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SUPREME COURT BANS CRACKERS: JUDICIAL ACTIVISM AND IMPACT ON DELHI AIR POLLUTION USING TREND ANALYSIS

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ABSTRACT: One of the prime concerns of all the growing economies around the globe is a environmental hazard. Due to the trends of industrialization and globalization, every economy is facing the challenges of increasing pollutants concentration in their natural environment and India is no exception. The capital of the country is having the worse levels of pollutants in its air making it dangerous for human habitation. This has been further brought into limelight recently towards 2017-year end, when the city experienced worst levels of air pollution, popularly called as the Great Smog of Delhi. All the stakeholders have been taking measures from time to time to control the emissions of pollutants but their effectiveness is still questionable. This paper concentrates on the case study of impact of banning of firecrackers by Supreme Court of India around Diwali period. This is evaluates by using trend analysis technique on last 12 years' concentration of SO_2 , NO_2 and PM10 for three major locations of Delhi.

Key words: Air pollution, Delhi, Trend Analysis, Air Quality index (AQI), Judicial Activism, Firecrackers, PM 10, NO2, SO2, Environmental Hazards

I. INTRODUCTION

In today's era, air pollution is one of the prime concerns for all developed and developing economies throughout the world. India has also seen tremendous growth in last few years thanks to technology, industrialization; inter country trade, globalization and urbanization. But all these have also resulted in environment degradation particularly of basic life necessities like air and water. With huge amount of unrestricted and unfiltered emissions from industries, vehicles, power plants and burning of crops and crackers, our country is having worst levels of air quality and recent example of this was seen in November 2017, popularly known as Great Smog of Delhi..

All the stakeholders are taking necessary steps to curb the increasing levels of air pollutants particularly in the capital region of India. One such major initiative, which caught the headlines, was the ban on firecrackers across the nation to control the air damage during the Diwali festival. Diwali, the festival of lights is celebrated with great enthusiasm throughout the country as per the Hindu lunar calendar in the month of October or November. On one hand, it brings festivities in every home and on the other, it ruins the progress made by different authorities to control air pollution. The concerned authorities have been trying continuously to curb the damage caused particularly during Diwali by burning of crackers. From the last few years, many measures were taken and citizens were made aware about the ill effects of crackers on the environment.

Judicial Activism in Air pollution Control

According to the *Black's Law Dictionary*, judicial activism is defined as "philosophy of judicial decision-making whereby judges allow their personal views about public policy, among other factors, to guide their decisions."

In simpler terms, it represents a scenario where judiciary acts as policy makers. The judges can revise or direct policies for general public benefits. Recent examples of this phenomenon were seen regarding burning of firecrackers during Diwali. Supreme Court of India has been taking strict decisions to curb the damage the caused by firecrackers.

On November 11 2016, Supreme Court passed the decision to ban the use of fire crackers considering the adverse situation of Delhi Air pollution post Diwali. For *I.A. NO.4 IN WRIT PETITION (CIVIL) No.728 OF 2015*, petition filed by ARJUN GOPAL AND ORS versus UNION OF INDIA & ORS., it stated to , "Suspend all such licenses as permit sale of fireworks, wholesale and retail within the territory of NCR".

For the same petition, *I.A. No. 52448 of 2017 IN WRIT PETITION (CIVIL) NO. 728 of 2015*, the justice stated on September 12, 2017 "Keeping in mind the adverse effects of air pollution, the human right to breathe clean

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air and the human right to health, the Central Government and other authorities should consider encouraging display fireworks through community participation rather than individual bursting of fireworks."

The above was revisited on OCTOBER 09, 2017, for *IA NO. 92862 OF 2017 IN WRIT PETITION (CIVIL) NO. 728 OF 2015.* Considering the past observations of post Diwali period, the judgment concluded "we are of the opinion that the judgment dated September 12, 2017 passed by this Court should be made effective only from November 01, 2017."

A benchmark judgment was passed by the Apex court on OCTOBER 23, 2018 with *IA NOS. 6 AND 8 OF 2016 IA NOS. 10, 11, 80176, 96202, 109668, 109720 AND 122778 OF 2017 IA NOS. 68888 AND 68897 OF 2018 IN WRIT PETITION (CIVIL) NO. 728 OF 2015*. The court did not totally ban the manufacture and sale of fire crackers but imposed restrictions. The major decision stated "On Diwali days or on any other festivals like Gurpurab etc., when such fireworks generally take place, it would strictly be from 8:00 p.m. till 10:00 p.m. only. On Christmas eve and New Year eve, when such fireworks start around midnight, i.e. 12:00 a.m., it would be from 11:55 p.m. till 12:30 a.m. only"

Impact of Supreme Court decisions on Air Pollution in Delhi

Authorities have been taking measures from time to time to curb the alarming level of air pollutants in Delhi. However, how far these measures are helping in improving the air quality in the area is still a debatable issue. To analyze the effect of the recent restrictions on burning of firecrackers, a trend analysis is done from 2007 to 2016 for three major pollutants, SO_2, NO_2 and PM_{10} for three prime Delhi locations B.S.Z Marg (ITO), Pitampura and Janakpuri. From the trend analysis, expected values of 2017 and 2018 will be compared with the actual levels observed on Diwali day at these locations.

