

An Investigation of Air Pollution Index in Nanded City and its Impact on Biological Aspects

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Abstract: *The air pollution has become a major problem of new civilized world where the number of different emission sources like industrial exhaust, Automobile exhaust are polluting the quality of air, but in small town areas like Nanded, motor vehicle emission contribute the major part of air pollution. According to WHO (World Health Organization) SO₂, NO_x, Particulate Matter, ground level ozone, CO and Pb these six pollutants are responsible for short and long term impact on human health, some common short term impacts includes respiratory disease, eye irritation, skin diseases, cardiovascular diseases and long term chronic diseases such as Cancer. In early study we focus on Local air pollution produced by automobile exhaust & some small scale industries and construction fields in Nanded city. During study we calculated the concentration of major air pollutants (including particulate matters SPM and RSPM, SO₂ and NO_x) and founded sources of emission and impact of pollution on human health and measured the susceptibility status of some plants to the air pollution because There are several plant species that are susceptible in polluted atmosphere, they can reduce atmospheric pollutants by natural way, and therefore it is necessary to find out the air pollution tolerant value of plants for their sensitivity and tolerance value to air pollutants.*

Keywords: Air Pollution, Particulate Matter, RSPM, Eucalyptus, Mangifera indica, pH, Sensitive plants

I. INTRODUCTION

The air we breathe is a mixture of solid, liquid and gaseous particles which come from natural atmosphere and the substances which spoils the natural Air quality at high concentration is called air pollutants. Air pollution can also be defined as, the presence of pollutants such as, particulate matters, sulfur dioxide (SO₂), Nitrogen Oxides (NO_x) in air we breathe at high concentration which create some negative impact on environment and human health (Bayram, H. el. 2006) Air pollution is caused by both Natural and anthropogenic activities which made up of different types of pollutants including solid, liquid and gaseous (Vallero D.2007). The substances, which are contaminating the atmospheric air, are called as air pollutants; it can be either gaseous, liquid or particles in nature (Alias M.et al, 2007) Human activities contributes more air pollution problems as compare to natural sources. It was that until 1980's, 1.3 billion people living in cities where pollution was above Air Quality Standards (Bayram,H. el.(2006) in urban areas vehicle traffic are the major source of harmful pollutants such as carbon monoxide(CO) Sulfur Dioxide (SO₂) Nitrogen Oxide(NO_x) and particulate matter(PM) (Lima Ling L. Hughesh el. 2005) in India, air pollution has become a serious problem due to enhanced anthropogenic activities like burning of fossil fuels, motor vehicles exhaust, combustion of coals natural gas and oil in power industrial process these activities damages the natural processes in the atmosphere (Kilburn, K.H. 1992).Air quality is very important aspect as per pollution is concern and it is mainly depending on concentration of pollutants and strongly depends on the magnitude, density, topography, and atmospheric stability however, Air quality varies from time to time, day to day (Kindzierski W.B el. 2006).The air pollution concentration vary with change in weather as well (Kumar P.(1990) pointed out the seasonal and diurnal variations in air pollution in mining areas around Dhanbad, he found low concentration of SPM in monsoon period as compare to other months, similarly NO_x and SO₂ contribute 90% of air pollution in the atmosphere (Hameed,S and Dignon J.1988, Dignon,J. 1992) the release of noxious gases such as SO₂, CO, NO_x, NO₂ chemical vapors are exhaust from burning of fossils and fuels in indoor, automobiles and industries. These can take part in further reactions in atmosphere to form smog and acid rain[URL01] Such type of air pollutants can harmfully affects humans, plants, animals and materials (Kampa, M. & Castanas, E. 2008) human health effects can ranges from nausea, eye irritation, skin irritation difficulty in breathing to cancer (Kampa, M. & Castanas, E.2008). Lots of research work has been done to study the impact of air pollutants on human health but on

