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COMPARATIVE STUDY OF POLLUTION LEVEL IN THREE MEGACITIES OF INDIA (2015-2019)

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ABSTRACT

The study is about the present and future concentration level of air pollutants in Indian cities. Some of the cities selected from different parts of India based on some parameters. The major pollutants taken for the study are NO2, SO2 and PM10. It is a simple study about present concentration and expected concentration in near future as well. The study is based on absolutely secondary data sources. Data analysis part has done with the help of statistical methods. The study aimed at to explore present and future trend of the pollutants in Delhi, Kolkata and Chennai for the period of 2015 to 2019. It is also representing the relation between pollutants. Finally the predictive studies of pollutants have been calculated for all the selected cities and a conclusion is drawn based on all studies on pollutants of these selected cities.

KEY WORDS: Pollution, Concentration, Air Quality

INTRODUCTION

Oxford dictionary defines *pollutants* as a substance that pollutes, or make an area or substance, or earth dirty or harmful to people, animals and plants. Another definition of air pollution is an imbalance in the quality of air(Saxena, 2017). According to *The Air (Prevention and Control of Pollution) Act, 1981*, "Air pollution is the presence of any solid, liquid, or gaseous substances in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or property or environment". Hence pollutants are hardly part of the nature naturally and they have negative impact in short term as well as in long term. Major air pollutants are SO_2, NO_2 and PM_{10}. Indian cities, specifically the mega cites are over populated, experiencing traffic congestion, with depleting green part. The changing rate of concentration of pollutants and the impartial negative impacts are increasing beyond the expected level of change. So, it is very significant to analyse the present scenario of pollutants and expected level concentration of these pollutants in future.

Study Area: Some megacities of India have been selected for the study. They have been selected based on some parameters, i.e. total population, percentage of urban Population, pollution level etc. The Delhi is being selected from north of India. For past few decades Delhi is designated as most polluted city in India hence it has been selected to study the facts about it. The second one is Kolkata from the eastern part of India and from south Chennai has been selected. Some sub stations have been selected within each station. For Delhi eight sub-stations have been selected. In Kolkata six sub-stations included for the study and for Chennai it is nine sub-stations.

Methodology: The entire work is based on secondary data collected from the CPCB, India. The data collected for each sub-station of Delhi, Kolkata and Chennai. Then the data have been analysed by statistical methods like linear and multi variable regression analysis. The time period of analysis is from 2015 to 2019. The predictive analysis is taken for coming 30 years of period (till 2050).

Pollution Level in Some Selected Cities of India: The analysis begins with some emphasis given on the trend of average concentration of pollutants

within the specified 5 years period. Assuming the sample mean (Harris, 2013) will represent centrality of d The concentration level of PM_{10} (Fig. 1) is quite above the break point of the pollutant (CPCB) in Delhi though it is declining in every year in comparison to the past years. It is towards the poor condition in Delhi but improving gradually. While the concentration level of the same pollutant is in negligible level in Chennai. Kolkata having a concentration of the same pollutant in such an amount throughout the five years period that it is in satisfactory level. The average concentration of NO_2(Fig.2) is in satisfactory level in Delhi where it is not bad in Chennai and in Kolkata. For the average concentration of SO_2, there is a increasing trend in Kolkata (Fig. 3) where as it has decreasing trend in Delhi and in Chennai. Hence in overall analysis two pollutants; NO_2 and PM_{10} are decreasing in all three cities though there are more fluctuation of average concentration in different years. It means the volatile nature in the concentration may be the result of other factors. The concentration level of PM10 is quite surprising as the mean average level is

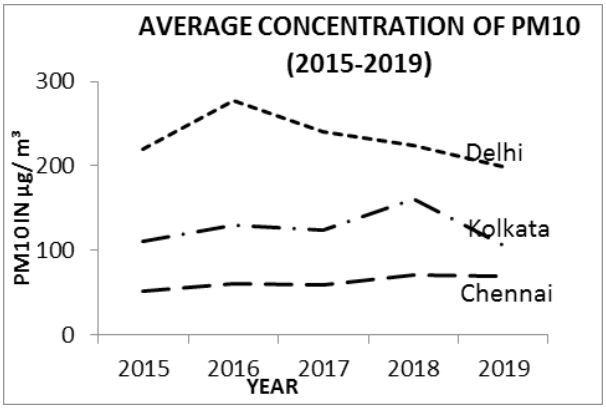

Fig. 1.

