ASSESSMENT FOR AIR POLLUTION FORECASTING IN DELHI-NCR

SUMIT RANA, DR. SHOBHA RAM
Research Scholar , Assistant professor, Gautam Buddha University

Abstract: Air pollution is becoming into a major health problem that influences a large number of people around the world. This paper is concerned about the improvement, support and employments of greater environment friendly system utilizing Air Pollution Forecasting. Air pollution estimating is the utilization of science and advancement to predict the bit of the environment for a given area and time. The forecast will give the Air Quality Index (AQI) status of Delhi. The estimate considers neighborhood emanation sources (like close-by traffic or industry) and remote sources (for example dust that is conveyed via air allocates pursues the breeze course). The conditions through Regression analysis estimate relationships between factors. By breaking down recorded informational indexes, affiliations are made between pollution levels and meteorological information factors. The outcome is a condition that can be utilized to gauge future pollution levels.
This investigation fundamentally manages the alternative system; particularly it bases on decrease of pollution in Delhi-NCR. The pollution loads were determined based on information gathered from the Central Pollution Control Board (CPCB), Environment Protection Agency and past investigations completed in such manner by different critical organizations. The examination utilized the multiple regressions on the information accessible through AQI data.

Key Words: **Air Pollution, Air Pollution Forecasting, Air Quality Index (AQI), Central Pollution Control Board (CPCB), Environment Protection Agency**

I. INTRODUCTION

Air pollution is in charge of numerous medical issues in the urban areas. The air pollution status in Delhi has experienced numerous adjustments as far as the levels of pollutants and the control estimates taken to reduce them. This paper gives the ways to deal with gauge Air Pollution and its effects on health.

As per World Health Organization (WHO) India positions among the world's most polluted countries. Out of the 20 most dirtied urban domains on earth, 13 are in India. In which, Delhi is the most polluted city on the world today.

II. NEEDS OF THE STUDY

Air pollution is one of the great killers within recent memory. In 2015, polluted air was in charge of 6.4 million passings around the world: 2.8 million from household air pollution and 4.2 million from encompassing (open air) air contamination. Information from that year demonstrates that air pollution overall caused:
• 19% of every single cardiovascular deaths
• 24% of is chaemic heart disease deaths
• 21% of stroke deaths
• 23% of lung cancer deaths Moreover, open air contamination gives off an impression of being an essential hazard factor for neuro formative issue in kids and neurodegenerative ailments in grown-ups. With the financial, ecologic and human toll air contamination takes, determining innovation is an increasingly important endeavor.

III. SURVEY RESULT

The data for the Project was obtained from the website of Central Pollution Control Board (CPCB). Air pollution in the national capital is likely to peak in November as toxic fumes from the stubble-burning regions of Punjab and Haryana gush in because of a change in wind direction. The Supreme Court-appointed body Environment Pollution (Prevention and Control) Authority (EPCA) has warned these states. So the data for previous four years 2015-2018 for November month is collected form https://app.cpcbccr.com/AQI/. The data is collected for fours most polluted areas of Delhi city. These areas are

- Anand Vihar
- R.K.Puram
- Punjabi Bagh
- ITO

Anand Vihar

Anand Vihar tops the charts when it comes to being the most polluted area in Delhi due to a variety of reasons:
1. Anand Vihar has a railway station , bus station and auto stand
2. The dumping ground situated in Gazipur that almost looks like a hill now

3. Anand Vihar is the enter and exit point of many interstate trucks and buses.
4. The influx of vehicles from Kaushambi, Vaishali, Noida and other areas of NCR.
5. Sahibabad and Patparganj industrial area that has many small factories continuously emitting pollutants and of course the construction in the NCR that never ceases.

Table - 1 : Pollutants in Anand Vihar in November Months

	PM10 (ug/m3)	NO (ug/m3)	NO2 (ug/m3)	NOx (ppb)	Ozone (ug/m3)	PM2.5 (ug/m3)	CO (mg/m3)	SO2 (ug/m3)
2015	835.71	217.48	93.54	356.76	31.4	400.89	2.81	31.99
2016	917.2	291.87	138.12	510.31	34.66	335.93	3.89	30.25
2017	436.79	70.29	119.69	414.37	47.66	316.29	3.41	19.33
2018	465.37	156.71	142.91	192.14	24.14	251.61	3.48	14.29