the other side identification of plants to find out its sensitivity tolerance capacity to air pollutants is also important (Angold,1997). Air Pollution Tolerance Index is a most common method to find out the plants sensitivity and tolerant ability to air pollution (Das S. and Prasad P. 2010) sulfur dioxide is a colorless gas with pungent odor and produced by the combustion of fossil and fuels (Naik Shrikanta 2005) from different sources including industrial activities such as thermal power stations, flaring at oil & gas facilities, indoor heating and vehicle emissions. The amount of SO₂ emitted is directly related to sulfur content of the fuel (Air quality monitoring network, 2008) nitrogen oxides represents the sum of the various nitrogen gas forms found in the air, out of which Nitric oxide(NO) and Nitrogen Dioxide(NO₂) are most harmful forms, forest fires are largest source of NO_x emission (Air quality monitoring network, 2008) these gases are not only responsible for air pollution but also there is a correlation between gases like SO₂ , NO₂ and particulate matter concentration (Evyapan, F.2008) Particulate matter are nothing but a mixture of solid particles and liquid droplets found in the air which varies from different size, the particles with diameter 10 micrometers or less are inhalable and known as Respirable Suspended Particulate Matter (RSPM) and the particles with diameter more than 10 µm are Non Respirable Suspended Particulate Matter(NRSPM)[URL02] Particulate matter formed in the atmosphere by the chemical reaction of gases, combine to form less volatile compounds that than condense into particles (Balaceanu C., Stefans. 2004).

1.1 Effect of air Pollutants on Health

Air pollution is a serious problem we are facing today and air pollution has now emerged in developing countries due to rapid industrial activities and rising vehicular emission (Robinson DL 2005) many investigations has been published on the health impact of air pollution showing variations in concentration and their associated problems, the effect of air pollution on human health is mainly depends on period of exposure to air pollution and intensity of air pollution and also health condition of individual, negative effects of air pollution also observed on children and old agers those with respiratory tract diseases[URL03] Major health hazards associated with outdoor air pollution, some common chronic impacts are cardiovascular stress, lung cancer, Asthama, Chronic bronchitis and pre-existing health conditions are also affected[URL04] there are 7,12,000 deaths per year due to air pollution in South Asia including India[URL05]

1.2 Effect of air Pollutants on Plants

Air pollutants especially SO_x, NO_x, CO and O₃ can affect the physiological process of plants (Agrawal et al 2004). Air pollutants cause damage to plants directly through leaf cuticles and stomata conductance and also effect on photosynthetic systems and pattern of carbon allocation within plants or indirectly by acidic soil (Steubing L. and Fangmier A. 1989). Plants provides natural purification of atmosphere by absorbing gaseous and some particulate matters through leaves (Varshney, 1985). The present study aims to determine the air pollution tolerance and index values of various plants and to find out the ability of plants to reduce pollutants from atmosphere.

II. STUDY AREA

The city of Nanded is the second largest city in Marathwada region after Aurangabad of Maharashtra. It is located along bank of river Godavari. Nanded is very ancient and historical place and well known for ‘Sachkhand Gurudwara’ which is a famous Sikh pilgrimage in Maharashtra state and was constructed on behalf of Shri Guru Gobindsingh Ji Maharaj, it is a holy place of Sikh religious therefore thousands of peoples and tourist visit to this place. Therefore, vehicular traffic pollution has become a big problem in Nanded city. The city is spread across 63.44 sq.km. (18°30^l N latitude and 77°10^l longitude, 489 meters above sea level). The air quality of the city is quite polluted by vehicular emission and small industrial emission with different concentration of air pollutants SO_x, NO_x and Particulate matter in ambient air.

III. MATERIALS AND METHODS

In present study we examined two gases pollutants SO₂, NO_x and Total Suspended Particulate Matters (TSP) by the methods prescribed by Central Pollution Control Board (CPCB)

1. For SO₂ (Modified West and Gaeke Method)
2. For NO_x (Modified Jacob Hochheiser Method)
3. For Total Suspended Particulate Matter (High Volume Method)

For the investigation of air pollution impact on plants we have collected Eight different plant species from different civil regions of Nanded city were investigated with respect their Air Pollution Tolerance index value level and their biochemical characteristics, for this purpose: *Ficus glomerata*(Audumber), *Tamarindus indica*(Chinch), *Mangifera indica*(mango), *Eucalyptus*(Nilgiri), *Aegle marmelos*(Bel), *Azadirachta indica*(Neem), *Rose indica*(Rose) and *Citrus lemon*(Lemon) plants were selected for analysis. The fresh leaves of fully matured plants in same ecological condition were collected and brought to research laboratory. During sampling care was taken that sample should not be damaged by high intensity of light and temperature. Each collected sample were analyzed for Ascorbic acid, leaf extract pH, Total chlorophyll content, Relative water content and finally APTI of each sample was determined.

