

An Analytical Research Study of Air Pollution Biology in Particular Reference To Festival Days Of Diwali In Delhi

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ABSTRACT: Diwali is the festival of light it is celebrated with great enthusiasm and joy all over India. Burning of crackers and large scale of fireworks create huge amount of air pollution. Air pollution has been defined as the presence of any air pollutant in the atmosphere. As per Section 2(a) of Air (Prevention and control of pollution) Act, 1981 "Air pollutant" has been defined as any solid, liquid or gaseous substance, present in the atmosphere in such concentration that may be or tend to be injurious to human beings or other living creatures or plants or environment. In the present study air pollution level has been analyzed on the basis of data available from CPCB and variation in the concentration level of four major air pollutants namely SO₂, NO₂, SPM, and RSPM is analyzed for Diwali in different areas of Delhi, and it was observed that concentration of SO₂ and NO₂ do not show constant pattern of increase or decrease in consecutive years, whereas SPM and RSPM exceeded the maximum limit of PM₁₀ by about 10 times the legal limit. Therefore there is an urgent need of joint effort of government organizations, non-government organization and community.

I. INTRODUCTION

Air pollution is a mixture of natural and man-made substances in the air we breathe. It is typically separated into two categories: outdoor air pollution and indoor air pollution. Diwali is a festival of light that is celebrated with great Enthusiasm and joy all over India. Burning of crackers and illumination of light is a symbol of joy and Prosperity. Burning of crackers and large scale of fireworks create huge amount of air pollution. Air pollution has been defined as the presence of any air pollutant in the atmosphere. As per Section 2(a) of Air (Prevention and control of pollution) Act, 1981 "Air pollutant" has been defined as any solid, liquid or gaseous substance, present in the atmosphere in such concentration that may be or tend to be injurious to human beings or other living creatures or plants or environment. Therefore ambient air quality standard is developed as a policy guideline that regulates the effect of human activity upon the environment so that pollutant emission into the air can be regulated.

Breathing polluted air can make your eyes and nose burn. It can irritate your throat and make breathing difficult. In fact, pollutants like tiny airborne particles and groundlevel ozone can trigger respiratory problems, especially for people with asthma. Air pollution can also aggravate health problems for the elderly and others with heart or respiratory diseases. Some toxic chemicals released in the air such as benzene or vinyl chloride are highly toxic and can cause cancer, birth defects, long term injury to the lungs, as well as brain and nerve damage. And in some cases, breathing these chemicals can even cause death. Other pollutants make their way up into the upper atmosphere, causing a thinning of the protective ozone layer. This has led to changes in the environment and dramatic increases in skin cancers and cataracts (eye damage).

Air Pollution and the Environment: Air pollution isn't just a threat to our health, it also damages our environment. Toxic air pollutants and the chemicals that form acid rain and ground-level ozone can damage trees, crops, wildlife, lakes and other bodies of water. Those pollutants can also harm fish and other aquatic life. In general, plants are more sensitive to pollutants than human.

Air Pollution and the Economy: The health, environmental, and economic impacts of air pollution are significant. Each day, air pollution causes thousands of illnesses leading to lost days at work and school. Air pollution also reduces agricultural crop and commercial forest yields by billions of dollars each year.

Need and Importance: Pure air consists of roughly 78.09% nitrogen, 20.95% oxygen, 0.93% argon, 0.039% carbon dioxide, and small amounts of other gases (by volume). Air also contains about 1% variable amount of water vapor. Air

pollution is a major problem of our environment today. Pollution is harmful to every creature on this planet. Toxic air pollutants, or air toxics, are known to cause or are suspected of causing cancer, birth defects, reproduction problems, and other serious illnesses. Exposure to certain levels of some toxic air pollutants can cause difficulty in breathing, nausea or other illnesses. Exposure to certain toxic pollutants can even cause death. There are industrial as well as residential causes of air pollution. We all know its harmful effect to the environment and human. Delhi is jointly governed by the Central government and State government. According to a study population of Delhi is approximately 1.5 crore. Generally fireworks contains about 75% of potassium nitrate, 15% of carbon and almost 12% of sulphur. Nitrate being a strong oxidizing agent is converted to NO_2 . Sulphur oxidizes to SO_2 which is more toxic gas, because it slowly mix with fine particulate and reaches deep into respiratory tract and lungs.