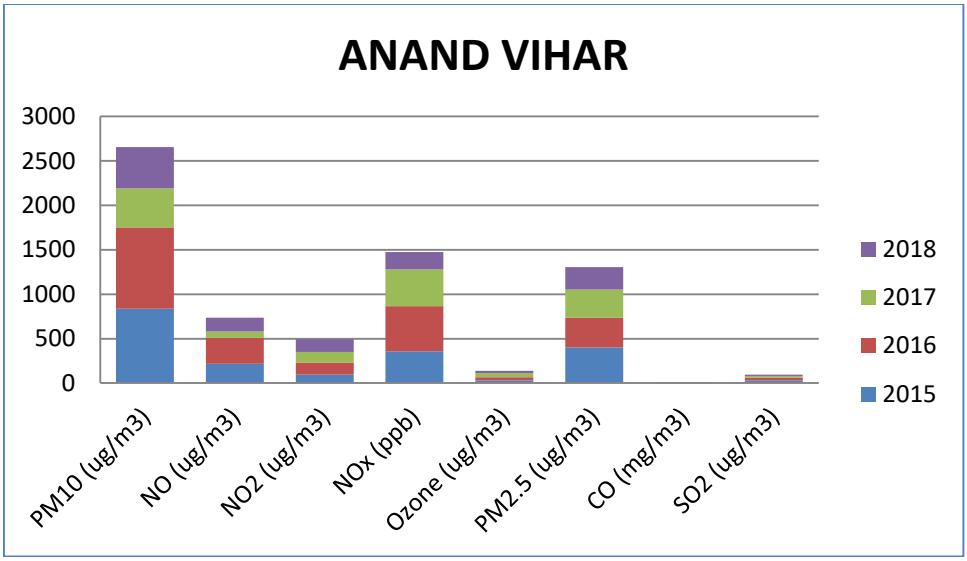
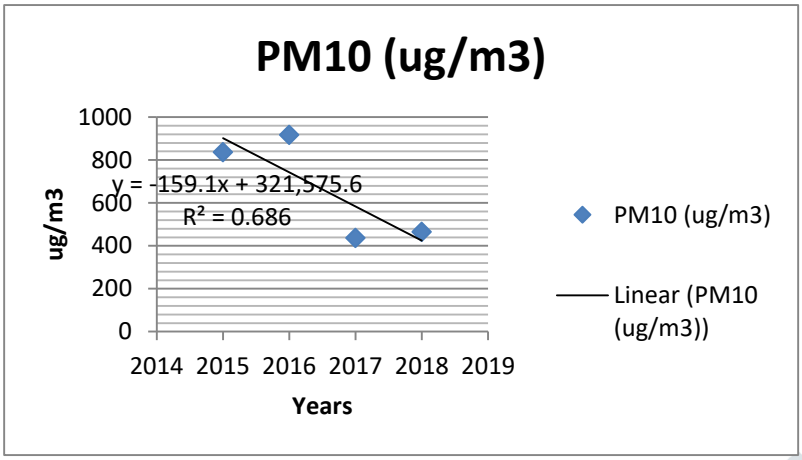
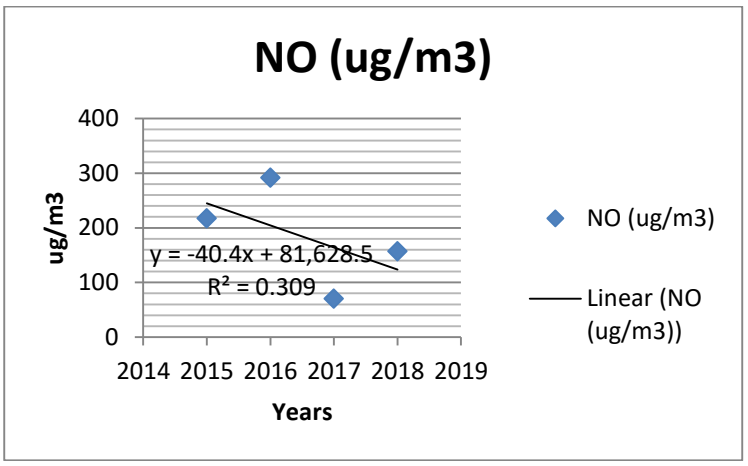


Figure 1 : Yearly values of Pollutants in Anand Vihar

YEAR WISE PREDICTION



a) PM10



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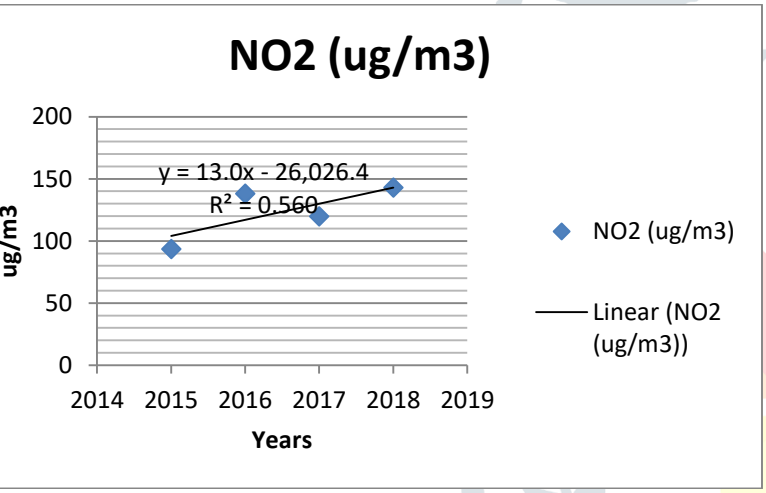
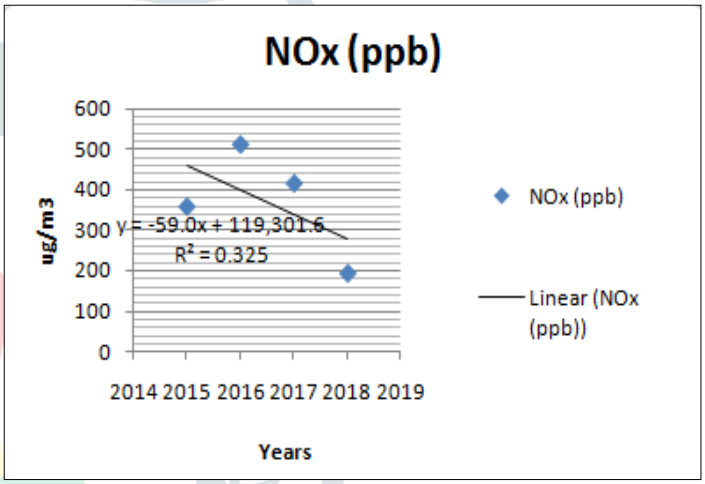
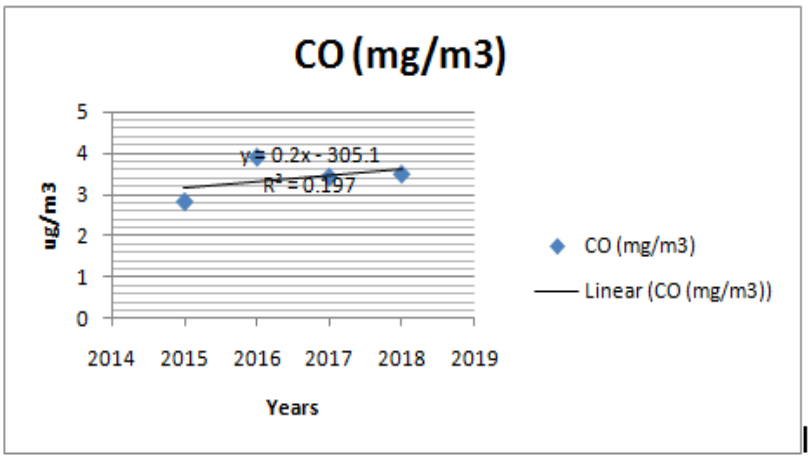