Ascorbic acid was determined by 2, 6-dichlorophenol indophenols dye method (S. Sadasivam and A. Manickam, 2005) In brief, extraction of fresh leaves of selected plant species was added with 4% oxalic acid solution and the mixture is centrifuged for 15 minutes then supernatant was collected then 10 ml of 4% oxalic acid was added and titrated against 2,6-dichlorophenol indophenols dye. Total chlorophyll content was estimated by using 80% acetone extraction method through spectrophotometer at 645 nm and 663 nm wavelength (Singh et al 1991). Leaf extract pH was determined by using digital pH meter in brief, 5 grams of leaf was homogenized with 50 ml of distilled water and pH of leaf extract was measured on digital pH meter. Relative water content was examined by the method of Sivakumaran and Hall (1978). The leaves of selected plant species were weighted as early as possible. They were dipped into water in a beaker. After 8 hr the leaves were blotted and reweighed before being dried at 80°C for 24 hr and reweighed. The present RWC was determined by using the equation:

$$RWC(\%) = \frac{\text{Initial weight} - \text{Dry weigh}}{\text{Saturated weight} - \text{Dry weight}} \times 100$$

The air pollution tolerance index (APTI) was determined by formula developed by Singh and Rao (1983) as follow:

$$APTI = \frac{A(T + P) + R}{10}$$

Where, A is ascorbic acid content in (mg/g),

T is total chlorophyll content in (mg/g),

P is leaf extract pH,

R is relative water content in (%)

The Total Sum is divided by 10 to get APTI value.

Table 1: Analysis report of various plant species collected from different regions of Nanded city

Plants	TC(mg/g)	AA(mg/g)	RWC(%)	LEP	APTI
<i>Aegle marmelos</i> (Bel)	8.92	5.12	77.25	6.9	10.29
<i>Azadirachta indica</i> (Neem)	5.05	7.44	71.98	7.7	12.45
<i>Citrus lemon</i> (Lemon)	6.63	4.68	83.21	8.1	11.92
<i>Eucalyptus</i> (Nilgiri)	2.17	2.77	75.16	6.8	8.14
<i>Ficus glomerata</i> (Audumber/Umber)	3.78	2.42	65.77	6.1	9.88
<i>Mangifera indica</i> (Mango)	9.4	5.38	78.9	5.7	12.84
<i>Rosa indica</i> (Rose)	5.86	4.27	74.38	7.16	9.76
<i>Tamarindus indica</i> (Chinch)	3.42	4.18	79.94	7.2	11.7

[TC= Total Chlorophyll, AA= Ascorbic Acid, RWC= Relative Water Content, LEP= Leaf Extract pH, APTI= Air pollution tolerance index]