Some toxic air pollutants are of concern because they degrade slowly or not at all, as in the case of metals such as mercury or lead. These persistent air toxics can remain in the environment for a long time and can be transported great distances. Toxic air pollutants, like mercury or polychlorinated biphenyls, deposited onto soil or into lakes and streams persist and bioaccumulate in the environment. They can affect living systems and food chains, and eventually affect people when they eat contaminated food. NO_2 being toxic gas destroys the lining of respiratory tract, when inhaled. As a result reduces the intake of oxygen in lungs and causes Asthma and other Bronchitis problem. Beside this the air pollution in Delhi contributes about 67% due to vehicular pollution, and shows a rising trend as monitored by the CPCB. Air toxics are also released from industrial sources, such as chemical factories, refineries, and incinerators, and even from small industrial and commercial sources, such as dry cleaners and printing shops.

Threat to Ozone Layer: Ozone can be good or bad depending on where it is located. Close to the Earth's surface, ground-level ozone is a harmful air pollutant. Ozone in the stratosphere, high above the Earth, protects human health and the environment from the sun's harmful ultraviolet radiation. This natural shield has been gradually depleted by manmade chemicals. Ozone in the stratosphere, a layer of the atmosphere located 10 to 30 miles above the Earth, serves as a shield, protecting people and the environment from the sun's harmful ultraviolet radiation. The stratospheric ozone layer filters out harmful sun rays, including a type of sunlight called ultraviolet B. Exposure to ultraviolet B (UVB) has been linked to cataracts (eye damage) and skin cancer. Scientists have also linked increased UVB exposures to crop injury and damage to ocean plant life.

Study Area: Different location ITO, Pitampura, Sirifort, Janakpuri, Nizamuddin, Shahazada Bagh, and Shahdra in Delhi during Diwali for the year 2005, 06, 07, 08, 09 have been studied for four major air pollutants. Data is obtained from CPCB and analysed for sulphur dioxide (SO_2), nitrogen dioxide (NO_2), Suspended Particulate Matter (SPM), Respiratory Suspended Particulate Matter (RSPM) with size less than $10\mu\text{m}$ (PM_{10}) which are the major pollutants ingredient in the environment.

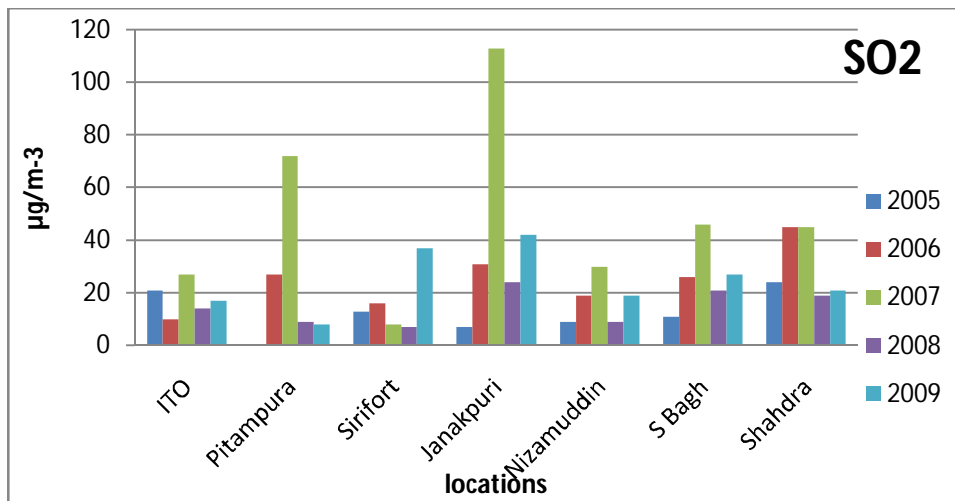
II. ANALYSIS AND INTERPRETATION

Sulphur Dioxide (SO_2) : SO_2 is colorless gas with characteristic pungent smell. It is produced due to the combustion of fossil fuel, like coals, factories, thermal power plants, combustion of diesel huge burst of crackers. SO_2 in ambient air can also effect the human health mainly for Asthmatic people, person with lung diseases or with respiratory problem. SO_2 can also cause visibility impairment, and it is main cause of acid rain. Sulfur dioxide affects human health when it is breathed in. It irritates the nose, throat, and airways to cause coughing, wheezing, shortness of breath, or a tight feeling around the chest. The effects of sulfur dioxide are felt very quickly and most people would feel the worst symptoms in 10 or 15 minutes after breathing it in. Allium, Arabis, Oenothera, and Atriplex grow on soils rich in sulphur minerals. Mosses, lichens and some fungi are much sensitive to SO_2 . Ficus, Xenia and Pinus are some of the plants used as bio-indicators of SO_2 pollution.