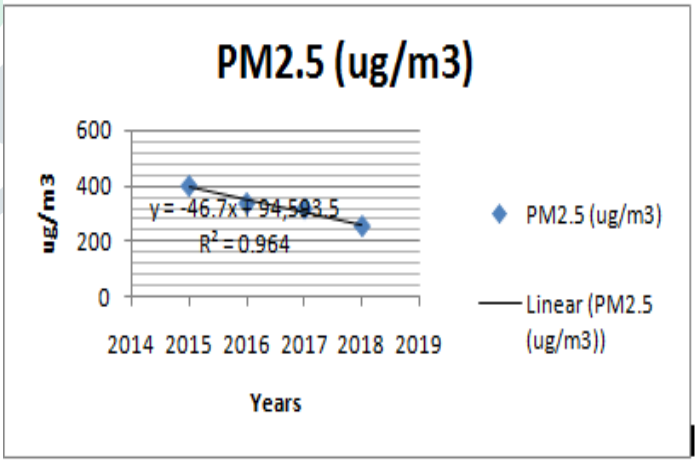
c)NO2



d)NOX



e)CO



f)PM2.5

Figure 2: Regression Lines for Air Pollution Forecasting for Anand Vihar

Table 2 : Equations for Air Pollution Forecasting in Anand Vihar

	y	R^2
PM10 (ug/m3)	-159.1x + 321,575.6	0.686
NO (ug/m3)	-40.4x + 81,628.5	0.309

NO2 (ug/m3)	13.0x - 26,026.4	0.560
NOx (ppb)	-59.0x + 119,301.6	0.325
Ozone (ug/m3)	-0.9x + 1,805.0	0.013
PM2.5 (ug/m3)	-46.7x + 94,593.5	0.964
CO (mg/m3)	0.2x - 305.1	0.197
SO2 (ug/m3)	-6.4x + 12,933.6	0.936

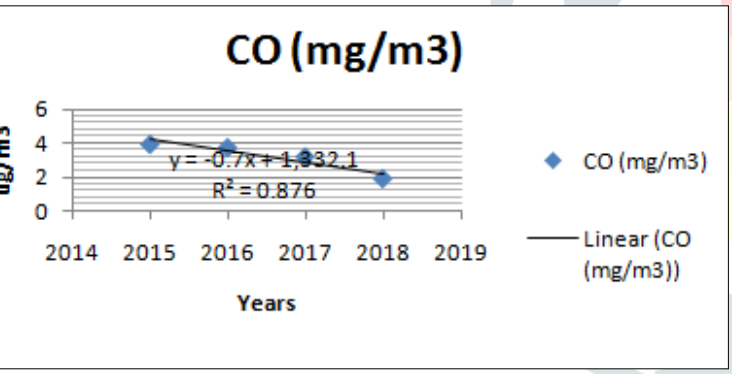
RK Puram

Sandwiched between two ring roads and metro work. Away from the commercial hustle and bustle, RK Puram looks like a peaceful, green neighbourhood of central government employees. This colony is, however, one of Delhi's most polluted spots where residents breathe toxic gases almost every day.

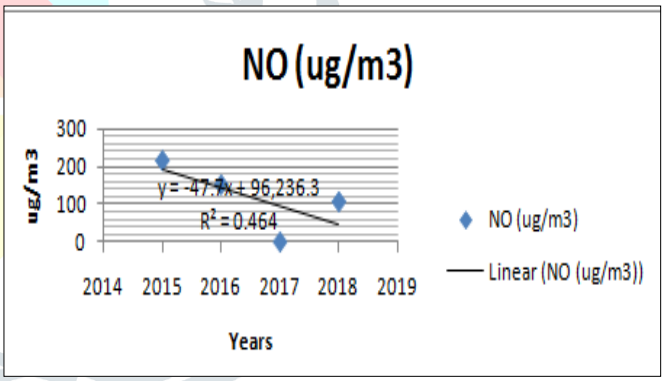
Table - 3 : Pollutants in R.K.Puram in November Months

RK PURAM								
	CO (mg/m3)	**NO (ug/m3)**	**NO2 (ug/m3)**	**NOx (ppb)**	**Ozone (ug/m3)**	**PM10 (ug/m3)**	**PM2.5 (ug/m3)**	**SO2 (ug/m3)**
2015	3.95	214.57	96.84	378.79	54.99	436.7	246.67	41.68
2016	3.75	150.71	113.64	307.07	44.01	0.00	266.04	32.88
2017	3.22	0.00	117.92	400.9	31.8	439.89	265.34	29.08
2018	1.93	105.92	91.69	137.46	36.13	335.94	198.57	6.8