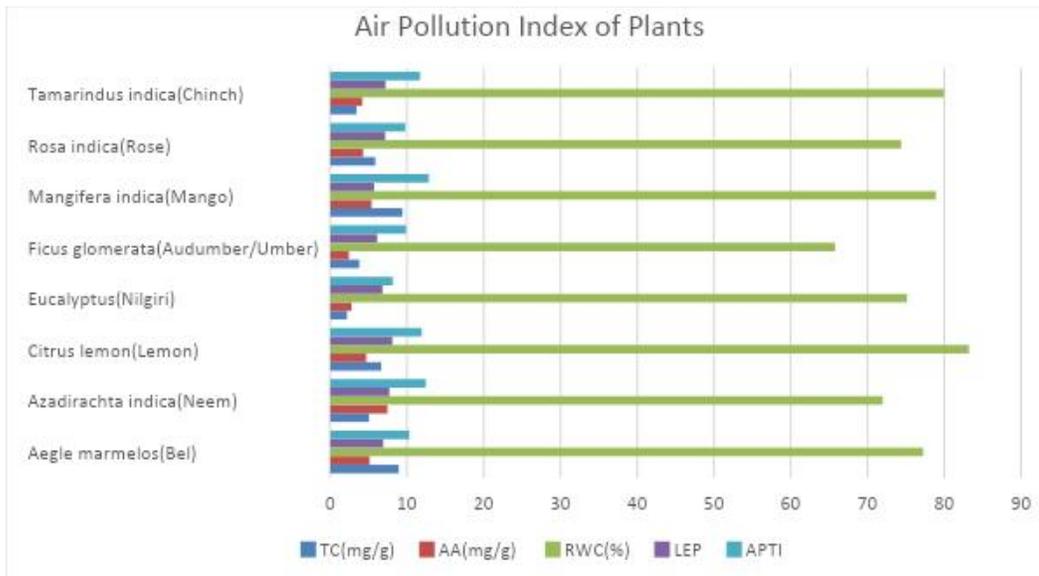
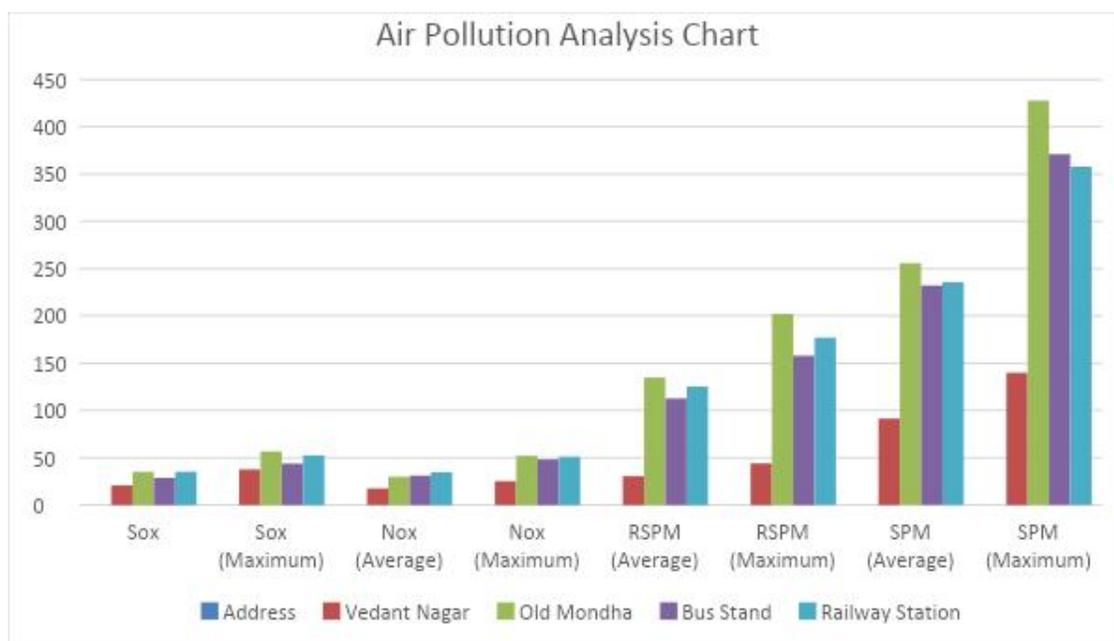


Table 2: Air Quality Observations at various sampling stations in Nanded City (Year 2019)

Sr. No.	Sampling Location Address	Station Type	Sox (Average)	Sox (Maximum)	Nox (Average)	Nox (Maximum)	RSPM (Average)	RSPM (Maximum)	SPM (Average)	SPM (Maximum)
1	Vedant Nagar	Res.	21.94	36.80	18.51	25.38	30.52	44.11	91.47	142
3	Old Mondha	Comm	34.21	57.8	28.92	54.2	135	202	256	438
4	Bus Stand	Comm	28.85	43.9	31.2	48.3	112.83	158	232.33	377
5	Railway Station	Comm	36.23	52.6	34.75	51.2	125.33	177	235.58	348



