, combustion is the chief contributor to air pollution and greenhouse gas emission. In most cities, the major source of combustion is fuel use, which tends to increase along with population size and economic activity. The major source sectors for GHG emission in Delhi include road transport, thermal power plants, domestic, commercial, industries and landfill sites. CO₂ emission in Delhi from road transport is 7.66 million tons. CH₄ emission in Delhi from road transport is 2.26 Kilo tons in which CNG contribute 56% (Ghosh, 2009).

5 CONCLUSION

By analyzing the air quality of Delhi, the main pollutants are particulate matter and nitrogen oxide; whereas the other pollutants such as sulphur dioxide, carbon monoxide, and ozone are within the permissible limits. The pollution level is increasing at an alarming rate and if this trend remains constant then, Delhi has to face many climatic problems because of higher concentration of PM and NO_x which on react with other pollutants leads to forming of more harmful pollutants like O₃ (Ozone) which is formed due to the presence of CO, NO_x, VOCs and CH₄ (originates from CNG and landfill sites).

Particulate matter concentration in Delhi is three times higher than the permissible limit due to this there is an urban-haze or rural smoke and ultimately become trans-regional and trans-continental plumes consisting of sulphate, nitrogen and hundreds of organics, black carbon (Ramanathan, 2009).

Particulate matter have the tendency to reflect back the sunlight to space before it reaches the surface and thus contribute to a cooling of the surface. Particulate matter enhances scattering and absorption of solar radiation and produce brighter clouds that are less efficient at releasing precipitation. These in turn lead to large reduction in the amount of solar radiations that reaches Earth's surface and a corresponding increase in atmospheric solar heating, changes in atmospheric thermal structure, surface cooling, disruption of regional circulation system such as monsoon, suppression and less efficient removal of pollutants.

Due to the presence of black carbon, Delhi already faces the dimming effects (Ramanathan, and Carmichael, 2008). In addition, due to this reason man-made aerosols (particulate matter, black carbon, sulphate and organics) have dimmed the surface of the planet, while making it brighter at the top of the atmosphere. To mitigate the

climate change problem in Delhi we need to control the activities in the National Capital Region (NCR) like channelizing the vehicular movement, stop the burning of crop residue, last but not least control the industrial pollution.

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