Analysis of SO_2 levels on Diwali day in Delhi locations

Sulfur dioxide is one of the major air pollutants causing numerous health issues throughout the world. This gas has a pungent smell and combines with other air constituents to form harmful compounds such as sulfuric acid which causes acid rain.

Major sources of SO_2 include emissions from industries, power plants and vehicles in Delhi area. It is emitted in large amount with burning of firecrackers as well. In addition to harming buildings with acid rain, this gas has harmful effects on human health too. It causes asthma, throat infection and breathing problems.

Delhi Locations	Diwali Day Data based on manual monitoring SO2 (µg/m3)											
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
B.S.Z Marg (ITO)	27	14	17	18	28	13	11	8	22	16	11	5
Pitampura	72	9	8	23	22	17	18	10	19	16	28	29
Janakpuri	113	24	42	51	40	63	56	32	18	45	43	44
Average	70.66667	15.66667	22.33333	30.66667	30	31	28.33333	16.66667	19.66667	25.66667	27.33333	26

Table 1: Diwali Day Data based on manual monitoring SO_2 (µg/m3) *Source*: Report on Ambient Air Quality & Noise on Deepawali 2007-2018, CENTRAL POLLUTION CONTROL BOARD

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Long term trend for SO2 level during Diwali Day						
Years	Deviation from median year (2011.5)	Step deviation (i)	X=Deviation from median year/i	SO2 levels (Y)	XY	X*X
2007	-4.5	0.5	-9	70.67	-636	81
2008	-3.5	0.5	-7	15.67	-109.7	49
2009	-2.5	0.5	-5	22.33	-111.7	25
2010	-1.5	0.5	-3	30.67	-92.01	9
2011	-0.5	0.5	-1	30	-30	1
2012	0.5	0.5	1	31	31	1
2013	1.5	0.5	3	28.33	84.99	9
2014	2.5	0.5	5	16.67	83.35	25
2015	3.5	0.5	7	19.67	137.69	49
2016	4.5	0.5	9	25.67	231.03	81
(N=10)	**Total**		0	290.68	-411.3	330

Table 2: Calculation of long term trend for SO_2 levels with 2011.5 as median year and .5 as step deviation

Comparison of original SO2 values and trend values of ten years			
Years	**X=Deviation from median year/i**	**Trend Value (Trend Equation = 29.068 - 1.246x)**	**Actual Data**
2017	11	15.362	27.33
2018	13	12.87	26

Table 3: Comparison of trend values with original data for SO_2 levels in 2017 and 2018

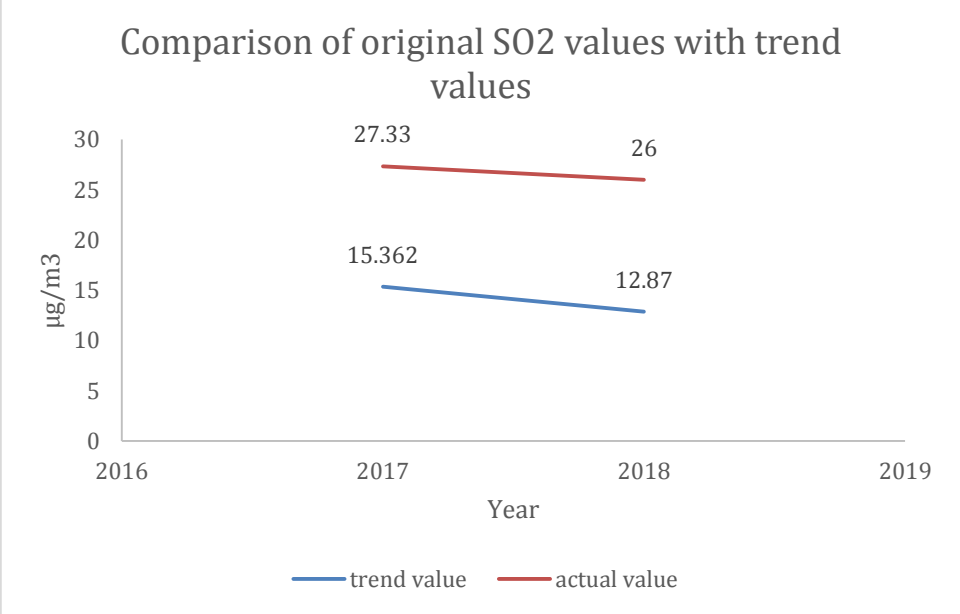

Chart 1: Comparison of trend values with original data for SO_2 levels in 2017 and 2018