Table 1: showing concentration of SO_2 from year 2005 to 2009 in different areas of Delhi under study during Diwali festival.

Year	ITO $\mu\text{g}/\text{m}^3$	Pitampura $\mu\text{g}/\text{m}^3$	Sirifort $\mu\text{g}/\text{m}^3$	Janakpuri $\mu\text{g}/\text{m}^3$	Nizamuddin $\mu\text{g}/\text{m}^3$	Shahazada Bagh $\mu\text{g}/\text{m}^3$	Shahdra $\mu\text{g}/\text{m}^3$
2005	21		13	7	9	11	24
2006	10	27	16	31	19	26	45
2007	27	72	8	113	30	46	45
2008	14	9	7	24	9	21	19
2009	17	8	37	42	19	27	21

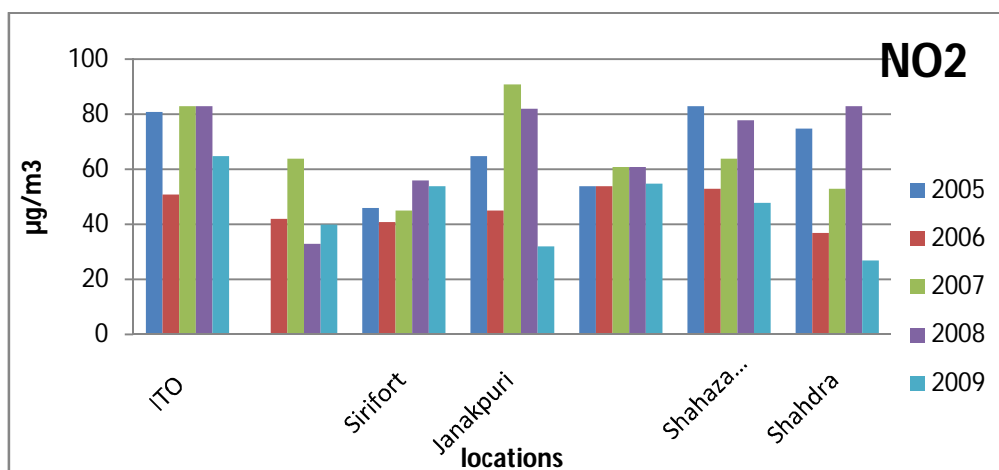
From the table 1 it is evident that SO₂ level during the Diwali days is within the ambient limit in all the years in the areas under study, except Pitampura and Janakpuri where the level of SO₂ increased significantly upto 113 µg/m³ during the year 2007 at Janakpuri and 72 µg/m³ for Pitampura.



From the graph 1 it is evident that SO₂ level was higher in the year 2007 in all the area under study in Pitampura and Janakpuri it is fairly high as compared to year 2005 and 2006. There is no constant pattern of increase or decrease is observed in the graph.

Nitrogen dioxide (NO₂): Table 2 indicates that NO₂ level is within ambient limits except slightly higher in certain areas. During 2005 the NO₂ level at ITO and S. Bagh registered 81 µg/m³ and 83 µg/m³ which was marginally above the ambient limit of 80 µg/m³. Whereas the NO₂ level at other places was within the ambient limit. In the year 2006 during the Diwali days all the places in Delhi recorded NO₂ level within the ambient limit. But again during 2007 the NO₂ level exceeds the ambient limit marginally at ITO and Janakpuri which recorded 83 µg/m³ and 91 µg/m³ respectively. Also in the year 2008 NO₂ level was marginally above the ambient limit at ITO (83 µg/m³), Janakpuri (91 µg/m³), Shadra (83 µg/m³). And in 2009 the level was within the ambient limit. Table 2: showing concentration of NO₂ from the year 2005 to 2010 in different areas of Delhi under study on Diwali

	ITO µg/m ³	Pitampura µg/m ³	Sirifort µg/m ³	Janakpuri µg/m ³	Nizamuddin µg/m ³	Shahazada Bagh µg/m ³	Shahdra µg/m ³
2005	81		46	65	54	83	75
2006	51	42	41	45	54	53	37
2007	83	64	45	91	61	64	53
2008	83	33	56	82	61	78	83
2009	65	40	54	32	55	48	27