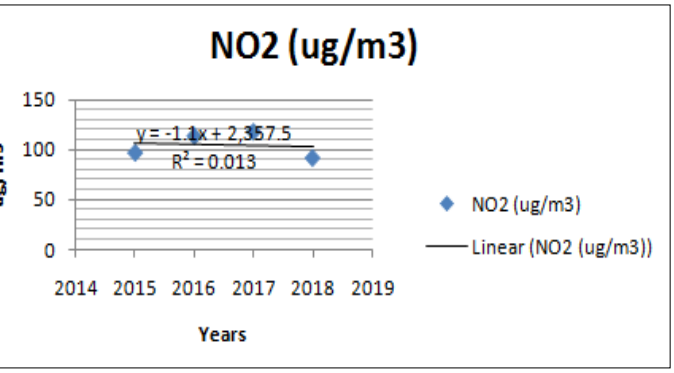
YEAR WISE PREDICTION



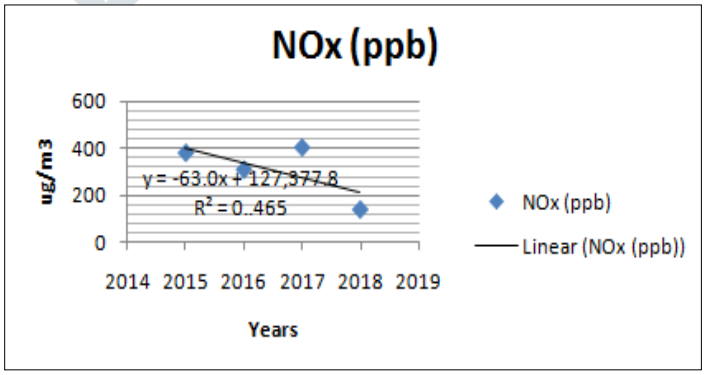
a) CO



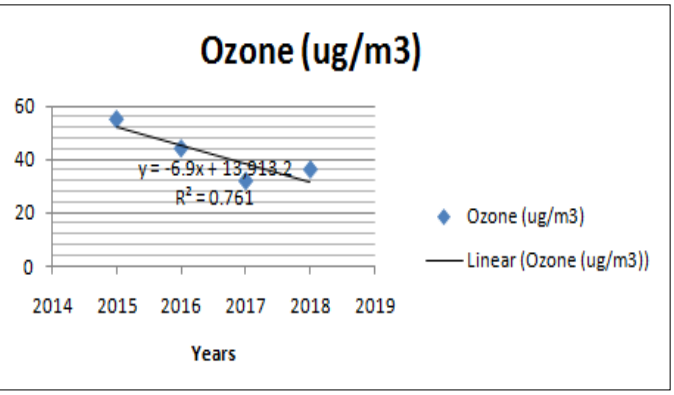
b) NO



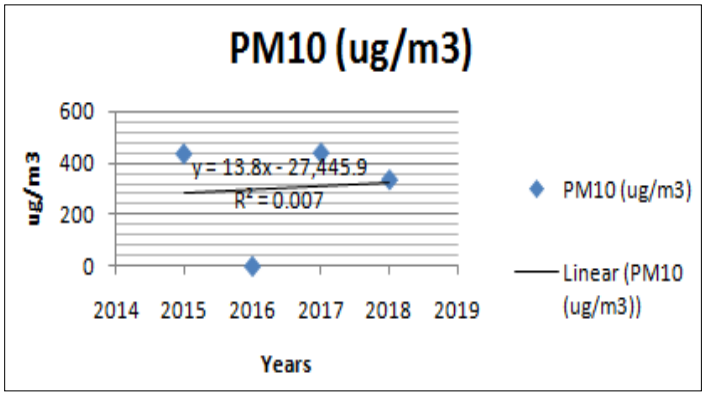
c)NO2



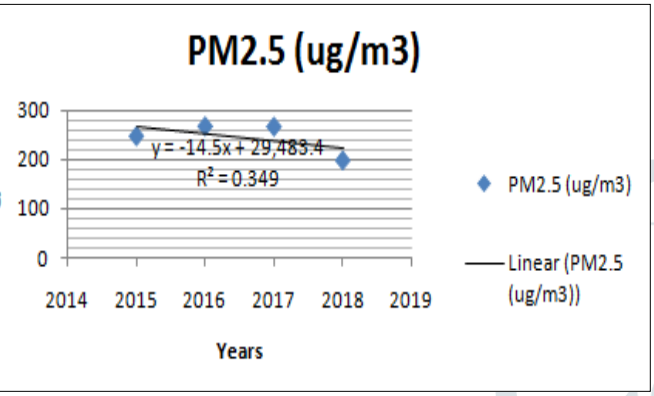
d) NOx



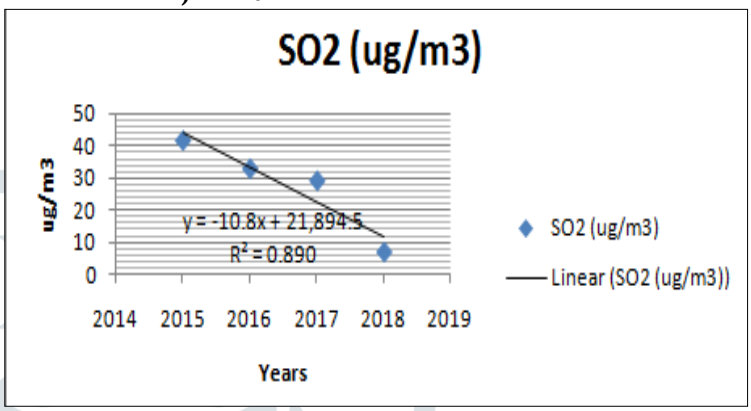
e) Ozone



f) PM10



g) PM2.5



h) SO2

Figure 3: Regression Lines for Air Pollution Forecasting

Table 4 : Equations for Air Pollution Forecasting in R.K.Puram

	Y	R^2
CO (mg/m3)	-0.7x + 1,332.1	0.876
NO (ug/m3)	-47.7x + 96,236.3	0.464
NO2 (ug/m3)	-1.1x + 2,357.5	0.013
NOx (ppb)	-63.0x + 127,377.8	0.465
Ozone (ug/m3)	-6.9x + 13,913.2	0.761
PM10 (ug/m3)	13.8x - 27,445.9	0.007
PM2.5 (ug/m3)	-14.5x + 29,483.4	0.349
SO2 (ug/m3)	-10.8x + 21,894.5	0.890

Punjabi Bagh

Thousands of trucks pollute Punjabi Bagh every day. Punjabi Bagh in West Delhi suffers from a major disadvantage when it comes to its location. The Rohtak Road crosses the area from one end and the Ring Road from another. This adds to the high pollution concentration here.