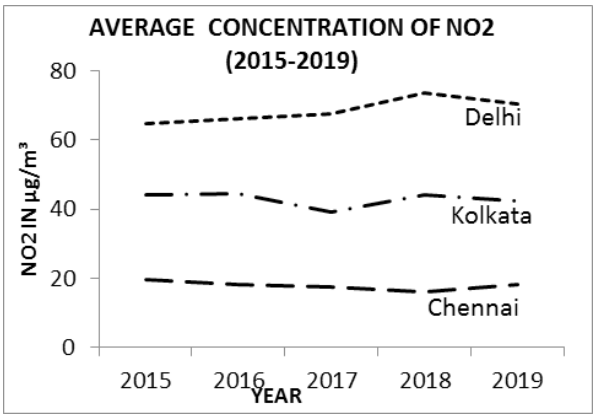

Fig. 2

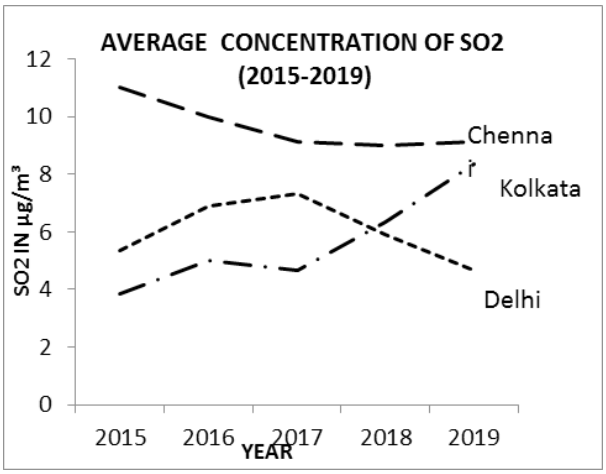

Fig. 3.

noticeable Delhi. Among all the cities Chennai seems to be less polluted city whereas Delhi appears as a hub of pollution. The pollution level of NO_2, SO_2 and PM_{10} moderate to high in Delhi as illustrated, yet it is almost going in the same stage like Kolkata, If the comparison is drawn based on concentration in percentage among specified pollutants, the PM_{10} concentration increasing in much faster rate than others. In Delhi there is a negative correlation between PM_{10} and NO_2 concentration whereas in Kolkata there is a sharp positive relation between these variables. It is a normal probability distribution but it is negatively skewed in Delhi and positively skewed in Chennai. All studies showing that both the variables are strongly related. An inference can be drawn out of this correlation regression analysis which implies that there is an association (Hammond and McCullagh, 1978) is that somehow the PM_{10} is