3.1 Health Survey

A Health survey was conducted in the selected areas by asking some health related questions to the local residents, shopkeepers, Traffic Police, Autorickshaw drivers to list the occurrence of respiratory problems like cough, bronchitis, Asthama, pneumonia, dry cough, Wheezing along with Eye problems, skin diseases and Heart problems...etc. some information was also collected from the Doctors in these areas. The residential area covers two-third of the Nanded city. In this health survey most of the cases with multiple diseases in single respondent was reported in traffic zone areas because vehicular pollution is a major source of pollution in Nanded city. In some region construction activities are discharging particulate pollutants.

IV. RESULT AND DISCUSSION

The Table No. 01 shows the analysis report of Total chlorophyll content, Ascorbic acid level, Relative water content, Liquid extract pH and Air pollution tolerance index value of selected plant species. The total chlorophyll content was found higher in Aegle marmelos as compare to other plant species and it was found lower in Eucalyptus plant, chlorophyll content indicates the productivity of plants (Raza S.H. 1988). The chlorophyll content of plants decreases in polluted area (Speeding and Thomas 1973) While plants exposed to high concentration of SO₂ might be degrade the chlorophyll content in plant (Bell and Mudd 1976). The concentration of ascorbic acid in plant indicates the resistance ability of plants to defense the pollution existence, higher the concentration of ascorbic acid indicates more resistant to pollution and lower the concentration of ascorbic acid indicates more sensitive plant while expose to pollution (Keller and Schwager. 1977). Relative water content (Table No. 01) shows Citrus lemon was found to be higher percentage of water level and Ficus glomerata found to be lower percentage of water content as compare to other selected plant species. It has been reported that relative water content in plant is important to maintain the balance of physiological process of plant while plant expose to air pollution (Dedio, W. 1975). Higher the percentage of water content in plant are more tolerant in polluted air. The leaf extract pH (Table No. 01) shows that, Citrus lemon plant species shows higher value of pH while Mangifera indica shows lower value of pH. It has been reported that plants with higher pH are great tolerant to acidic pollution condition where Sox and Nox concentration is high (Scholz and Reck, 1977). The air quality data presented in above mentioned table shows the average concentration of Sox, Nox, SPM and RSPM. The concentration of each air parameter has been observed throughout the year (January to December-2019) at each sampling stations. After investigation it has been observed that during winter season the concentration of Sox and Nox are showing slightly higher results as compare to summer and Monsoon, due to low wind velocity. In pre and post monsoon season the air quality was found good due to scrubbing action of rain water and humidity. Hence, the concentration of pollutants lower down in this season. From the result, it is evident that, the air quality in Nanded do not need any attention presently but may be in the future we need to formulate same ways to counteract the increase in air pollution at specific sites. Presently vehicular pollution is a main source of emission.

V. CONCLUSION

Ambient air quality was assessed using six monitoring stations in Nanded city. The studies has clearly revealed the level of air pollutants for Sox, Nox, SPM, and RSPM. The values of these pollutants are observed below National Ambient Air Quality Standards. The air quality is giving the entire view of air pollution level, As per the results it is evident that, for the time being the ambient air in Nanded do not need any attention from the policy makers except the residential area but may be in the future need to formulate some ways to counteract the increase in air pollution. At specific sites as we may never know when the growing urbanization and the traffic will increase the air pollution level in Nanded much more than the maximum permissible limit. Air pollution index determination is necessary to find out the plant species which are working as a bio-monitoring and also useful to reduce air pollution. The present study suggest that, Mangifera indica, Azadirachta indica, Tamarindus indica and Citrus lemon are more tolerant to air pollutants and plantation of such plant species during city planning will be very beneficial to city to reduce air pollution load and the sensitive plant species like Eucalyptus can be used as bio-indicator to air pollutants.

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