Looking at the huge difference between the expected levels of SO_2 from the trend observed in ten years and the original values, we can clearly see that its concentration is still increasing at an exponential level. We can see some drop in concentration from the year 2017 to 2018 but it's still very minimal looking at the expected values.

Analysis of NO_2 levels on Diwali day in Delhi locations

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Nitrogen dioxide is one of the chief air pollutants across the globe. It becomes even more hazardous than the other pollutants after combining with compounds like ozone, SO_2, PPM , etc. to form acid rain. Chiefly the combustion processes in fossil fuels, vehicles and crackers produce it. It is released in the form of Nitric oxide, which then combines with atmospheric oxygen to form NO_2.

The gas itself has adverse effects on human health esp. for their respiratory systems. The compounds form by this gas with other atmospheric constituents for e.g. ozone; acid rain, etc. increase the scope of damage caused.

Delhi Locations	Diwali Day Data based on manual monitoring NO2 (µg/m3)											
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
B.S.Z Marg (ITO)	83	83	65	56	56	85	52	82	57	77	74	50
Pitampura	64	33	40	44	27	58	31	67	27	43	61	82
Janakpuri	91	81	32	43	31	69	35	53	25	65	73	73
Average	79.33	65.67	45.67	47.67	38.00	70.67	39.33	67.33	36.33	61.67	69.33	68.33

Table 4: Diwali Day Data based on manual monitoring NO_2 (µg/m3) *Source*: Report on Ambient Air Quality & Noise on Deepawali 2007-2018, CENTRAL POLLUTION CONTROL BOARD

Long term trend for NO2 level during Diwali Day						
Years	**Deviation from median year (2011.5)**	**Step deviation (i)**	**X=Deviation from median year/i**	**NO2 levels (Y)**	**XY**	**X*X**
2007	-4.5	0.5	-9	79.33	-713.97	81
2008	-3.5	0.5	-7	65.67	-459.69	49
2009	-2.5	0.5	-5	45.67	-228.35	25
2010	-1.5	0.5	-3	47.67	-143.01	9
2011	-0.5	0.5	-1	38	-38	1
2012	0.5	0.5	1	70.67	70.67	1
2013	1.5	0.5	3	39.33	117.99	9
2014	2.5	0.5	5	67.33	336.65	25
2015	3.5	0.5	7	36.33	254.31	49
2016	4.5	0.5	9	61.67	555.03	81
(N=10)	**Total**		0	551.67	-248.37	330

Table 5: Calculation of long-term trend for NO_2 levels with 2011.5 as median year and .5 as step deviation

Comparison of original NO_2 values and trend values of ten years			
Years	**X=Deviation from median year/i**	**Trend Value (Trend Equation = 55.167 - .752636x)**	**Actual Data**
2017	11	46.889	69.33
2018	13	45.383	68.33

Table 6: Comparison of trend values with original data for NO_2 levels in 2017 and 2018

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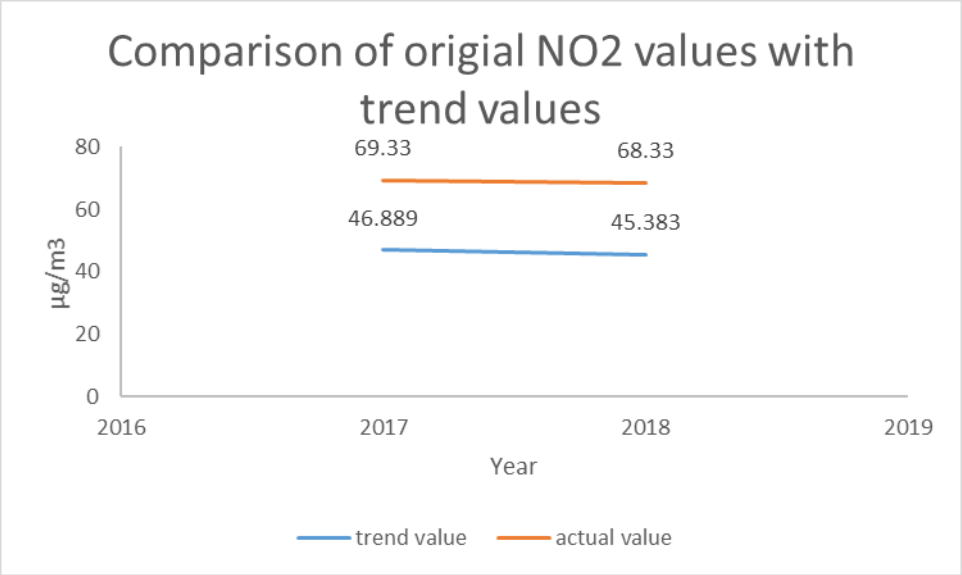