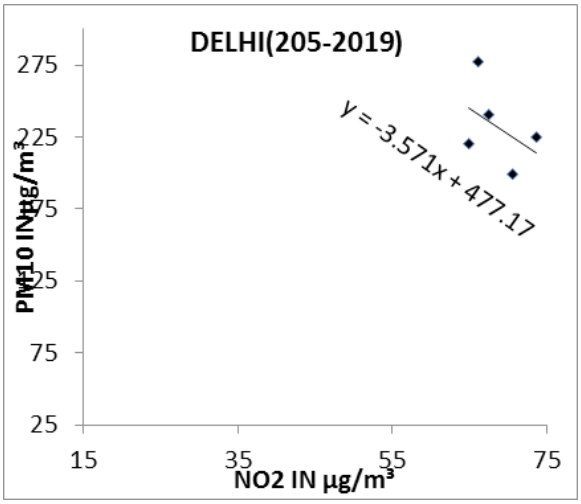

Fig. 4

increasing or decreasing with the increasing concentration of NO_2. Both the pollutants are quite harmful and both of them having common source of origin. The predicted values have been calculated for the PM_{10} and NO_2 as these two pollutants seem to be more constant in their concentration at higher level than SO_2. In Fig. 7 it is illustrated that the predicted change in concentration of PM_{10} surprisingly declined at the present rate of declination. Though the rate increasing in Chennai as well as in Kolkata. The change is sharper in Chennai but mild in Kolkata. The prediction period is from 2020 to 2050. During this phase the expected concentration level of NO2 has been changed drastically in Delhi (Fig. 8).

The Multi Variable Analysis (PM_{10}, NO_2, SO_2) Delhi: For the Multi variable regression study here the PM_{10} considered as dependent variable whereas the amount of NO_2 and SO_2 are considered as the independent variable. Though for the sake of the analysis it has been considered as dependent and independent yet they can be treated individually. It is a predictive analysis for the future level of pollutants.The analysis reveals that the predicted level of NO_2 has been in negligible amount in