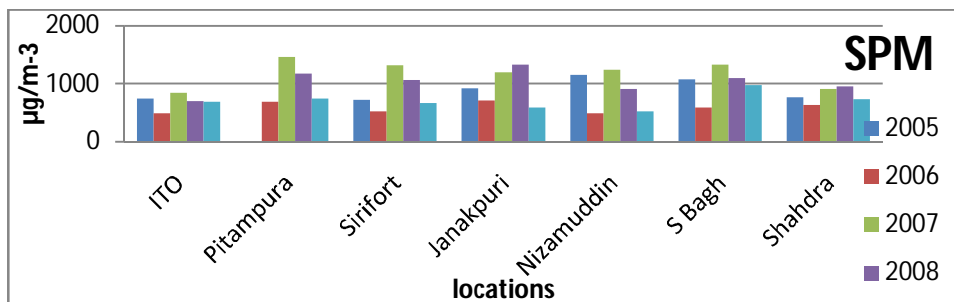
Concentration of NO₂ is higher in the years 2005,2007 and 2008 as compare to the years 2006 and 2009.The decrease in NO₂ level at certain places is attributed to the lesser burst of crackers, due to public awareness programme. The decrease in vehicles on road, Also due to the outsiders working in Delhi visit their respective native place. Beside this the change in metrological condition cannot be ruled out. Long-term exposure to NO₂ levels currently observed in Europe may decrease lung function and increase the risk of respiratory symptoms such as acute bronchitis and cough and phlegm, particularly in children.

Suspended Particulate Matter (SPM):SPM is the complex mixture of tiny or very fine suspended solid and liquid particle in the environment. The SPM Suspended Particulate Matter is found to be very high at all the location during Diwali.

Table 3: showing concentration of SPM from year 2005 to 2009 in different areas of Delhi under study on Diwali

	ITO $\mu\text{g}/\text{m}^3$	Pitampura $\mu\text{g}/\text{m}^3$	Sirifort $\mu\text{g}/\text{m}^3$	Janakpuri $\mu\text{g}/\text{m}^3$	Nizamuddin $\mu\text{g}/\text{m}^3$	S. Bagh $\mu\text{g}/\text{m}^3$	Shahdra $\mu\text{g}/\text{m}^3$
2005	742		723	916	1148	1070	761
2006	489	687	519	704	485	586	625
2007	842	1463	1314	1198	1236	1324	904
2008	692	1166	1059	1331	911	1097	945
2009	688	739	664	581	522	976	724

In the year 2005 and 2006 the SPM is relatively low compared to 2007 and 2008. The highest value of SPM was found to be at Pitampura which was 1463 $\mu\text{g}/\text{m}^3$. The SPM is bigger than coarse particle, these settles down fast hence have less adverse effect on health.



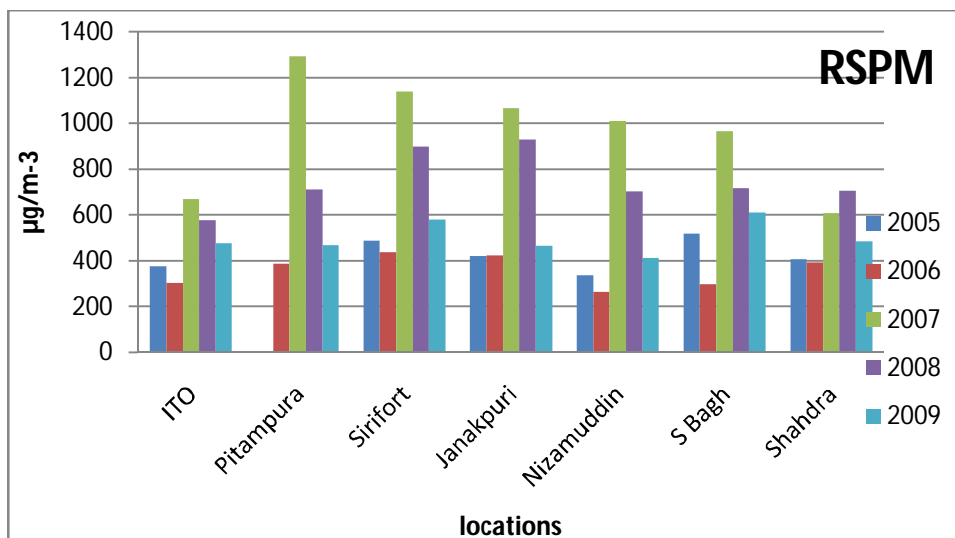
From the graph it is evident that SPM concentration was higher in the years 2007 and 2008 as compared to year 2005,2006 and 2009. Though SPM is less harmful compared to RSPM but its adverse effect on health cannot be ruled out. The high SPM level leads to the sub-clinical effects such as impaired pulmonary function, respiratory symptom ,medication and more doctor visit.