Senior Delhi Traffic Police officials said that every day over 10,000 trucks are diverted from the city's entry point via Rohtak Road to the Ring Road. Environmentalists have often pointed out that the trucks that enter the city are often poorly maintained and have high emissions.

Punjabi Bagh is also less than 30 minutes away from the industrial areas in Mayapuri and Mangolpuri.

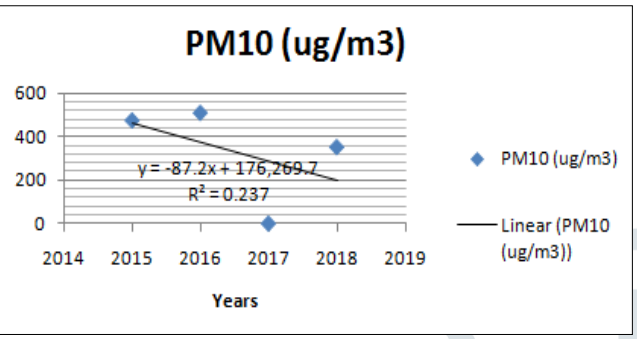
The Mangolpuri industrial area has units ranging in furniture and electric supplies while Mayapuri majorly deals with motor parts and plastic crockery. These small units start their operations majorly after 9pm to escape fines.

The walls of these units have a thick layer of soot on it which is a tell-tale sign of the emissions.

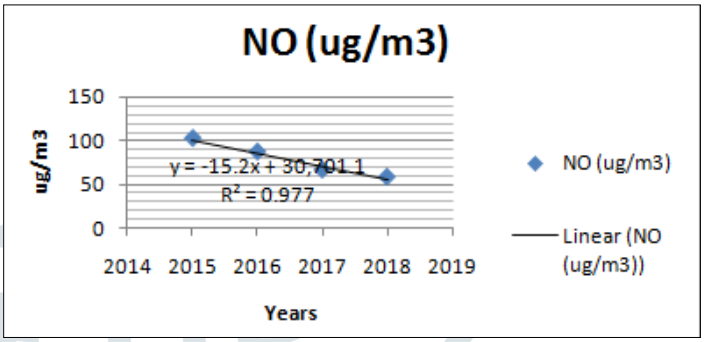
Table - 5 : Pollutants in Punjabi Bagh in November Month

	PM10 (ug/m3)	NO (ug/m3)	NO2 (ug/m3)	NOx (ppb)	Ozone (ug/m3)	PM2.5 (ug/m3)	CO (mg/m3)	SO2 (ug/m3)
2015	472.03	102.2	109.91	237.5	89.77	278.75	1.92	30.49
2016	506.34	86.87	109.19	215.91	67.7	72.16	3.38	23.54
2017	0.00	66.53	208.04	277.93	40.17	303.96	2.89	6.07
2018	349.98	58.36	130.16	111.24	39.69	207.69	2.07	16.13