Chart 2: Comparison of trend values with original data for NO_2 levels in 2017 and 2018

From the above analysis, it is clearly visible that the observed values of NO_2 concentration in the Delhi areas are higher than the expected. From the trend analysis, it should be near 45 µg/m3 but it is around 68 µg/m3. But we cannot ignore the fact that the concentration did decrease from year 2017 to 2018, though by a very little difference.

Analysis of PM10 levels on Diwali day in Delhi locations

Particle matter is a blend of solid particle and liquid droplets, which float in the atmosphere. These particles may be directly released from source or created by chemical reactions of other atmospheric constituents. The size of these particles is very minute and varies in diameter ranging till 10 micrometer.

The particulates we are including in our study are of size 10 micrometers i.e. PM10. Apart from burning of firecrackers, these are created by industrial and agricultural activities like grinding, crushing, etc. and vehicular emissions. These particles have adverse effects on human health ranging from ENT infections and breathing problems.

Delhi Locations	Diwali Day Data based on manual monitoring RSPM/ PM10 (µg/m3)											
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
B.S.Z Marg (ITO)	670	578	478	1303	416	795	1097	442	531	878	438	470
Pitampura	1294	712	469	1350	428	776	952	756	460	1297	690	990
Janakpuri	1068	931	466	1100	441	951	969	648	554	902	706	1076
Average	1010.67	740.33	471.00	1251.00	428.33	840.67	1006.00	615.33	515.00	1025.67	611.33	845.33

Table 7: Diwali Day Data based on manual monitoring PM10 (µg/m3) *Source*: Report on Ambient Air Quality & Noise on Deepawali 2007-2018, CENTRAL POLLUTION CONTROL BOARD

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Long term trend for PM10 level during Diwali Day						
Years	**Deviation from median year (2011.5)**	**Step deviation (i)**	**X=Deviation from median year/i**	**PM10 levels (Y)**	**XY**	**X*X**
2007	-4.5	0.5	-9	1010.67	-9096.03	81
2008	-3.5	0.5	-7	740.33	-5182.31	49
2009	-2.5	0.5	-5	471	-2355	25
2010	-1.5	0.5	-3	1251	-3753	9
2011	-0.5	0.5	-1	428.33	-428.33	1
2012	0.5	0.5	1	840.67	840.67	1
2013	1.5	0.5	3	1006	3018	9
2014	2.5	0.5	5	615.33	3076.65	25
2015	3.5	0.5	7	515	3605	49
2016	4.5	0.5	9	1025.67	9231.03	81
(N=10)	**Total**		0	7904	-1043.32	330

Table 8: Calculation of long-term trend for PM10 levels with 2011.5 as median year and .5 as step deviation

Comparison of original PM10 values and trend values of ten years			
Years	**X=Deviation from median year/i**	**Trend Value (Trend Equation = 790.4 - 3.1616x)**	**Actual Data**
2017	11	755.6224	611.33
2018	13	749.2292	845.33

Table 9: Comparison of trend values with original data for PM10 levels in 2017 and 2018