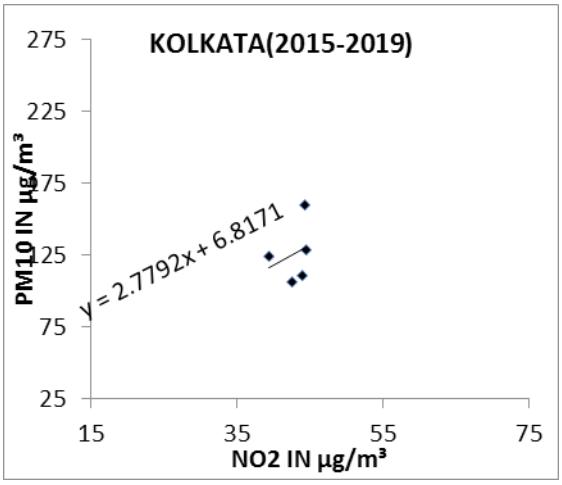

Fig. 5

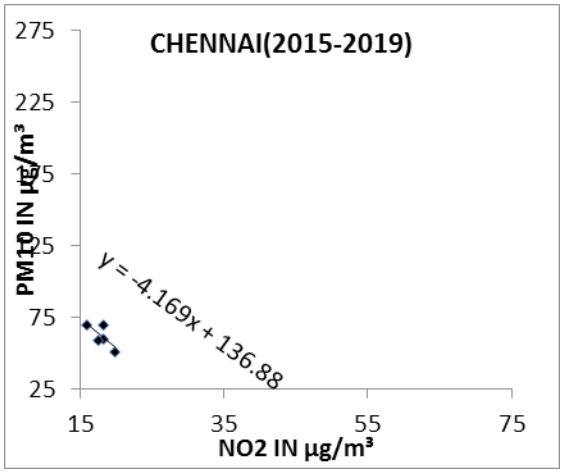

Fig. 6

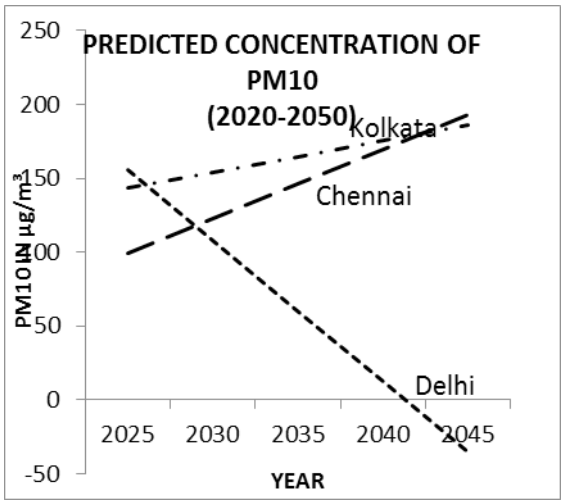

Fig. 7

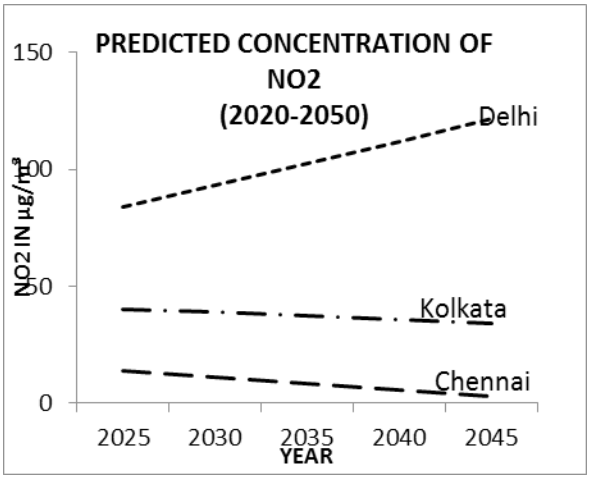

Fig. 8

Table 1. Multivariable analysis for Delhi station

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	203.7988534	56.15076721	3.629494	0.02217	47.89933067	359.698376	47.8993307	359.698376
6	6.98268156	9.679273491	0.721406	0.510575	-19.8912899	33.8566531	-19.8912899	33.8566531
91.2	0.030334226	0.269054939	0.112744	0.915665	-0.71668204	0.7773505	-0.71668204	0.7773505

Table 2. Multivariable analysis result of Kolkata station

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-38.67721069	14.08984209	-2.7450422	0.111039	-99.3009	21.94649	-99.3009	21.94648685
4.2	-2.486148025	2.565619252	-0.9690245	0.434758	-13.5251	8.552821	-13.5251	8.552820653
37.2	4.172305059	0.658841484	6.33279045	0.02404	1.337539	7.007071	1.337539	7.007071169

Table 3. Multivariable analysis result of Chennai station

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-46.64086905	38.62586077	-1.2075	0.281236	-145.931805	52.650067	-145.931805	52.650067
13.4	2.139564935	1.097855705	1.948858	0.108829	-0.682563	4.96169287	-0.682563	4.96169287
16	4.94021184	1.929967773	2.559738	0.050663	-0.02092826	9.90135194	-0.02092826	9.90135194

Chennai where as in Delhi it is quite high even far above the average concentration level for at least a satisfactory level (Table 1). With Reference to the AQI table given by CPCB and the Break point of pollutants, it is a matter of concern that for next coming 50 years of period or more than that the level of pollutants will determine ambient air quality. The intercept, coefficient values and the P-values of three variables viz PM_{10}, NO_2 and SO_2 are explained in the table. The predicted values of these three can be drawn by the intercept and two other variables. The standard error as well as the t-stat explains the relationship. The P-values of Kolkata; (Table 2). The Multi variable analysis for Kolkata has been dawn based on same dependent variable and independent variable for Kolkata. The amount of NO_2 and SO_2 are considered as the independent variable. The study considers the strength of the relation and accurate predictions based on regression (Ebdon, 1985).

Chennai: The intercept, coefficient values and the P-values of three variable viz PM_{10}, NO_2 and SO_2 are analysed and explained in the Table 3 for Chennai also. The multivariate regression analysis also done for this location based on same aspect like Delhi and Kolkata, the intercept, coefficient values and the P-values of three variable viz PM_{10}, NO_2 and SO_2 are also analysed for Chennai station in the above table. The P-values for the third factor can be rejected only.

CONCLUSION

A number of factors came out of the entire analysis; the trend of the pollutants for most of the cases is increasing. If some of them are decreasing, then it may be contributed to some good projects for clean environment. This conclusion can be drawn as none of the economic activities is not going to shut down but only can cut down the pollution level at present and future also. So it is contributed to some green technologies or to some environment friendly projects. Another aspect of the study is that there are some untold story about the relationship among variables of the same place. Though each pollutants have their own role to play in the degraded air quality but still they are together creating a more harmful ambient air to inhale.

Conflict of Interest - None

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