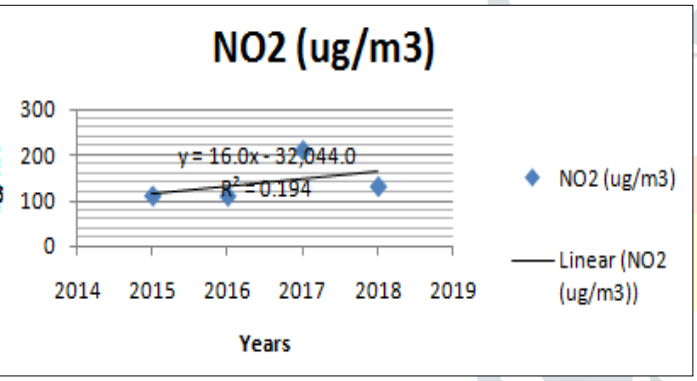
YEAR WISE PREDICTION



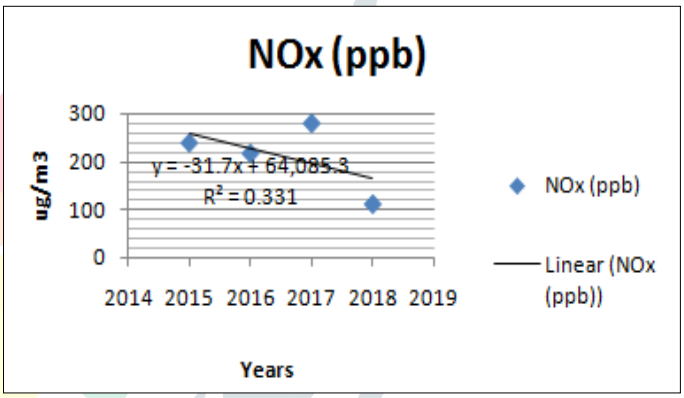
a) PM10



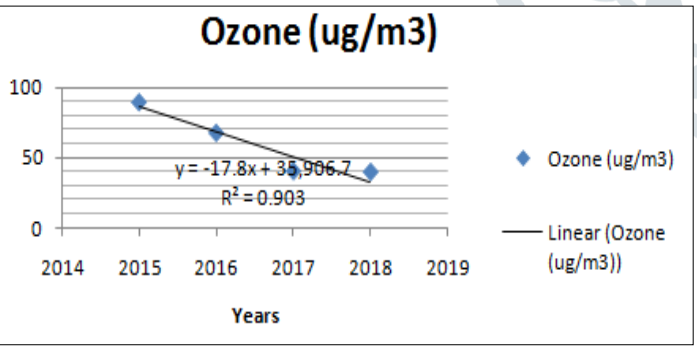
b) NO



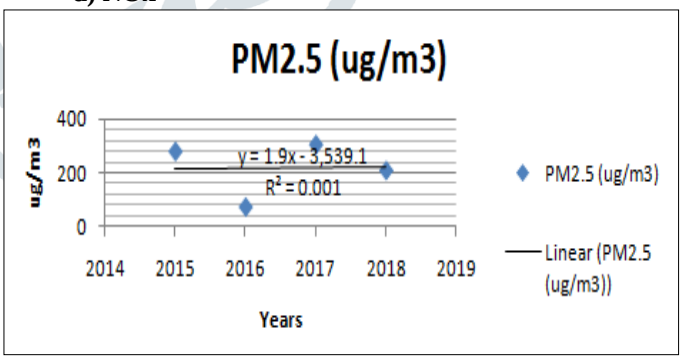
c) NO2



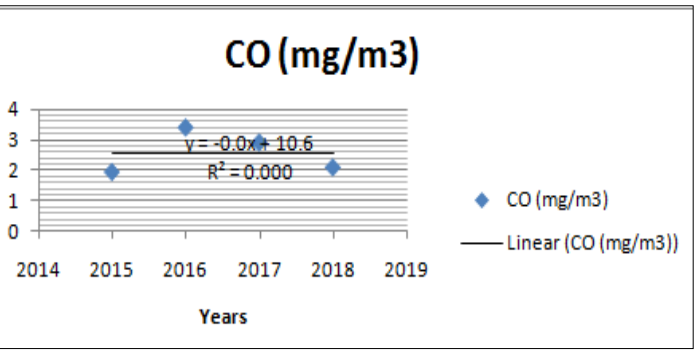
d) NOx

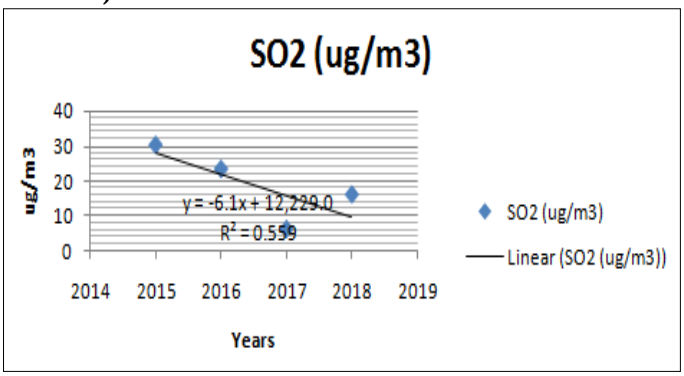


e) Ozone



f) PM2.5





g) CO h) SO

Figure 4: Regression Lines for Air Pollution Forecasting in Punjabi Bagh

Table 6 : Equations for Air Pollution Forecasting in Punjabi Bagh

	y	R^2
PM10 (ug/m3)	-87.2x + 176,269.7	0.237
NO (ug/m3)	-15.2x + 30,701.1	0.977
NO2 (ug/m3)	16.0x - 32,044.0	0.194
NOx (ppb)	-31.7x + 64,085.3	0.331
Ozone (ug/m3)	-17.8x + 35,906.7	0.903
PM2.5 (ug/m3)	1.9x - 3,539.1	0.001
CO (mg/m3)	-0.0x + 10.6	0.000
SO2 (ug/m3)	-6.1x + 12,229.0	0.559

ITO

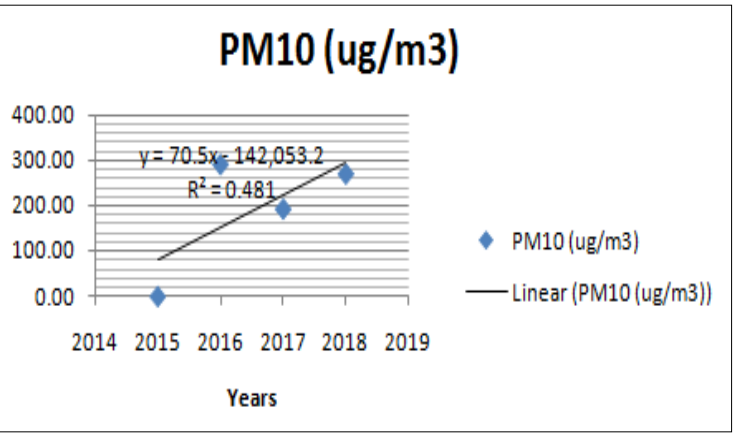
In order to curb the deadly air pollution in the national capital, outdoor air purification devices have been installed across the roads around the ITO red light by the authorities. The Central Pollution Control Board (CPCB) under the Ministry of Environment has begun installing outdoor air purifiers in order to curb air pollution. Reportedly, the project was announced in August. Although, environment experts have been skeptical about these machines if at all they would be able to improve the air quality of the capital. According to a report by the Indian Express, CPCB was installing these air purifiers as a part of the six-month pilot project and at a cost of Rs 2.6 crore. These units are called Wind Augmentation and Air Purifying Units (WAYU) which were developed by the Indian Institute of Technology, Bombay.

The national capital's air quality has been constantly dwindling due to regional factors, construction activities, and vehicular emissions. Experts have been warning residents about the negative repercussions of the rapidly degrading air quality.