RSPM (Respiratory Suspended Particulate Matter):The major constituent of RSPM are the dust, organic waste, carbon, iron, magnesium, nitrates etc. The anthropogenic source of RSPM are mechanical breakup of the particles, windblown dust, fly ash, combustion of fossil fuel, coal heavy fuel oil used in the thermal power plant, industrial emission, combustion of diesel and petrol.

Table 4: showing concentration of RSPM from the year 2005 to 2009 in different areas of Delhi under study on Diwali

	ITO $\mu\text{g}/\text{m}^3$	Pritampura $\mu\text{g}/\text{m}^3$	Sirifort $\mu\text{g}/\text{m}^3$	Janakpuri $\mu\text{g}/\text{m}^3$	Nizamuddin $\mu\text{g}/\text{m}^3$	S Bagh $\mu\text{g}/\text{m}^3$	Shahdra $\mu\text{g}/\text{m}^3$
2005	378		489	422	337	520	407
2006	304	388	440	426	265	300	395
2007	670	1294	1139	1068	1012	966	610
2008	578	712	901	931	703	719	708
2009	478	469	580	466	414	611	486

According to the report by CPCB Central Pollution Control Board the 24 hours continuous Air quality monitoring was carried out on Diwali days. The variation of RSPM which is commonly known as PM₁₀ from the given data for different location in Delhi. It is found that during all the five years of monitoring RSPM exceeds the ambient limit of 100 µg/m³.



During the year 2005 and 2006 the level of RSPM at different location in Delhi is comparatively less compared to 2007 and 2008 which recorded the maximum PM₁₀. RSPM or PM₁₀ is very important in terms of health hazards. According to the air quality guidelines by WHO the annual mean concentration recommended for PM₁₀ was 20 µg/m³ beyond which health risk increases. RSPM particulate remains in the atmosphere for the longer duration due to its low settling velocity. Hence it enter easily into the respiratory tract causing Asthma, cardiac disease and respiratory problems. RSPM may also decrease the function of lungs in adult and children. In certain cases it is also found to be the cause of lung cancer. Such pollution also increases hypertension among the people, the prevalence of hypertension was 36% in Delhi which shows a positive relation with air pollution.

III. CONCLUSION

Analysis of above data for four major air pollutants shows that there is no constant pattern of increase or decrease in different pollutants in different areas of Delhi on Diwali in five consecutive years from 2005 to 2009. According to the study conducted by CPCB (Central Pollution Control Board) in 2008 regarding respiratory disease in Delhi. The result was compared with the rural Pollution Control West-Bengal. It was found that Delhi had 1.7 times higher prone to respiratory symptom. From time to time Govt. take initiative to educate and create awareness, among the people to use less and the recommended crackers only. There is a need to educate people regarding severe health hazards due to pollution, Ban on the sale of crackers everywhere, tough norms to issue license for the sale of crackers. Only governmental efforts are not enough, participation of Non Government Organization (NGO) and community is crucial in order to make a palpable effect in the reduction of pollution. Pollution-related nutritional changes, that are complex in both domesticated and wild populations, cannot be evaluated in laboratory, which means that a species living in its natural environment may be in hazard even though laboratory experiments fail to show any impact. One of the main issues in our study is the different ability of species to tolerate environmental stress such as pollution, and how this ability is connected to their diet. At the moment we are especially interested in some important dietary components, calcium, carotenoids and vitamins, all of which may be affected by air pollution.

Clearly, much more research is urgently needed to inform efforts to implement national regulations. It should focus on acute effects (such as on cardiopulmonary or inflammatory changes), chronic effects (such as cancers and long-term cardiac and pulmonary problems), and the potentially unique effects on children. On the basis of data that already exist, we believe that suspended dust particles and other secondary pollutants increases considerably during the diwali festival season poses a threat comparable to or even greater than that emanating from cigarette smoking. New policies and legislation should be implemented to protect people from the harmful effects of dangerous pollution.

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