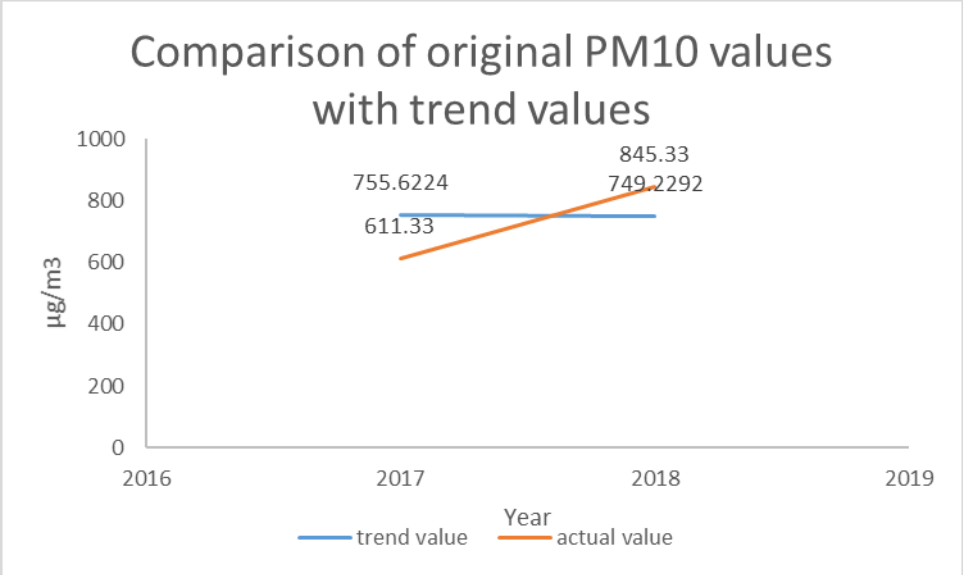

Chart 3: Comparison of trend values with original data for PM10 levels in 2017 and 2018

From the above calculations and data we can see that the observed value of PM10 concentration in 2017 in the Delhi areas is lower than the trend value but the case was reversed in 2018. The concentration showed steep

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increase from year 2017 to 2018, thus proving the fact that imposing ban on fire crackers cannot curb pollution on a larger scale. There are multiple other sources of air pollutants creations which should be studied in detail.

Conclusion

In Delhi, Air quality index (AQI) for most of the year (Jan to Sep) remains moderate i.e. in the range of 101-200 level but it deteriorates drastically in the remaining three months to lower levels of Very Poor (301-400), Severe (401-500) and Hazardous (500+) levels. Though the highlighted factor here is burning of crackers specifically around Diwali and New Year but couple of other factors like weather conditions, industrial and agricultural waste burnings and vehicular emissions. A recent case of worst air pollution was seen in November 2017, the Great Smog, which pressed the immediate need to take actions in this direction.

In a recent decision on March 12, 2019 headed by Justice SA Bobde, the apex of the country raised questions on the undue importance given only to firecrackers where other sources like emission from automobiles could be contributing more to the pollutant levels. The study here proves that even after regulating the burning of fire crackers not much improvement was seen in the pollutants level in Delhi. There are multiple factors contributing to the increased air pollution levels in the capital , thus actions should be concentrated to curb all of them rather than concentrating on one.

Appendices

Appendix 1 Calculation of trend for SO_2 levels

Trend analysis equation is $Yc = a + bx$
Where x is the Deviation from median year/i

For calculating values of a and b we use the following equations,
$\sum Y = Na + b \sum X$

From table 2,

$290.68 = (10*a) + b * 0$
$290.68 = 10a$
Hence, $a = 29.068$

$\sum XY = a \sum X + b \sum X^2$

From table 2,

$-411.3 = 29.068 * 0 + b * 330$
$b = -411.3/330$
Hence, $b = - 1.246$

Thus, $a = 29.068$ and $b = - 1.246$ and we get the following equation:
$Yc = 29.068 - 1.2464242x$

Putting these in table 3, we get the trend values for 2017 and 2018.

Appendix 2 Calculation of trend for NO_2 levels

Trend analysis equation is $Yc = a + bx$
Where x is the Deviation from median year/i

For calculating values of a and b we use the following equations,
$\sum Y = Na + b \sum X$

From table 5,

$551.67 = (10*a) + b * 0$
$551.67 = 10a$

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Hence, a = 55.167

$\sum XY = a \sum X + b \sum X^2$

From table 5,

-248.67 = 55.167* 0 + b * 330
b = -248.67 /330
Hence, b = - .752636

Thus, a = 55.167 and b = - .752636 and we get the following equation:
Yc = 55.167 - .752636x

Putting these in table 6, we get the trend values for 2017 and 2018.

Appendix 3 Calculation of trend for PM10 levels

Trend analysis equation is Yc = a + bx
Where x is the Deviation from median year/i

For calculating values of a and b we use the following equations,
$\sum Y = Na + b \sum X$

From table 8,

7904 = (10*a) + b * 0
7904= 10a
Hence, a = 790.4

$\sum XY = a \sum X + b \sum X^2$

From table 8,

-1043.32 = 790.4* 0 + b * 330
b = -1043.32 /330
Hence, b = - 3.1616

Thus, a = 790.4 and b = - 3.1616 and we get the following equation:
Yc = 790.4 - 3.1616x

Putting these in table 9, we get the trend values for 2017 and 2018.

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