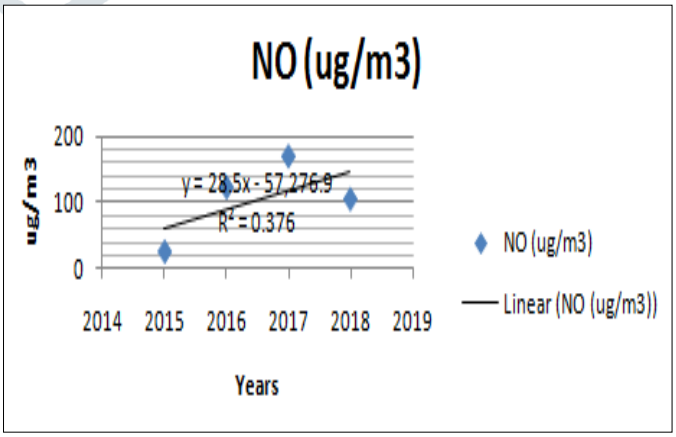
Table - 7 : Pollutants in ITO in November Months

	PM10 (ug/m3)	NO (ug/m3)	NO2 (ug/m3)	NOx (ppb)	Ozone (ug/m3)	PM2.5 (ug/m3)	CO (mg/m3)	SO2 (ug/m3)
2015	0.00	24.61	86.52	65.9	26.82	0.00	0.00	20.53
2016	288.22	121.69	72.03	137.2	0.00	201.36	0.00	0.00
2017	190.86	168.53	0.00	103.97	0.00	220.38	0.00	0.00
2018	267.58	103.85	70.11	119.35	24.41	203	1.81	5.34

YEAR WISE PREDICTION



a) PM10



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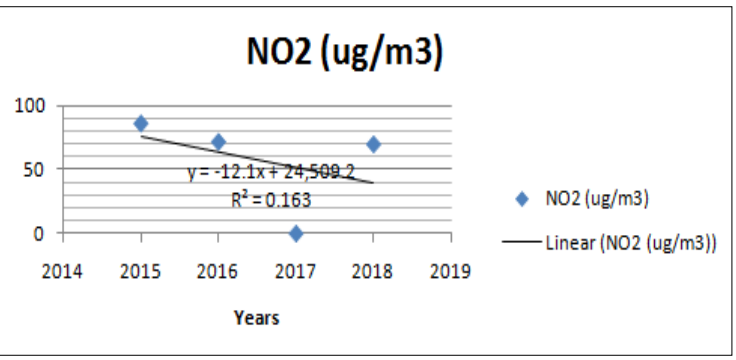

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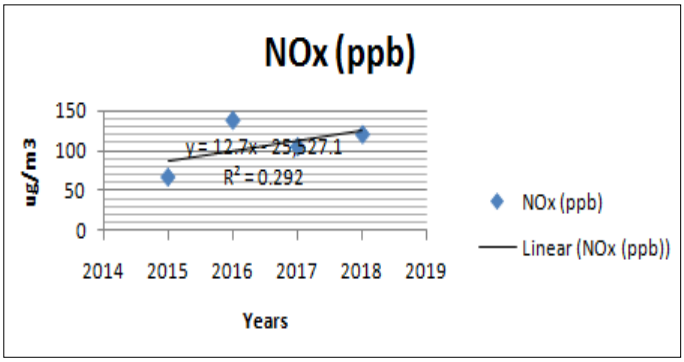
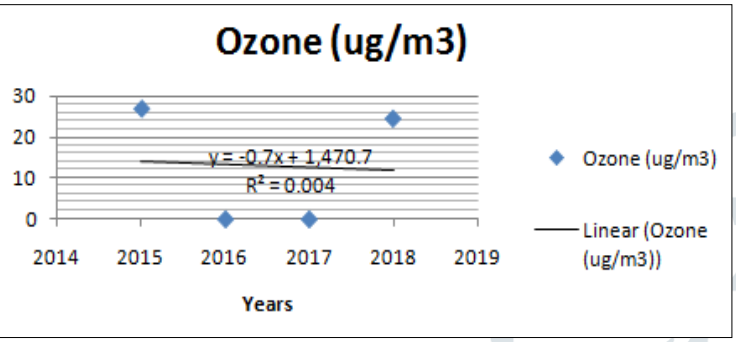
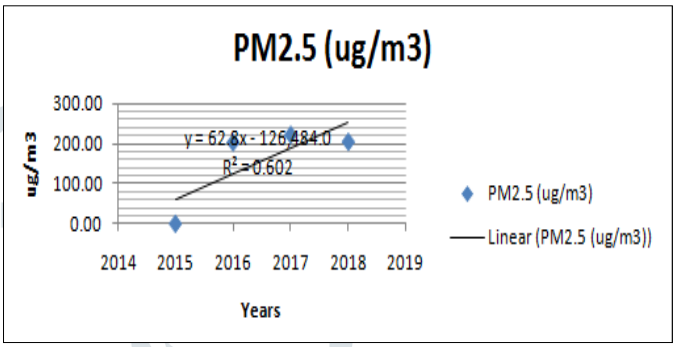


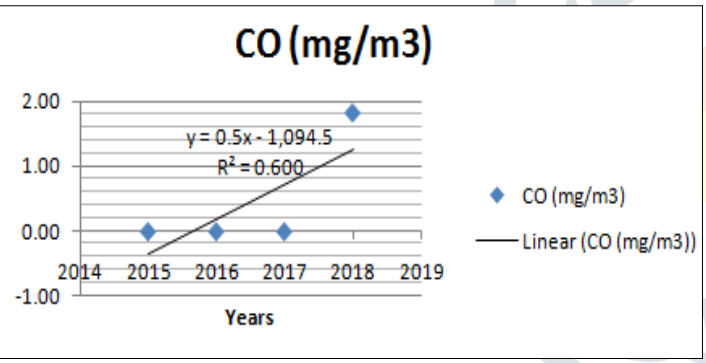
d) NOx



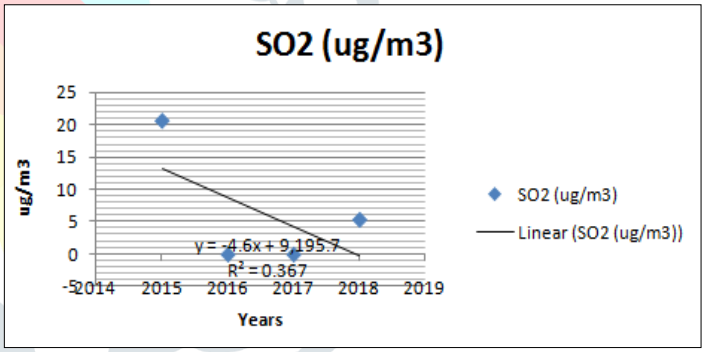
e)Ozone



f) PM2.5



g) CO



h) SO2

Figure 5: Regression Lines for Air Pollution Forecasting for ITO

Table 8 : Equations for Air Pollution Forecasting in ITO

	y	R^2
PM10 (ug/m3)	70.5x - 142,053.2	0.481
NO (ug/m3)	28.5x - 57,276.9	0.376
NO2 (ug/m3)	-12.1x + 24,509.2	0.163
NOx (ppb)	12.7x - 25,527.1	0.292
Ozone (ug/m3)	-0.7x + 1,470.7	0.004
PM2.5 (ug/m3)	62.8x - 126,484.0	0.602
CO (mg/m3)	0.5x - 1,094.5	0.600
SO2 (ug/m3)	-4.6x + 9,195.7	0.367

IV. SUGGESTIONS TO AVOID AIR POLLUTION

1. Stop trucks from plying within Delhi city limits between 6am and midnight.

2. Strict enforcement of lower pollution norms: Trucks and buses mixing kerosene and diesel should be impounded, and fined.
3. Buses from other states should be allowed to enter Delhi only if they meet certain pollution norms. Right now, they're spewing horrible black smoke with carbon particles and there's no pollution check on them.
4. Constant monitoring of garbage dumps such as those in Bhalswa and New Ashok Nagar and any fire incidents at these places need to proactively put out. Remember what the Chembur dump fire did to Mumbai? Not as bad with Bhaslwa, but still pretty bad.
5. Complete ban on burning of leaves in Delhi through the year. MCD workers do this all the time, through the year.
6. Shut down the Badarpur power plant. Delhi government has a solar plan, speed that up.
7. All construction activity in Delhi should be done with draping, to ensure that dust and dirt doesn't fly into the air. This is done everywhere else in the world.
8. Dust soppers can be run through Delhi roads regularly, every morning.
9. Increase frequency of metro trains through the year, not just when there is more pollution. Single card/token for bus + metro to make travel convenient.
10. Disallow all vehicles older than 15 years in Delhi. I still see old Bajaj Chetaks spewing smoke.
11. All commercial transportation vehicles need to be CNG or electric. Lots of goods carriers in Delhi do not have CNG, but also not meet pollution norms.
12. Improve short-run feeder services to Delhi Metro stations. Right now, this is grossly insufficient. The electric vehicles guys actually charge more than the metro does.
13. Ban firecrackers through the year for next 5 years, not only during Diwali. After 5 years, for Diwali, designate an area in each district for bursting firecrackers, if at all.
14. Set up a realtime-pollution monitoring system across Delhi: at least 100 sensors should be live in Delhi-NCR. Right now, the data is different for different systems, and quite often, sensors don't work.
15. Have a protocol for govt action for different pollution levels which should be enforced and followed. Govt is failing in doing this, even though there is a protocol. That's just irresponsible of the govt.
16. To prevent burning of wood etc during peak winters, build shelters for the homeless to sleep at night in the winters. Some of this has been done by the govt. More needs to be done.
17. Increase fines on vehicles not meeting pollution norms. Fine them so heavily that they'll not risk it. Enforcement is key, and Delhi Traffic Police doesn't do a good enough job here.
18. Government vehicles, especially MCD vehicles, clearly do not meet pollution norms. Better enforcement here. Never seen Delhi Traffic Police fine a government vehicle. In fact, even police buses don't appear to meet pollution norms.
19. Force Ola/Uber to do a certain number of pool rides, to allow them to ply in the city. Forces them to incentivise pooling. Might make regular rides more expensive, so let them subsidise car-pooling. No carpooling allowed right now from airport. Strange.
20. Allow setting up of offices in residential areas in Delhi and Noida. Currently, not enough office space in Delhi/too expensive because of scarcity, and more people have to commute across the city, or to Noida/Gurgaon.
21. Move Brick kilns out of Delhi within 3 years. This was done with tanneries almost 20 yrs ago.

V. CONCLUSION

Air pollution forecasting is a worthwhile investment on multiple levels - individual, community, national and global. Accurate forecasting helps people plan ahead, decreasing the effects on health and the costs associated. Air pollution in Delhi is a result of a complex mix of anthropogenic and natural sources. The urban air database released by the WHO, reported that Delhi has exceeded the maximum PM10 limit by almost 10-times at 198 µg/m3.

Enhanced action needed

The Center for Science and Environment(CSE) had recommended “immediate and enhanced action to stop smoke emissions from Ghazipur”. For the Anand Vihar ISBT, the CSE suggested that the terminal area be paved and cleaned. The emissions from nearby industrial areas at Patparganj and Sahibabad should be controlled to bring the level of particulate matter down.

Anand Vihar have worst air quality index because Anand Vihar is on the border line of Delhi NCR(U.P.) and Delhi so almost all the traffic start from their and end up there . And Delhi is marketing hub not a manufacturing. Pollution levels attributed to presence of ISBT, Ghazipur landfill, NH-24, as per the Centre for Science and Environment.
The levels of harmful pollutants that people are exposed to in east Delhi’s Anand Vihar were recently found to be two to four times higher than the ambient air pollution levels, which themselves are several times over the standards.

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